SUMMIT RESEARCH
Book of Abstracts

Book of abstracts of the Research Summit 2024

July 16-19, 2024

University of Aveiro, Portugal

universidade de aveiro

ECIU university

Research Summit 2024
Universidade de Aveiro

Book of abstracts of the Research Summit 2024
under the theme "50 Years of Research at the UA: Challenges for the Future"

held in Aveiro, Portugal
16-19th July 2024

Edited by:

Artur M.S. Silva
Vice-Rector for the Research, Innovation and Training in the 3rd cycle, University of Aveiro
Aveiro, Portugal

A. Gil Andrade Campos
Doctoral School, University of Aveiro
Aveiro, Portugal

A publication of:

UNIVERSIDADE DE AVEIRO
Aveiro, Portugal

Cataloging-in-Publication data

Title:	Research summit 2024 - Book of abstracts
Editors:	Artur M.S. Silva, A. Gil Andrade Campos
Publisher:	UA Editora – Universidade de Aveiro
	1st edition – July 2024
ISBN:	**978-972-789-937-1**
DOI:	https://doi.org/10.48528/5rnm-k519

Acknowledgements

The editors and the conference organizers acknowledge the support towards the publication of the Book of Abstracts and, particularly, the organisation of the Research Summit 2024 to the following organizations and individualities:

- Universidade de Aveiro (UA), Portugal;
- Fundação para a Ciência e a Tecnologia (FCT), Ministério da Educação e Ciência, através do Fundo de Apoio à Comunidade Científica (FACC);
- Research units of the University of Aveiro, Aveiro, Portugal;
- All heads of the doctoral programs of the University of Aveiro;
- The research office, in particularly Vera Fernandes, Luísa Fernandes, Miguel Conceição, Jacinta Oliveira e Diana Oliveira;
- The Doctoral School, particularly to Emília Castro;
- All students that helped technically in the sessions;
- All students representing each doctoral program for their help promoting the event;
- All SCIRP staff;
- All everyone that, directly or indirectly, helped in the preparation or during the event.

Preface

The Research Summit 2024 took place from July 16-19 under the theme “50 Years of Research at the UA: Challenges for the Future”. This forum aimed to foster important debates among the University of Aveiro’s research community, increase collaboration, advance the state of the art, and boost research efforts on campus. This year, discussions also focused on the future of the UA. The objectives of Research Summit 2024 were:

- To strengthen networking among faculty members, researchers, and students on campus, developing sustainable research partnerships for more efficient use of infrastructure, sharing of know-how, and contacts;
- To reflect on the past 50 years and discuss the future challenges for the research of the institution;
- To showcase the research carried out at the Research Units;
- To provide PhD students the opportunity to present their work, encouraging them to improve their communication and networking skills.

The Research Summit 2024 was organized differently at this year, with one extra day being added to the general programme. Regarding the structure, 6 UA commissioners were responsible for 6 topics (Materials and Energy, Information, Communication and Microelectronics, Environment and Ocean, Health and Society, Music and Digital Cultures & Education for the XXI Century) to be discussed by international and national experts. The research units coordinators also demonstrated in a pitch how the Unit has contributed to promoting inter, trans, and multidisciplinary research approaches, projecting the future of the unit along these lines. On the following 2 days, presentations by PhD students, as well as first and second cycle students involved in extracurricular research activities, took place, with more training provided to Ph.D. students and a “Best communication Award” in the end of the Summit. We thank the participants for their participation.

This Book of Abstracts and Proceedings, of the Research Summit 2024, is the result of remarkable contributions from young scientists and PhD students working on the topics of the Doctoral Programmes of the University of Aveiro. Although the Research Summit 2024 is aimed at young researchers, senior researchers have also contributed to the success of the conference through their contributions, fostering discussion and collaboration in the research papers included in the book of abstracts and proceedings. The presence of senior scientists and PhD supervisors was very fruitful for all participants and it is hoped that young researchers and PhD students benefited from this experience.

The organisers hope that this Research Summit 2024 was a remarkable opportunity for a fruitful exchange of ideas between the participants and a milestone in the history of the Forums at the University of Aveiro.

Artur M.S. Silva
A. Gil Andrade-Campos

Aveiro, Portugal, July 2024.

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Accounting

Responsabilidade social empresarial e desempenho esg: divulgações, persistência e greenwashing

Ângela Cristina Oliveira Pereira[†,⋆,1]

1. University of Aveiro

⋆ Corresponding author; acopereira@ua.pt; † Presenting author; Accounting.

Abstract. O presente projeto de tese tem como objetivo analisar a relação entre a Responsabilidade Social Empresarial (RSE) e o desempenho ESG (ambiental, social e de governanção) das empresas.
Com o aumento das pressões por parte dos stakeholders para práticas empresariais sustentáveis e transparentes (Amel-Zadeh et al., 2017; Christensen et al., 2021), este estudo analisa a qualidade e a integridade das divulgações ESG das empresas, bem como a persistência do desempenho ESG ao longo dos anos. Este projeto aborda também a questão do greenwashing, procurando identificar este tipo de práticas.
Neste sentido, a metodologia passa por uma análise de conteúdo das divulgações ESG, um estudo empírico sobre a persistência do desempenho ESG e a aplicação de um modelo para detecção do greenwashing. Este estudo visa contribuir para a compreensão de como as empresas se estão a adaptar às crescentes exigências sustentáveis e de como estas práticas impactam a relação com os stakeholders.

Keywords: *Responsabilidade Social Empresarial, ESG, Divulgações, Desempenho, Greenwashing*

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Essays on gender diversity on the boards of directors of Angolan listed companies.

Edson Domingos Alfredo[†,1]

1. University of Aveiro

* Corresponding author; † Presenting author; Accounting.

Abstract. Ding et al. (2022) Gender equality is one of the United Nations' 17 Sustainable Development Goals (SDGs) to be achieved by 2030. Fila e Lopes (2018) in Africa, the insistence on the prevalence of customs and traditions prevents female ascension to any form of power that could mean the emancipation of women. This research addresses global social issues (Zalata et al. 2022) including issues of promoting justice, sustainability in business, women's empowerment, human rights, employability and much more. The aim of this study is to analyse three aspects: firstly, the impact of gender diversity and the intervention of managers in providing high-quality financial reports (earnings management); secondly, to analyse the impact of gender diversity on corporate social performance issues (social responsibility); and thirdly, the impact of gender diversity on companies' financial performance.The study's innovation lies in the unexplored market on the subject in question, and brings insights that could contribute to a broader vision of top management in Angola. This study uses a sample of Angolan companies over the last 10 years. The data is collected manually from the companies' reports and accounts on their official websites and on the website of Bodiva (the Angolan stock exchange regulator). Quantitative methods are used, with descriptive statistics and ordinary multiple squares to achieve the intended objectives, with the variables based on the hypotheses defined through the bibliographical development of each research essay. Finally, we will present our contributions and suggestions for future studies.

Keywords: *Board gender diversity, corporate governance, earnings management, social-responsibility, Profitability, directors.*

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Acknowledgements. Funding from the Angolan Institute for Scholarship Management (INAGBE) and my supervisor: Professor Sandra Alves.

Accrual-based earnings management: Critical perspectives

Rui P. Chaves da Silva[†,⋆,1], Carlos Pinho[1]

1. Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), University of Aveiro, Campus Universitário de Santiago, 3810-193 AVEIRO, Portugal

⋆ Corresponding author; ruisilva21@ua.pt; † Presenting author; Accounting.

Abstract. Recently, several critiques were addressed on the earnings management topic, especially on discretionary accruals, a recurrent proxy to identify earnings management practices (e.g. Ball, 2013; Chen et al., 2018; Jackson, 2018). These critiques are based on the lack of economic reasoning of discretionary accruals as a proxy for earnings management (Ball, 2013; Jackson, 2018) and econometric issues on the models used (Chen et al., 2018).

This thesis will address these critiques, contributing to advance the discussion on the best models and practices in earnings management research. A sample of public European firms will be used, with data collected from Orbis BvD and Audit Analytics for the period 2012-2022. This thesis will include the following three main topics, one for each article. First, an empirical comparison of discretionary accrual models will be conducted, comparing seminal models results with other methods, such as critics proposed solutions (e.g. Chen et al., 2018) and other models (e.g., F-Score by Dechow et al., 2011 and earnings co-movements by Jackson et al., 2017). Machine learning methods will also be explored to ensure the reliability of their results in identifying earnings management by comparing the different validation methods applied in the literature. Finally, a new approach will be studied based on the specific deviations of accrued financial components. This approach assumes that specific accrued financial components might be more informative than aggregate earnings in earnings management detection in non-financial industries. The extent of manipulation of each financial component is a joint function of the opportunity to manage that financial component, based in Jackson et al. (2017), and its deviation from the industry and from itself, during a certain period.

Theoretical implications will derive from this thesis on the earnings management literature, specifically on the use of discretionary accruals. Practical implications will also emerge, providing more reliable frameworks for stakeholders to identify earnings management practices.

Keywords: *earnings management, discretionary accruals, machine learning*

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Acknowledgements. I want to thank my supervisor, Professor Carlos Pinho, for his guidance. I greatly acknowledge Professor Andrew Jackson for his comments on the research proposal and his motivation to follow the topic.

Financialization, corporate governance and CEO compensation

Rita Vieira†,1, Graça Azevedo⋆,2, Jonas Oliveira3

1. Centro de Investigação em Contabilidade e Fiscalidade (CICF-IPCA)
2. Universidade de Aveiro
3. ISCTE University Institute of Lisbon

⋆ Corresponding author; grava.azevedo@ua.pt; † Presenting author; Accounting.

Abstract. The literature on CEO remuneration is already extensive and has received attention from multidisciplinary research. Today, it remains a key topic in public conversations about corporate influence and wealth distribution, with implications for regulators, employers and shareholders. However, according to Shin (2012), the debate on this subject has been explored from both the financial perspectives of Fama and Jensen (1983) and Jensen and Mecking (1976). According to Babchuck and Fried (2003), the notion that managers wield authority in publicly traded firms, despite the separation of powers, dates back to the work of Berle and Means (1932), who noticed a high level of discretion in management.In the 1980s and 1990s, a new corporate governance model emerged - Financialized Corporate Governance - focusing on increasing shareholder value through executive decisions and managing corporate efficiency through maximizing dividends and maintaining high share through accounting metrics. Financialization directs firm strategy, emphasizing on shareholder value and capital accumulation via executive remuneration schemes based on profit, share price, and return on equity.Therefore, we created the following study question to determine whether businesses have put in place the required safeguards to guarantee and maintain this finance-based model: Is there a connection between corporate governance and financialization?We posed the second question in light of the literature's presentation of the financialization ideology as a crucial component, the fact that financialization has benefited large company managers by linking their compensation to stock market performance, and the fact that CEOs prioritize generating shareholder value when allocating resources: Is there a connection between financialization and the CEO's compensation schemes?Aiming to address the two key study questions by examining data directly from the financial statements of companies listed on Euronext Lisbon from 2006 to 2022. Using SPSS and STATA, our first results demonstrate that financialized businesses pay their executives greater wages. But further results are expected since we're just begging to work our data.

Keywords: *Financialization, Corporate Governance, Executive Compensation Systems, Shareholder Value*

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Acknowledgements. This work is financed by national funds through FCT - Foundation for Science and Technology, I.P., within the scope of multi-annual funding UIDB/04043/2020

O contributo da inteligência artificial na contabilidade de gestão

Carolina Campos[†,1]

1. Universidade de Aveiro

⋆ Corresponding author; † Presenting author; Accounting.

Abstract. A contabilidade de gestão tem um papel importante no contributo para a tomada de decisões operacionais e estratégicas, no mundo dos negócios. De acordo Rikhardsson e Yigitbasioglu (2018) e Nielsen et al. (2015a) a contabilidade de gestão é o principal suporte para a tomada de decisões e o controlo de uma organização.Recorrendo a diversas técnicas e ferramentas a contabilidade de gestão necessita de recolher, analisar e interpretar informações financeiras e não financeiras que permitam avaliar o desempenho financeiro das empresas e contribuir para que os gestores tenham informações úteis para a tomada de decisão. Melhor informação irá permitir melhores decisões, que por seu lado, conduzirão à criação de valor.No ambiente competitivo dos negócios e num contexto de transformação digital e industrial, a inteligência artificial surge como uma ferramenta que poderá conduzir as empresas a uma vantagem competitiva sustentável. Pérez e Blasco (2022) refere que a contabilidade de gestão vai mudar no futuro próximo, uma vez que a ciência dos dados irá modular a forma como os contabilistas de gestão fornecem as informações para os processos de tomada de decisão e servirá de alavanca para obter uma vantagem competitiva. A integração de sistemas de inteligência artificial na contabilidade de gestão permite a automatização de tarefas, o tratamento de grande quantidade de dados num curto espaço de tempo, conduzir a previsões melhoradas, utilizando algoritmos pode, ainda contribuir para a deteção de erros. Para implementar com sucesso um sistema de inteligência artificial na contabilidade de gestão é importante o aval da gestão de topo, a disponibilidade de recursos (financeiros, tecnológicos, materiais e humanos), cultura organizacional flexível à mudança e conhecimento.Marques et al. (2023) consideram necessário que as empresas se adaptem e comecem a pensar na combinação de capacidades humanas e de sistemas inteligentes.Portugal e a União Europeia, têm promovido a adoção de sistemas de inteligência artificial, reconhecendo que a sua adoção podem contribuir para o desenvolvimento económico e competitivo. No entanto, também têm revelado preocupações na regulamentação de sistemas de inteligência artificial, na medida que poderão fragilizar os princípios e valores adotados pela União Europeia. A implementação de sistemas de inteligência artificial na contabilidade de gestão pode contribui para melhorar a tomada de decisões, e deste modo as empresas melhorarem os seus resultados, contribuindo para o crescimento económico nacional e europeu.

Keywords: *Contabilidade de Gestão; Inteligência Artificial; Tomada de decisão*

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Benefícios fiscais em Moçambique: uma análise dos créditos fiscais por investimento e suas implicações

E. Alfândega[†,1]

1. University of Aveiro

[⋆] Corresponding author; [†] Presenting author; Accounting.

Abstract. Na presente proposta de tese pretende-se investigar sobre os benefícios fiscais no ponto de vista de sua relevância para o desenvolvimento económico dos países subdesenvolvidos, particularmente em Moçambique, buscando evidenciar os resultados que são gerados a partir deste mecanismo de estimulação de investimentos comparando-os com o custo da renúncia de arrecadação da receita tributária proveniente dos impostos. A motivação para a investigação a ser desenvolvida está assente, sobretudo, no interesse de analisar se o sacrifício realizado pelo Estado, ao abdicar da arrecadação parcial ou total de impostos que seriam cobrados às entidades abrangidas pelos regimes de benefícios fiscais, é de facto um fator dinamizador da economia, e se não afeta indiretamente o princípio constitucional da igualdade no que concerne ao tratamento dos contribuintes, por um lado, e por outro lado, dado que o Código de Benefícios Fiscais, em Moçambique, foi reformulado em 2009, pode-se questionar, com base nos últimos acontecimentos nacionais e internacionais, o ajustamento daquelas normas ao atual contexto económico e social do país. Por isso, espera-se que os resultados desta investigação, na qual se perspetiva utilizar a abordagem quali-quantitativa seguindo três ensaios, sendo o primeiro de revisão sistemática da literatura sobre a relevância dos créditos fiscais por investimento, o segundo sobre a repercussão dos créditos fiscais por investimento no desenvolvimento económico de Moçambique e o terceiro sobre os créditos fiscais por investimento e o atual contexto económico moçambicano, cujo objetivo é apresentar um contributo para a avaliação das políticas fiscais na medida que a investigação possa (i) constituir uma base de reflexão sobre a adequação dos benefícios fiscais em vigor para o atual cenário de negócios, no ponto de vista de sua eficiência e eficácia, (ii) contribuir como uma base empírica para futuras investigações sobre a efetividade dos fatores que influenciam positivamente no desenvolvimento económico e no crescimento económico com a implementação dos benefícios fiscais.

Keywords: *Benefícios Fiscais; Crédito Fiscal por Investimento; Desenvolvimento Económico.*

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A economia circular (CE) como mecanismo para realização dos ODS: um estudo nas maiores empresas de eletricidade do Brasil, Espanha, Portugal.

Maria Tereza de Medeiros Barros[†,⋆,1]

1. University of Aveiro

⋆ Corresponding author; medeiro.barros@ua.pt; † Presenting author; Accounting.

Abstract. Esta pesquisa de investigação aborda a Economia Circular (CE) como uma ferramenta agregadora dos Objetivos de Desenvolvimento Sustentáveis (ODS) nas maiores empresas de eletricidade do Brasil, Espanha e Portugal. A pesquisa planeja estudar os pontos de ligação entre a EC e os ODS, analisando quais as práticas adotadas na EC que fomentam a sustentabilidade e a legitimação das organizações corporativas junto aos stakeholders.
A investigação está enquadrada a luz das teorias da Legitimidade e Institucional. A metodologia adotada tem a natureza exploratória, numa perspectiva qualitativa, que permitirá ampliar o conhecimento sobre a materialidade no reporte dos ODS, reconhecendo as referências e práticas que vinculam as organizações corporativas com os princípios EC e a agenda da ONU/2030.
A investigação contribuirá para o fortalecimento da sustentabilidade corporativa ao produzir insights sobre como as maiores empresas de eletricidade estão se comportando para tornar a economia circular mais sustentável.

Keywords: *Sustentabilidade; Objetivos de desenvolvimento sustentável (ODS); Economia Circular(EC); Teoria da Legitimidade; Teoria da Institucional; Setor Elétrico.*

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A importância dos determinantes da divulgação online nas entidades do sector não lucrativo: o caso das instituições particulares de solidariedade social.

Rui Marinha Gomes†,1

1. Universidade de Aveiro

⋆ Corresponding author; † Presenting author; Accounting.

Abstract. Dispersa pelo mundo, a economia social é um setor fundamental no desenvolvimento e acompanhamento das comunidades onde o Estado, por vezes, não consegue chegar (Ruela & Albuquerque, 2016). Tendo a responsabilidade acrescida de uma boa fatia dos rendimentos depender tanto de subsídios estatais, bem como de mecenas privados ou particulares, as Entidades do Setor não Lucrativo (ESNL), não só devem prestar contas aos demais stakeholders, mas também as devem divulgar nos meios que têm ao seu dispor (Veríssimo, 2021). No caso das Instituições Particulares de Solidariedade Social (IPSS), perante o artigo 14.ž-A do Decreto-Lei nž 172-A/2014, elas são obrigadas a divulgar a prestação de contas no seu sítio oficial da internet, caso que nem sempre acontece (Ferreira et al., 2022). Este trabalho tentará apurar e explicar alguns dos determinantes que influenciam a publicação das contas destas instituições. Para tal, do universo das mais de cinco mil entidades em Portugal, será criada uma amostra estratificada, por forma a garantir a representatividade dos vários tipos de entidades. De seguida será criada uma base de dados com os dados económicos e financeiros das instituições, perfil do presidente e nível de reporte. Os dados serão recolhidos dos relatórios e contas, dos sites das instituições, e ainda, através da realização de entrevistas. Serão analisados vários exercícios económicos para assim se conseguir ter uma ideia da evolução da realidade estudada. Por fim, os dados serão tratados no programa Microsoft Excel e analisados no programa STATA. No fim espera-se que as conclusões reflitam que a divulgação da prestação de contas pode ser influenciada tanto por determinantes internos (características das entidades e presidentes), bem como por determinantes externos (isomorfismo coercivo ou mimético). Integrando o estudo com outras realidades geográficas, será feita uma comparação para ver se as conclusões se verificam noutros países.

Keywords: *Divulgações, Economia Social, IPSS, Online, Prestação de Contas*

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Acknowledgements. No fim deste trabalho espera-se que as conclusões reflitam que as divulgações das IPSS podem ser influenciadas tanto por determinantes internos (características das entidades e presidentes), bem como por determinantes externos (isomorfismo coercivo ou mimético).

A implementação do Custeio Baseado em Atividades: Um estudo de caso numa Instituição de Ensino Superior Privada de Luanda

Eduardo Nkossi Ngo[†,1], Alberto J. Costa[2], Phd[3], Patrícia Rodrigues Quesado, Phd

1. Campus Universitário de Santiago. 3810-193 Aveiro.
2. Coordinating Professor. Head of the Master in Accounting and Management Control
3. Professor at the Department of Accounting and Taxation

⋆ Corresponding author; alberto.costa@ua.pt; † Presenting author; Accounting.

Abstract. A Contabilidade de Gestão desempenha um papel crucial nas organizações, fornecendo ferramentas fundamentais para o processo decisório e acompanhamento das mesmas. As Instituições de Ensino Superior Privadas (IESP) em Angola enfrentam desafios devido à fraca funcionalidade da administração financeira, o que compromete a capacidade dos gestores em tomar as melhores decisões. Neste contexto, este projeto de pesquisa tem como objetivo implementar e validar o Custeio Baseado em Atividades (CBA) na gestão de uma IESP em Luanda, a fim de encontrar soluções para a ineficácia das práticas de gestão existentes. A pesquisa adota uma abordagem qualitativa, quantitativa e descritiva, com base em três ensaios científicos. O primeiro ensaio consiste em uma revisão bibliográfica que fundamenta teoricamente o tema, abordando a Contabilidade de Gestão, o CBA, a estrutura do ensino superior em Angola e conceitos relacionados. O segundo ensaio investiga as práticas de contabilidade de gestão nas universidades, com foco na implementação do CBA, desafios, benefícios e resultados observados. O terceiro ensaio compreende um estudo de caso em uma IESP para desenvolver um modelo específico de CBA adequado à sua gestão. O objetivo é explorar como o CBA pode avaliar os custos das atividades acadêmicas e administrativas da instituição, fornecendo insights valiosos para a tomada de decisão e aprimoramento da gestão financeira. A aplicação do CBA espera-se trazer benefícios práticos, tais como melhorias na gestão, imputação de custos, processos internos, crescimento e satisfação dos stakeholders. Espera-se também que isso resulte na criação de um modelo de apoio à tomada de decisão, destacando a importância do sistema na educação. Em suma, a implementação do CBA na gestão de uma IESP em Luanda visa superar os desafios enfrentados devido à deficiência na administração financeira, proporcionando uma gestão mais eficaz, análise clara dos custos de cada processo e políticas de decisão mais realistas. A pesquisa pretende contribuir para o aprimoramento da gestão e tomada de decisão nas instituições de ensino superior privadas em Angola, destacando a importância da Contabilidade de Gestão e do CBA nesse contexto específico.

Keywords: *Contabilidade de Gestão, Custeio Baseado em Atividades, Instituições de Ensino Superior Privadas, Estudo de Caso, Angola*

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Acknowledgements. A elaboração deste resumo não teria sido possível sem a colaboração, disponibilidade e apoio de várias entidades que merecem ser reconhecidas. Primeiramente, gostaríamos de agradecer a todos os professores e pesquisadores cujos estudos e publicações foram fundamentais para a construção da fundamentação teórica deste projeto de investigação. Por fim, gostaríamos de agradecer aos nossos orientadores e colegas pela orientação e apoio ao longo de todo o processo de investigação. A contribuição deles foi fundamental para a conceção e implementação bem-sucedida deste projeto.

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Impacto dos fatores contingenciais na adoção do método de custeio baseado em atividades na província de Luanda-Angola

Osvaldo Tito Nunes Pires[†,1]

1. Universidade de Aveiro

⋆ Corresponding author; † Presenting author; Accounting.

Abstract. O Custeio Baseado em Atividades (CBA) surge por volta dos anos 80, pelos seus precursores Kaplan e Cooper, para fornecer informações mais precisas sobre os custos aos gestores e facilitar a tomada de decisões estratégicas adequadas sobre a combinação dos produtos, a fixação de preços, a melhoria e avaliação dos processos empresariais, (Cooper & Kaplan, 1988; Johnson & Kaplan, 1987). A partir da década de 90, tornou-se numa das áreas mais investigadas em Contabilidade de Gestão. A sua adoção ou implementação por parte das empresas é explicada por diferentes fatores contingenciais que podem variar de acordo com a dimensão da empresa, contexto, país, região, cultura organizacional, entre outros, (Otley, 1980). O presente estudo tem como objetivo determinar os fatores contingenciais que influenciam o nível de adoção ou implementação do método CBA na província de Luanda-Angola. O mesmo é abordado à luz da teoria da contingência. O estudo será aplicado na província de Luanda-Angola por ser a província com maior número de empresas, adota a pesquisa quantitativa, o método de amostragem será por acessibilidade num universo de 2 505 empresas, a recolha de dados será efetuada por via de inquéritos, que serão distribuídos por correio eletrónico, numa primeira fase, e numa segunda fase de forma presencial nas empresas que não o preencheram via correio eletrónico na primeira fase. A presente tese de doutoramento terá o formato de uma tese tradicional, isto é, formada por capítulos sendo que o primeiro capítulo versará sobre a introdução que apresentará uma contextualização e justificação do tema em si, objetivos e questões de investigação. O segundo capítulo será de revisão da literatura, onde se avaliará, analisará, resumirá e apresentará as principais discussões sobre o tema por via de uma revisão sistemática da literatura, que será realizada com recurso a artigos extraídos da base de dados da SCOPUS e da WEB of SCIENCE, por serem bases de dados amplamente reconhecidas em termos académicos. O terceiro capítulo será o de metodologia, onde serão detalhados os principais procedimentos metodológicos utilizados, a técnica de recolha de dados, amostra e o processamento dos dados, bem como explicações sobre modelos econométricos a utilizar. O quarto capítulo abordará a análise e interpretação dos resultados obtidos, discussão dos mesmos através da comparação com outros estudos já realizados em outros países. O quinto capítulo apresentará as conclusões finais da tese bem como limitações e sugestão de linhas de investigação futura.

Keywords: *Custeio baseado em atividades, fatores contingenciais, estudo quantitativo, teoria da contingência, Angola.*

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A lobbying approach to ISSB standards and post-implementation effects on sustainability disclosure in the Brazilian financial sector

Denis Tavares Simões [†,1], Graça Azevedo[2], Maria Tavares[3]

1. Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), University of Aveiro, Aveiro, Portugal
2. Departamento de Economia, Gestão, Engenharia Industrial e Turismo
3. Universidade de Aveiro

⋆ Corresponding author; † Presenting author; Accounting.

Abstract. The global push for sustainability has spurred the establishment of accounting standards addressing environmental, social, and governance (ESG) issues, with significant advancements seen since 2020, including initiatives by TCFD, CDSB, and the European Union, among others. Major audit firms have been instrumental in providing metrics for ESG impact reports. The endorsement of guidelines for a Sustainability GAAP accounting standard by the 2020 World Economic Forum highlighted the importance of standardization. The creation of the International Sustainability Standards Board (ISSB) in September 2021 marked a pivotal moment, consolidating initiatives like SASB, GRI, IIRC, VRF, and CDSB in 2022. Also, ISSB and EFRAG declared a common goal of agreeing on a framework to maximize the interoperability of their standards and align critical climate disclosures.

The ISSB, like the International Accounting Standards Board (IASB), follows a structured due process. This process, which includes public consultations on proposed standards, ensures the incorporation of global stakeholder input and enhances the transparency and credibility of the standards. In March 2022, ISSB released its inaugural exposure drafts, addressing general requirements and climate-related disclosures, leading to final standards in June 2023. Brazil became the first country to adopt ISSB's sustainability standards, integrating them into its regulatory framework with a phased transition to mandatory use by 2026.

Over 20 jurisdictions, representing over half of the global GDP, have announced plans to align with the ISSB standards, which indicates broad international support. This global backing reassures us about the widespread acceptance of sustainability reporting. However, as a new entity, the ISSB faces challenges in gaining legitimacy and acceptance similar to those encountered by the IASB. Research suggests that stakeholder participation and lobbying significantly influence standard-setting processes, highlighting the need for further studies on the ISSB's issues and post-implementation effects.

In this context, the research aims to investigate the ISSB sustainability standards regarding lobbying issues and the post-implantation effects of these standards in the Brazilian financial sector sustainability disclosures. It will be structured into five sections: an introduction, a literature review, an examination of lobbying issues, an analysis of post-implementation effects, and conclusions. Key research components involve delineating stakeholder groups, examining comment letters, and applying statistical techniques like p-value and chi-square tests. The findings aim to contribute to understanding the ISSB's role in sustainability reporting and its implications for corporate practices.

Keywords: *lobby, ISSB, sustainability, standards, post-implementation, financial sector, Brazilian*

O impacto do risco de carbono na teoria trade-off: um estudo do contexto brasileiro

Fernando Ramos dos Reis[†,1], Mara Teresa da Silva Madaleno[⋆,1]

1.

⋆ Corresponding author; † Presenting author; Accounting.

Abstract. A sustentabilidade tem sido tema recorrente de debates financeiros, sendo muitas vezes percebida como um obstáculo ao desenvolvimento e ao crescimento econômico. Em resposta, a ONU distribuída, em 2015, 17 Objetivos de Desenvolvimento Sustentável (ODS) para um mundo mais sustentável e justo. Neste contexto, empresas e governos estão ajustados à estabilidade financeira e à sustentabilidade (Battiston et al., 2021).
Essa preocupação com a sustentabilidade tem refletido no interesse dos stakeholders (Adeneye et al., 2022). No entanto, observam que a integração do desempenho ESG nas estruturas de capital ainda é limitada. Isso sugere uma necessidade de exploração mais profunda, pois a sustentabilidade pode estar incorporada na gestão financeira das empresas, especialmente em relação à volatilidade das estruturas de capital.
Na análise na base de dados Scopus encontrou apenas 11 artigos relacionados a estrutura de capital (trade-off) e sustentabilidade. Esses resultados corroboram com Ellili, N. (2023), que propõem estudar o impacto da sustentabilidade ambiental nas decisões corporativas, incluindo aspectos como a estrutura de capital.
Inovando neste campo, esta pesquisa se concentra nos impactos e na relação da sustentabilidade com a teoria do trade-off. Em vez de focar na alavancagem, esta análise utiliza a proposta variável de DeAngelo e Roll (2015), que mede o nível de estabilidade das empresas.
Para realizar esta análise, serão usados dados via software Economática, entre 2003 e 2022 no Brasil. Utiliza-se o software Stata 18, com modelos de regressão estáticos e generalizados, bem como uma análise de causalidade de Granger.
As variáveis dependentes incluem a volatilidade das estruturas de capitais, o risco de carbono e a qualidade das divulgações sustentáveis. As controladoras independentes abrangem o tamanho das empresas, crescimento de vendas, Market-to-book, capex, ROA, ROE, pegada de carbono, consumo de energia renovável e compromisso corporativo com ações de mudança climática.

Keywords: *Trade-off, Volatilidade, Sustentabilidade, Risco de Carbono*

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Créditos fiscais à investigação e desenvolvimento: o impacto do sistema de incentivos fiscais à investigação e desenvolvimento empresarial em Portugal

Paula Leitão[†,*,1], Graça Azevedo[2], Daniel Polónia[2]

1. Departamento de Economia, Gestão, Engenharia Industrial e Turismo (DEGEIT)
2. Departamento de Economia, Gestão, Engenharia Industrial e Turismo

* Corresponding author; paulaleitao@ua.pt; † Presenting author; Accounting.

Abstract. Os benefícios fiscais são um importante instrumento de política pública, representando uma despesa fiscal do Estado. Com base na premissa de que a Investigação e Desenvolvimento (I&D) é um fator essencial para a inovação e o crescimento económico, governos de todo o mundo têm procurado formas de estimular estas atividades, nomeadamente através de incentivos fiscais à I&D empresarial. Em Portugal, o Sistema de Incentivos Fiscais à Investigação e Desenvolvimento Empresarial (SIFIDE) é um benefício fiscal que opera como um crédito fiscal. No entanto, a eficácia dos incentivos fiscais à I&D é um tema que, embora não seja recente, não é consensual. Enquanto alguns estudos apontam para um efeito positivo na inovação e no desempenho económico (e.g. Ivus et al., 2021; Minniti & Venturini, 2017), outros indicam que os resultados podem ser ambíguos e influenciados por diversos fatores (e.g. Chen & Gupta, 2017; Choi & Jeong, 2015; OECD, 2023). Este trabalho tem como objetivo avaliar qual o impacto do SIFIDE na inovação em Portugal. A avaliação do impacto dos incentivos fiscais à I&D, apresenta muitos desafios. Se, por um lado, as medidas disponíveis para medir a inovação e o desempenho económico são imperfeitas, por outro lado, verifica-se, numa análise preliminar, que não existem ou não estão publicamente acessíveis diversos dados em Portugal, essenciais para uma adequada avaliação dos efeitos do SIFIDE. Um exemplo, são as despesas na vertente indireta de I&D, como as contribuições para fundos de investimento, que não têm sido consideradas nos estudos efetuados e que pode enviesar os resultados obtidos. A fragmentação dos dados e a ausência da sua disponibilização ao público, não permitem a sua rastreabilidade e aferição do efetivo investimento em I&D realizado. A metodologia proposta neste trabalho envolve uma combinação de análise quantitativa e qualitativa, com foco nas empresas que beneficiaram do SIFIDE, procedendo-se à análise do processo de avaliação deste benefício fiscal e à identificação dos desafios e oportunidades na disponibilização de dados para medir o impacto do SIFIDE. No atual contexto económico e político, onde se debate quais os setores e atividades que devem ser estimulados e apoiados através de instrumentos de política pública, a avaliação do impacto do SIFIDE na promoção da inovação nas empresas, pode ser uma importante contribuição para o poder legislativo.

Keywords: *Benefícios fiscais, créditos fiscais, I&D, SIFIDE*

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Acknowledgements. Um agradecimento aos meus orientadores, Professora Doutora Graça Azevedo e Doutor Daniel Polónia, pelo apoio e disponibilidade demonstrada.

Práticas de contabilidade e de controlo de gestão na real fábrica do tabaco de lisboa (1656 -1840)

Jorge Pedro do Vale Martins[†,1]

1. Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Accounting.

Abstract. Estudo baseado em fontes de arquivo, pretende analisar o papel do sistema de contabilidade na organização e no controlo da Real Fábrica do Tabaco de Lisboa, uma das mais antigas indústrias monopolísticas do tipo manufatureiro existentes em Portugal. A Real Fábrica do Tabaco de Lisboa (RFTL) foi o único produtor legítimo de tabaco em Portugal a partir de meados do século do século XVII e perdurou nove reinados, num período de 188 anos. O objetivo é demonstrar o papel da contabilidade e do controlo de gestão quando associados aos desejos da coroa em matéria de captação de impostos (Álvarez et. al, 2002), contextualizado num regime político absolutista e num setor altamente lucrativo cujo produto original é o tabaco. Este estudo permite conhecer, para um período da história da contabilidade pouco estudado em Portugal, as práticas de contabilidade de gestão já então implementadas, demonstrando que as mesmas já eram utilizadas pelo estado/monarquia como forma de controlo de custos e controlo da performance dos trabalhadores (Carmona & Macías, 2001).
Embora se fixe o período de exploração da RFTL entre 1656 e 1843, o Subfundo dispõe de livros disponíveis entre 1664 e 1834 (Junta do Tabaco, 1833). A investigação concentra-se numa fase da indústria portuguesa em que os estudos são raros.
Com base no objetivo deste estudo, propõe-se a seguinte pergunta de partida: Qual o papel da contabilidade na organização e controlo na RFTL, em particular em termos de práticas de contabilidade de gestão? Este trabalho abrange um longo período temporal, todos referentes à quarta dinastia monárquica. Vários regimes políticos caracterizam estilos de governação diferentes. Este estudo contribui para a literatura internacional ao estudar a contabilidade e o controlo de gestão num período da história de Portugal pouco explorado. O interesse neste artigo pode ser aferido a dois níveis: na originalidade, porque consiste no estudo de uma fábrica real cuja investigação é inexistente, e, na influência do poder do estado nas práticas da contabilidade e do controlo de gestão.
Espera-se que esta investigação proporcione um entendimento de como as práticas contabilísticas sucederam no contexto organizacional e social da sua época (Gomes & Rodrigues, 2017), evitando-se uma descrição histórica das técnicas tomadas isoladamente do seu contexto (Fleischman & Tyson, 1997).
Este estudo utiliza o quadro teórico de Foucault na forma de estrutura conceptual que fundamenta a pesquisa e fornece uma estrutura para a análise e interpretação dos resultados (Bowden & Stevenson-Clarke, 2021).

Keywords: *Real Fábrica do Tabaco de Lisboa, Contabilidade de Gestão, Controlo, Foucault*

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A three-dimensional analysis of tax avoidance: family business, non-family business, and real earnings management.

Cledilson de Jesus Câmara Viana[†,1]

1. Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), University of Aveiro, Aveiro, Portugal

* Corresponding author; † Presenting author; Accounting.

Abstract. Tax planning is undeniably relevant for companies, influencing aspects such as cash flow, long-term growth, and investments (Chen S., Chen X., Cheng, & Shevlin, 2010; Cho, 2020; Dinis, Martins, & Lopes, 2023; Landry, Deslandes, & Fortin, 2013; Lastiati, Siregar, Diyanty, & Samingun, 2020; Parisi & Federici, 2023; Sánchez-Marín, Portillo-Navarro, & Clavel, 2016). On the other hand, tax collection plays a relevant role in maintaining the financial sustainability of governments, representing an essential source of revenue to drive economic growth and ensure budgetary coverage (Cho, 2020; Flamini, Vola, Songini, & Gnan, 2021; Vitols, 2023). In this dual context, the tax behaviour of companies has attracted growing interest from researchers and policymakers (Clemente-Almendros, Camisón-Haba, & Camisón-Zornoza, 2021; Gaaya, N. Lakhal, & F. Lakhal, 2017; Özbay, Adgüzel, & Karahan Gökmen, 2023).

In searching for gaps in scientific research on taxation, I found limited studies on the tax behaviour of family businesses compared to non-family businesses (38 articles) and few articles on the relationship between earnings management and firm tax behaviour (41 articles) in the Scopus database. Notably, no research has explored how earnings management influences tax avoidance in a comparative analysis between family and non-family firms. Most of the 41 articles on earnings management refer to accruals earnings management. Only 5 articles mentioned expressions related to real earnings management in their keywords. In this context, I will verify the impact of real earnings management on tax avoidance in family firms compared to non-family firms.

The research will culminate in three articles, one of which will be a literature review on the subject of the research (already submitted to a journal), and the other two will be empirical studies on the impact of real earnings management on tax avoidance in family businesses compared to non-family businesses.

The study population will comprise firm-year observation from non-financial companies listed on the official stock exchange of Brazil, spanning from 2017 to 2022. The Economatica database will be utilized for extracting financial data from the companies' financial statements.

Paneldata quantile regressions models will be used to assess the impact of real earnings management on tax behaviour in family firms in comparison to non-family firms. As a means of increasing the robustness of the results, a statistical model based on Generalized Estimated Equations (GEE) will be additionally used. The regressions will be done with the help of Stata 18 software.

Keywords: *tax avoidance; family firms; non-family firms; real earnings management*

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Applied Mathematics

Leveraging Machine Learning for Enhanced Patient Blood Management: Opportunities and Challenges

Daniel Ramos[†,⋆,1], Beatriz Lau[1], Diana Gomes[2], Ana Helena Tavares[1], Luís Silva[1], Vera Afreixo [3], Miguel Martins Felgueiras[4], Henrique Coelho[5], Firmino Machado[5]

1. CIDMA Center for Research and Development in Mathematics and Applications, Aveiro, Portugal
2. Centro Hospitalar Vila Nova de Gaia Espinho
3. CIDMA Center for Research and Development in Mathematics and Applications, Department of Mathematics, University of Aveiro (UA), Aveiro, Portugal
4. ESTG - Escola Superior de Tecnologia e Gestão
5.

⋆ Corresponding author; danielsramos@ua.pt; † Presenting author; Applied Mathematics.

Abstract. Patient blood management (PBM) is a patient-centered, evidence-based, and systematic approach that aims to manage and preserve the patient's own blood, minimizing blood loss, and optimizing the patients physiological tolerance of anaemia, which can improve patient outcomes while saving healthcare resources and reducing costs, due to the reduction in blood transfusions and hospitalization days. Despite being a relatively new field of knowledge, there is already a wide range of articles supporting the adoption of these measures. So much so that the World Health Organization urgently called for their integration into various healthcare institutions. However, this integration can be challenging due to the culture of healthcare professionals and the scarcity of resources, requiring precise allocation of them. Therefore, it is essential to understand the most determinative characteristics of patients for adverse outcomes, such as long periods of intensive care unit stays, extended ward admissions, or increased need for red blood cell transfusion. This can be achieved through the implementation of predictive algorithms, such as Random Forests. In this study involving 834 patients undergoing PBM, the variable Transfusion was created with three levels: 0, 1, and >1, reflecting the quantity of transfused red blood cells. Analyzing it using a Random Forest revealed sensitivities of 0.95, 0.05, and 0.28 for the levels "0", "1", and »1", respectively. Due to the imbalance in classes, a model was trained with a balanced dataset, with 64 observations for each transfusion level (representing 70% of the >1 level observations). In this new model, sensitivity improved to 0.98, 0.73, and 0.89 for the same levels, with Hemoglobin measured at the consultation, Glomerular Filtration Rate, EuroScore, and Platelet level, Age, Surgery and Creatinine level identified as the most important variables.

Keywords: *PBM, Machine Learning, Transfusion*

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Acknowledgements. This work was supported by CIDMA and is funded by the Fundação para a Ciência e a Tecnologia, I.P.(FCT, Funder ID = 50110000187) under Grants UIDB/04106/2020 (https://doi.org/10.54499/UIDB/04106/2020) and UIDP/04106/2020 (https://doi.org/10.54499/UIDP/04106/2020)

Indicators of Primary Health Care

Ana Leonor Saraiva[†,⋆,1], Catarina Cardoso[1], Cristiana Silva[1], Jorge Cabral[1], José Pedro Antunes[2], Paula Rama[1], Sofia Pinheiro[1], Vera Afreixo[1]

1. Center for Research and Development in Mathematics and Applications (CIDMA), Department of Mathematics, University of Aveiro, 3810-193 Aveiro, Portugal
2. USF Arte Nova, Aveiro Local Health Unit, Aveiro, Portugal

⋆ Corresponding author; ana.leonor@ua.pt; † Presenting author; Applied Mathematics.

Abstract. Primary Health Care (PHC) is centered around the needs of individuals and communities, addressing aspects of physical, mental, social, and well-being health. It is essential to monitor whether services are being well provided to the community. In recent years, PHC has undergone a reform to transform it organizationally, allowing for greater proximity to communities and better service delivery. In this regard, Health Indicators have been implemented, aiming for each Unit to manage and improve it according to the results of the indicators. Their results calculate the weighted score of the Multiprofessional Team Performance Index (IDE), indicating the team's overall performance in that unit. This study aims to find a possible correlation and proximity between certain indicators and their impact on Health Care Unit management and to predict their behavior so that actions can be anticipated.
Data were collected from the Primary Health Care Identity Card website - Contracting, Indicators. The databases corresponded to all months of each contractual year of 41 Health Units of ACES of Baixo Vouga. After the database was finalized, the correlation between different indicators was evaluated with all data and the correlation between indicators only with data from USF Arte Nova. From here, the analysis was restricted only to USF Arte Nova. An exploratory analysis was carried out, to evaluate if the behavior of different indicators of the same dimension was similar, with subsequent analysis of the consistency of different dimensions. Then, a hierarchical clustering of time series with Dynamic Time Warping distance measure was performed. Finally, for modeling the indicators, the time series approach was used to perform trend and seasonality decomposition models and find the best way to predict indicator results in the following months.
All statistical analysis was performed using R and RStudio, with the majority presented in shiny app format.

Keywords: *Primary Health Care, Indicators, Correlation, Prediction*

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Acknowledgements. This research was funded by Fundação para a Ciência e Tecnologia (FCT) through the Center for Research and Development in Mathematics and Applications (CIDMA)and projects UIDB/04106/2020 (https://doi.org/10.54499/UIDB/04106/2020) and UIDP/04106/2020 (https://doi.org/10.54499/UIDP/04106/2020).

Confidence intervals for association coefficients

Afonso Azevedo[†,⋆,1], Adelaide Freitas[2], Sara Escudeiro[3], Isabel Brás[2], Helena Sofia Rodrigues[4]

1.
2. Universidade de Aveiro
3. Escola Superior Agrária de Coimbra
4. Instituto Politécnico de Viana do Castelo

⋆ Corresponding author; av.azevedo@ua.pt; † Presenting author; Applied Mathematics.

Abstract. Association coefficients play a fundamental role in quantifying relationships between variables across various disciplines. In the scope of the thematic line BioMathemathics of the Center for Research and Development in Mathematics and Applications (CIDMA) and funded by the FCT, this work presents a comprehensive study on confidence intervals for association coefficients, focusing on Pearson's coefficient and Cramer's V. We explore the calculation of confidence intervals for Pearson's coefficient through Fisher Z transformation alongside bootstrap methods. Similarly, confidence interval estimation for Cramer's V is investigated using three distinct methodologies: Chi-square statistic, Fisher's Z transformation, and bootstrap techniques.
Furthermore, we delve into the analysis of the difference between two Pearson's correlation coefficients (1-2) employing Zou's confidence interval method (Zou [2007]), Wilcox-Muska (Wilcox, R. R., & Muska, J. [2002]), and Bootstrap methodologies. Additionally, we investigate the disparity between Cramer's V coefficients (V1-V2) using an adapted version of Zou's method and Bootstrap techniques.
Moreover, to facilitate practical implementation, we complement our theoretical developments by gathering existing R packages for established methods and developing R code for newly devised methodologies, such as the adaptation of Zou's method. Our findings provide researchers with robust tools and methodologies for accurately estimating and comparing association coefficients, thereby enhancing the reliability of statistical analyses in various domains.

Keywords: *Association coefficients; Confidence Intervals; Pearson's correlation coefficient; Cramer's V*

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Biochemistry

Understanding lipid plasticity in depression and the effects of pharmacological therapy and diet using advanced lipidomic approaches

Bruno Pinto[†,⋆,1], Inês Domingues[2], Tânia Melo[3], Maria do Rosário Domingues[3]

1. CESAM, Department of Chemistry, Santiago University Campus, University of Aveiro, 3810-193, Aveiro, Portugal
2. Mass Spectrometry Centre, LAQV-REQUIMTE, Department of Chemistry, Santiago University Campus, University of Aveiro, 3810-193, Aveiro, Portugal
3. CESAM, Department of Biology, Santiago University Campus, University of Aveiro, 3810-193, Aveiro, Portugal
4. and Mass Spectrometry Centre, LAQV-REQUIMTE, Department of Chemistry, Santiago University Campus, University of Aveiro, 3810-193, Aveiro, Portugal

⋆ Corresponding author; brunojpinto@ua.pt; † Presenting author; Biochemistry.

Abstract. Major depressive disorder (MDD) is a disabling mental illness with high prevalence worldwide. Diagnosis is subjective due to the lack of reliable and reproducible biomarkers and knowledge of pathophysiology [1]. Lipid plasticity appears to play a role in brain dysregulation during depression. Additionally, high-fat diet (HFD) characterized by a higher saturated fats and lower omega-3 fatty acids intake impairs brain function and increases the vulnerability to depression-like behavior. Associated conditions, such as obesity and metabolic syndrome, are causal risk factors for depression [2]. However, it is unclear how treatment with antidepressants or supplementation with omega-3 fatty acids, which have beneficial effects in the treatment of depression, may mitigate lipidome alteration in depression and contribute to restoring brain homeostasis [3].In this PhD work, we aim to contribute to the understanding of brain lipidome plasticity during MDD, with antidepressant treatment, and in combination with HFD or microalgae dietary supplementation, as source of omega-3 fatty acids, using advanced lipidomics approaches. The zebrafish, which has high genetic and metabolic homology with humans, will be used as a valid experimental model to study depression [4]. The results of this project will provide new insights, useful as diagnostic biomarkers, and therapeutic monitoring, as well as new therapeutic strategies.

Keywords: *Lipidomics, depression, brain, diet, omega-3 lipids, zebrafish*

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Ficus carica soluble fibers and oligosaccharides characterization: new insights into dried figs composition towards valorization as a functional ingredient

Elena Cassin[†,*,1], Elisabete Coelho[2], Clarisse Nobre[2], Manuel António Coimbra[2]

1. 1LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, Aveiro, Portugal
2.

* Corresponding author; † Presenting author; Biochemistry.

Abstract. Fig (Ficus carica), which can be consumed both fresh and dried, is an unexplored source of oligosaccharides and soluble dietary fibers (SDF). It was reported that F. carica polysaccharide extract has a beneficial effect on the human gut [1], nevertheless, figs polysaccharides, oligosaccharides, and SDFs composition and prebiotic activity have never been disclosed. Dietary fibers are classified as insoluble or soluble, based on their solubility in water [2]. SDFs with DP > 10, and oligosaccharides (DP 39) were found to be associated with prebiotic activity [3]. Prebiotic activity of SDFs and oligosaccharides constitute a relevant research topic and their introduction in industrial food products could be important for human health. Our objective is to isolate, identify and characterize oligosaccharides and polysaccharides of F. carica to identify their possible prebiotic activity. Their hydrolysis resistance during upper-gastrointestinal digestion and potential for microbiota and metabolite modulation will be evaluated. Figs will be proposed as a functional ingredient for food formulations, based on their natural sweetness added to the prebiotic potential associated with the composition in SDFs and oligosaccharides. To the present, we analyzed two different Portuguese varieties of fig, namely Lampa Preta fresh and Pingo de Mel, both fresh and dried, at different maturation stages. Dialysis with two different cut-offs (1 kDa and 12-14 kDa) were performed on each sample, and after that, the soluble and insoluble fractions were separated, and their total sugar analysis was performed by GC-FID. 82-89% of the total polysaccharides were retained in the insoluble fraction. Uronic acids were the most abundant sugars both in the insoluble (44-62% of total sugars), and soluble fractions (54-72%), suggesting that pectic polysaccharides are present in a large quantity. Moreover, the oligosaccharides profile of soluble fractions with molecular weight higher than 1 kDa, obtained by HPAE-PAD, suggests the presence of pectic oligosaccharides.

Keywords: *Carbohydrates, polysaccharides, dietary fiber, prebiotic, microbiota*

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Acknowledgements. This work was funded by InovFarmer.MED - Improving Mediterranean supply chain through innovative agro-food business to strengthen small-scale farmers competitiveness, using prickly pear and fig as case study (PRIMA/0006/2021) through FCT. The authors acknowledge the financial support through LAQV/REQUIMTE (UIDB/50006/2020 DOI:10.54499/UIDB/50006/2020, UIDP/50006/2020, DOI:10.54499/UIDP/50006/2020, and LA/P/0008/2020 DOI 10.54499/LA/P/0008/2020) within the PT2020 Partnership Agreement. Elena Cassin thanks the PhD grant 2023.02050.BD, funded by national fund through FCT. Elisabete Coelho thanks the research contract (CDL-CTTRI-88-ARH/2018 REF. 049-88-ARH/2018) funded by national funds (OE), through FCT, in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of the article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19. Clarisse Nobre acknowledges the Portuguese Foundation for Science and Technology (FCT) for the Assistant Research contract (DOI 10.54499/2021.01234.CEECIND/CP1664/CT0019), respectively. This study was supported by FCT under the scope of the strategic funding of UIDB/04469/2020 unit (DOI 10.54499/UIDB/04469/2020) and by LABBELS Associate Laboratory in Biotechnology, Bioengineering and Microelectromechanical Systems, LA/P/0029/2020.

Structure-function relationships of glycosaminoglycans able to valorise porcine cartilage in food applications.

Ricardo Silva[†,⋆,1], Elisabete Coelho[1], Manuel A. Coimbra[1]

1. LAQV-REQUIMTE and Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Biochemistry.

Abstract. Porcine cartilage is a by-product of meat industry with potential high value due to its unexploited content of glycosaminoglycans. Glycosaminoglycans are negatively charged polysaccharides constituted by a disaccharide repetitive unit of galactosamine or glucosamine and L-iduronic acid or D-glucuronic acid. These polysaccharides are commonly attached to core proteins, forming proteoglycans. Depending on sugar composition and sulphate pattern, glycosaminoglycans are classified as heparin, chondroitin sulphate, keratan sulphate, and hyaluronic acid. In this proposal, it is hypothesized that the knowledge of structural details of glycosaminoglycans present in porcine cartilage, a meat industry by-product, can allow to define different applications for their valorisation, including technological food ingredients as phosphate substitutes, emulsifiers, and chelating agents. To test this hypothesis, glycosaminoglycans extracted from porcine cartilage, will be characterized to present a portfolio of glycosaminoglycans which could be used to different applications (Ferreira, Sonia S., et al. 2018). Highly negatively charged oligosaccharides derived from glycosaminoglycans will be tested as substitute of the phosphates in a ham matrix, amphipathic proteoglycans will be tested as emulsifiers (Reis, Sofia F., et al. 2023) and negative charged glycosaminoglycans due to their carboxyl and sulphate groups, will be tested as chelating agents (Savani, Priya, et al. 2023), leading to development of new food technological ingredients.

Keywords: *Glycosaminoglycans, porcine cartilage, by-product, emulsifier, chelating agent, phosphates substitutes.*

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Acknowledgements. The authors gratefully acknowledge the financial support of the European Union (NextGenerationEU) through the project Agenda VIIAFOOD - Plataforma de Valorização, Industrialização e Inovação comercial para o AgroAlimentar (n.ž176/2023/BI/AgendasPRR , BI/UI64/11228/2023).

Optimization of cannabis sativa extraction targeting colorectal cancer

Rita Silva-Reis [†,⋆,1], Joana L. C. Sousa [2], Artur M. S. Silva [1], Paula A. Oliveira [1], Susana M. Cardoso [3]

1. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. 2 Centre for the Research and Technology of Agro-Environmental and Biological Sciences (CITAB), Inov4Agro, University of Trás-os-Montes and Alto Douro, 5000-801 Vila Real, Portugal
3. Centre for the Research and Technology of Agro-Environmental and Biological Sciences (CITAB), Inov4Agro, University of Trás-os-Montes and Alto Douro, 5000-801 Vila Real, Portugal
4. Clinical Academic Center of Trás-os-Montes and Alto Douro, University of Trás-os-Montes and Alto Douro, 5000-801 Vila Real, Portugal

⋆ Corresponding author; reis.rita@ua.pt; † Presenting author; Biochemistry.

Abstract. Cannabis sativa, one of humanity's oldest plants, has long been a subject of historical discussion. Its main active compounds are cannabinoids, and the most well-known ones are 9-tetrahydrocannabinol (THC), responsible for its psychoactive effects, and cannabidiol (CBD), acknowledged for its therapeutic benefits such as antioxidant and anti-inflammatory properties. Overall, a total of 125 cannabinoids have already been identified [1]. This plant also includes a complex array of other active substances, particularly terpenes, flavonoids, and other compounds [2].Current research on using extracts or isolated compounds from C. sativa for colorectal cancer (CRC) treatment suggests their potential as antitumor agents, capable of inhibiting CRC cell growth [3]. However, further investigations are needed to understand the underlying mechanisms of these effects, including exploring compound interactions and the impact of minority plant compounds.The present work aims at optimizing the extraction procedure of C. sativa, including the use of different solvents applied to non-decarboxylated and decarboxylated plant material, to achieve the highest yield and to obtain several extracts rich in different bioactive compounds, focusing on the enhancement of their biological application potential.

To establish the profile of valuable phytochemicals of C. sativa inflorescences, several organic extractions were performed using different solvents. Extraction yield, cannabinoids and other phytochemicals content, and antioxidant activity were analyzed through extracts. For cannabinoid analysis, both non-decarboxylated and decarboxylated forms of the plant were examined.

The main compounds detected by HPLC-MS were THCA, THC, and CBN. Regarding THCA recovery, the most promising non-decarboxylated extracts were methanol (MeOHND) and hexane (HexND), while THC recovery was maximal when extracting decarboxylated inflorescences with hexane (HexD). GC-MS analysis revealed that MeOHND had a higher number of sugars and asparagine; the non-decarboxylated ethanolic extract exhibited a broader diversity of compounds, while the dichloromethane extract was richer in fatty acids. In addition, the HexND contained mainly terpenes. As expected, extract decarboxylation deeply decreased the number of terpenes in all extracts.

The most promising extract will be purified and isolated for comparison with the original extracts regarding bioactivity. Bioactivity evaluations will be conducted using cell lines and a CRC animal model to assess their potential. This study has established a customized extraction method to generate extracts rich in specific target compounds, potentially possessing varied biological properties. The implications of these findings extend beyond the study, showing promise for addressing health issues such as CRC. Our future research will further explore the therapeutic potential of these extracts.

Keywords: *Cannabinoids, extraction, terpenes, ultrasound-assisted extraction, fatty acids, antioxidant*

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Exploring the potential of polysaccharides: development of chitosan, alginate, and galactomannan-based materials

Sara A. Valente[†,⋆,1], Ricardo J.B. Pinto[1], Carlos M. Silva[1], Bruno Sarmento[2], Manuel A. Coimbra[1], Cláudia P. Passos[1]

1.
2. c INEB - Institute of Biomedical Engineering Instituto, University of Porto, 4150-180 Porto, Portugal d i3S - Institute for Research Innovation in Health, University of Porto, 4150-180 Porto, Portugal e CESPU - Institute for Research and Advanced Training in Health Sciences and Technologies, 4585-116 Gandra, Portugal

⋆ Corresponding author; sara.valente@ua.pt; † Presenting author; Biochemistry.

Abstract. Polysaccharides are abundant, biocompatible, and versatile natural polymers ideal for various applications, including biomedical [1]. In this work, chitosan, alginate and galactomannans were assessed for their potential as primary components in the development of materials. Chitosan nanoparticles for DNA incorporation were made using two methods: electrostatic complexation for instant formation [2] and covalent crosslinking with genipin [3] for subsequent DNA incorporation. The nanoparticles prepared by coacervation were surface functionalized with a targeting agent (alendronate) using alginate oligosaccharides as spacer. Galactomannans were studied for their ability to form crosslinked networks, with special focus on their ability to form microparticles. The materials formed after supercritical CO2 drying (aerogels), freeze-drying (cryogels), and evaporative drying (xerogels) were characterized.

Chitosan-DNA materials prepared by coacervation were confirmed to be in nanoparticle form. The size of the nanoparticles was seen to be affected by chitosan molecular weight and volume of preparation, while not be affected by the method of agitation nor buffer nature. Zeta-potential of the nanoparticles was positive for all the preparations. Genipin-crosslinked chitosan nanoparticles were seen to tend to aggregate in water, limiting their use as nanoparticles per se in aqueous systems. FTIR analysis confirmed the successful conjugation of alendronate to alginate oligosaccharides. Locust bean galactomannan (LBG) was used to form networks that, when dried, produced materials with varied properties: fluffy, nanoporous aerogels; fluffy, macroporous cryogels; and film-like, non-porous xerogels. LBG based microparticles of different sizes were obtained using different microparticle preparation methodologies, and the size and morphology were characterized by SEM.

In conclusion, this study successfully employed chitosan, alginate, and galactomannans as polysaccharide building blocks to develop innovative materials with potential applications in biomedical and industrial fields. Overall, the diverse functionalities and adaptability of these biopolymers emphasize their potential as sustainable materials in a variety of applications.

Keywords: *Oligosaccharides; Nanoparticles; Microparticles; Aerogels; Locust bean gum*

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Acknowledgements. Thanks are due to University of Aveiro and FCT/MCT for the financial support to LAQV-REQUIMTE research units (FCT UIDB/50006/2020) and CICECO - Aveiro Institute of Materials, UIDB/50011/2020 & UIDP/50011/2020 through national funds and, where applicable, co-financed by the FEDER, within the PT2020 Partnership Agreement. Cláudia Passos contract (CEECIND/01873/2017) and Sara Valente PhD grant (DFA/BD/5430/2020) were supported by FCT. The research contract of Ricardo Pinto was funded by national funds (OE), through FCT in the scope of the framework contract foreseen in the numbers 4, 5, and 6 of the article 23, of the Decree-Law 57/2016, of 29 August, changed by Law 57/2017, of 19 July.

Impact of methylmalonic acid accumulation on mouse Sertoli cells metabolism: a crosstalk between aging and testicular dysfunction?

Ema A. Alves[†,1], David F. Carrageta[2], Bárbara Guerra-Carvalho[3], Pedro F. Oliveira[4], Rita Oliveira[4], Marco G. Alves[⋆,4]

1. Department of Medical Sciences, Institute of Biomedicine (iBiMED), University of Aveiro, Aveiro, Portugal
2. Clinical and Experimental Endocrinology, UMIB - Unit for Multidisciplinary Research in Biomedicine, ICBAS - School of Medicine and Biomedical Sciences, University of Porto, Porto, Portugal
3. ICBAS - School of Medicine and Biomedical Sciences, University of Porto, Porto, Portugal
4. LAQV-REQUIMTE and Department of Chemistry, University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; marcoalves@ua.pt; † Presenting author; Biochemistry.

Abstract. The accumulation of methylmalonic acid (MMA), a by-product of propionate metabolism mostly recognised as a clinical biomarker of vitamin B12 deficiency, emerges as contributing factor to a multitude of aging-related consequences. A prevalent outcome of aging is the notable decline in reproductive health and the potential onset of infertility. However, the impact of MMA accumulation on the male reproductive health is unknown. In this study, we aimed to assess the effects of a chronic MMA accumulation on Sertoli cells (SCs), which are responsible for providing the nutritional support of spermatogenesis. Mouse SCs (mSCs, TM4 cell line) were treated with increasing MMA concentrations (0.5, 1, and 5 mM). After 72 h, cellular viability and proliferation were assessed through lactate dehydrogenase (LDH) release and Incucyte proliferation assays, respectively. Metabolic activity was assessed using the MTT assay. LDH activity was also evaluated. Additionally, fluorogenic dyes JC-1 and CM-H2DCFDA were used to evaluate mitochondrial membrane potential and total ROS production, respectively. Finally, lipid peroxidation and protein tyrosine residues nitration were evaluated using the Slot Blot technique. Our results demonstrated that MMA accumulation had no impact on mSCs proliferation or viability. However, MMA increased mSCs metabolic activity and mitochondrial membrane potential, indicating a potential increased mitochondrial activity. Overall, our findings suggest that MMA impacts the metabolic and mitochondrial function of mSCs, further emphasizing MMA accumulation as an important contributor for aging-related male (in)fertility.

Keywords: *Aging; Male infertility; Methylmalonic acid; Mitochondria; Sertoli cells*

Impact of caloric restriction and GLP-1 administration in testicular acetyl-lysine levels

Diana C.A. André[†,⋆,1], Ana D. Martins[1], Rita Nogueira-Ferreira[2], Marco G. Alves[3], Rita Ferreira[1], Pedro F. Oliveira[1]

1. LAQV-REQUIMTE Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, Aveiro, Portugal
2. Cardiovascular RD Center - UnIC@RISE, Department of Surgery and Physiology, Faculty of Medicine of the University of Porto, Porto, Portugal
3. Department of Medical Sciences, Institute of Biomedicine (iBiMED), University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; dianacaa@ua.pt; † Presenting author; Biochemistry.

Abstract. Caloric restriction (CR) has been suggested as a strategy towards longevity and delaying the onset of age-related diseases. It consists of the reduction of caloric intake while maintaining the essential energy and nutritional requirements to achieve optimal health while avoiding malnutrition. However, the effects of this nutritional regimen on male reproductive health have not yet been comprehensively studied. CR affects a variety of metabolic sensors, including sirtuins (SIRTs). Concerning the testicular function and male fertility, SIRTs are known to interact with the hypothalamic-pituitary-gonadal axis and mitochondrial dynamics. However, the interplay between CR-SIRTs-Male reproductive health remains unexplored. Thus, in our work we aimed to elucidate the role of CR on male fertility, focusing on the impact in the effect over testicular SIRTs. For that, we used six-week-old Wistar rats, divided in three groups (n=15): ad libitum feed group; calorically restricted group (fed with less 30% food that control rats); and a group with GLP-1 administration (3.5 pmol/min/kg intraperitoneal for 28 days). As expected, CR promoted a lower weight gain and a decrease in insulin resistance. Notably, GLP-1 administration, beyond the expected increase in active GLP-1 levels, did not promote any change in glucose metabolism, hormonal profile and consequently in body weight. Concerning sperm quality, CR promoted an increase in sperm head defects, while the GLP-1 administration improved sperm morphology. In testicular tissue of rats subjected to GLP-1 administration, there were higher acetyl-lysine protein levels, when compared with rats fed ad libitum or under CR. In the future, we strive to continue to study the testicular tissue of this animal model, in order to assess the expression of different sirtuins, as well as to evaluate alterations in acetylation profiles through testicular proteome analysis. Lastly, selected protein targets will be examined to elucidate the impact of CR on testicular function, and subsequent correlation analysis of these targets with the established spermatozoa quality parameters will be performed.

Keywords: *Situins, male fertility, caloric restriction, spermatogenesis, protein (de)acetylation*

Acknowledgements. This research was funded by Fundação para a Ciência e a TecnologiaFCTto LAQVREQUIMTE (UIDB/50006/2020), IBIMED (UIDP/04501/2020 and UIDB/04501/2020). Ana D. Martins (2022.05444.CEECIND) were funded by national funds through FCTFundação para a Ciência e a Tecnologia, I.P.under the Scientific Employment Stimulus. The work was co-funded by FEDER through the COMPETE/QREN, FSE/POPH, and POCICOMPETE 2020 (POCI-01-0145-FEDER-007491) funds.

Alginate-derived carbohydrates as phosphate alternatives in meat products

Bernardo A. C. Ferreira[†,⋆,1], Pedro A. R. Fernandes[2], Sónia S. Ferreira[1], Elisabete Coelho[1], Maria A. Azevedo[3], Cláudia Nunes[4], Manuel A. Coimbra[5]

1. LAQV-REQUIMTE - Department of Chemistry, University of Aveiro
2. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, Aveiro, Portugal
3. Associação Colab4Food - Laboratório Colaborativo para a Inovação da Indústria Agroalimentar, Vairão, Portugal
4. CICECO Aveiro Institute of Materials, Department of Materials Ceramic Engineering, University of Aveiro, Aveiro, 3810-193, Portugal
5. LAQV-REQUIMTE Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; bacferreira@ua.pt; † Presenting author; Biochemistry.

Abstract. Phosphates are food additives used for the retention of water in several protein-rich products, enhancing texture, tenderness, succulence, and production yield in processed meats (Tarté, 2009). However, high values of phosphate intake have been associated with cardiovascular comorbidity, and chronic kidney disease, justifying the search for clean-label substitutes (Ritz et al., 2012). Alginate is an anionic polysaccharide from brown seaweed that when depolymerised into low molecular weight oligo- and polysaccharides have potential as alternatives to phosphates in meat products, by mimicking their size and charge. Alginate and alginate derived carbohydrates can be prepared and analysed by high-performance anion exchange chromatography with a pulsed amperometric detector (HPAEC-PAD) to reach the needed molecular size. The carbohydrate composition of an ideal fraction containing oligo- and polysaccharides can be introduced in cooked ham to test against phosphate use. For comparison purposes, hams without the additive incorporation (negative control), with the addition of sodium tripolyphosphate (positive control), and with alternative additives can be prepared. Overall, hams produced with alginate have the potential to serve as a clean-label substitute of synthetic phosphates additives in cooked ham formulations.

Keywords: *nan*

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Acknowledgements. Acknowledgments: The authors acknowledge to the projects of LAQV-REQUIMTE (LA/P/0008/2020 DOI 10.54499/LA/P/0008/2020, UIDB/50006/2020 DOI 10.54499/UIDB/50006/2020, UIDP/50006/2020 DOI 10.54499/UIDP/50006/2020) and CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), funded by FCT/MCTES through national funds. Bernardo A. C. Ferreira acknowledges FCT for his grant ref. 2023.03733.BDANA. P.A.R.F and S.S.F. would like to acknowledge the research contract funding from the project Agenda VIIAFOOD. Thanks are also due to Grupo Primor (Portugal) for providing the meat formulation and ingredients. Elisabete Coelho and Cláudia Nunes thanks FCT for funding through program DL 57/2016 Norma transitória (Ref. 049 88 ARH/2018 and DL 57/2016/CP1482/CT0031).
Funding: This research was funded by PT national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) and the European Union (NextGenerationEU) through the project Agenda VIIAFOOD - Plataforma de Valorização, Industrialização e Inovação comercial para o AgroAlimentar (n.ž C644929456-00000040).

Biosensors for rapid cyanotoxins detection

Miguel F. Galrinho[†,⋆,1], Alisa Rudnitskaya[2], Manuel A. Coimbra[1], Cláudia P. Passos[1]

1. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. CESAM and Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; miguel.fgalrinho@ua.pt; † Presenting author; Biochemistry.

Abstract. Harmful blooms of cyanobacteria (CyanoHABs) are a common occurrence in freshwater bodies worldwide. CyanoHABs represent a human health threat due to cyanobacterial toxins, which have been detected amongst European countries including Portugal (Benayache et al., 2019). For the detection of cyanotoxins the most conventional approaches include imaging techniques, enzyme-linked immunosorbent assays (ELISA) or mass spectrometry. These approaches, however, show disadvantages in terms of requiring specific kits or even a laboratory environment with skilled personnel. For this reason, significant efforts have been directed towards developing simpler and less costly screening tools for on-site detection. Biosensors comprise tools that allow to convert specific biological information such as reactions between analytes or binding of molecules into different types of signals, bringing advantages such as low-cost and high sensitivity whilst simplifying on-site screening.
Biosensors will be prepared based on enzyme inhibition assays, taking advantage of the interaction between cyanotoxins and specific enzymes such as proteases and phosphatases (Oh et al., 2022). These biosensors will be further immobilized, allowing to confer higher stability and portability for on-site screening. A gel-based approach will be taken, allowing to create a polymeric matrix that can host these enzymes, preserving their forms and functions (Du et al., 2021). For the preparation of these gels, polysaccharides will provide promising and sustainable materials, bringing advantages such as biocompatibility, and biodegradability. Additionally, their richness in hydroxyl groups will contribute with good targets for crosslink, allowing to assemble stable (pH, ionic concentration, and temperature effects) structures for the biosensors (Li & Lin, 2021).
This work aims to develop novel biosensors for rapid cyanotoxins screening, assembling a tool that can be applicable outside of laboratory settings. Immobilized biosensors will provide an easy and simple approach for on-site testing, allowing to monitor CyanoHABs occurrence on freshwater bodies.

Keywords: *Cyanotoxins, Biosensors, On-site screening, Polysaccharides, Gels*

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Differential Effects of Glyphosate and its Metabolite AMPA on Proliferation and Metabolic Activity of Testicular Sertoli Cells

Sara Branco[†,1], Patrícia Braga[2], Marco G. Alves[3], Pedro Fontes Oliveira[4], Ariane Zamoner[⋆,1]

1. Department of Chemistry, University of Aveiro, Portugal
2. Unit for Multidisciplinary Research in Biomedicine (UMIB), Institute of Biomedical Sciences Abel Salazar (ICBAS), University of Porto, Porto, Portugal
3. ITR - Laboratory for Integrative and Translational Research in Population Health,ăPorto,ăPortugal
4. Department of Medical Sciences, University of Aveiro, Portugal
5. Department of Biochemistry, Federal University of Santa Catarina, Brazil

⋆ Corresponding author; ariane.zamoner@ufsc.br; † Presenting author; Biochemistry.

Abstract. Glyphosate, the active ingredient in many herbicides, has been extensively used in agricultural practices worldwide. Glyphosate can degrade into aminomethylphosphonic acid (AMPA), a metabolite with its own set of implications. Sertoli cells, critical for maintaining spermatogenesis, serve as an essential model for assessing reproductive toxicity. This study aimed to investigate the impact of glyphosate and its metabolite AMPA on TM4 Sertoli cell lines.

The cells were treated with medium supplemented with fetal bovine serum or insulin-transferrin-selenium (ITS). Concentrations ranging from 0.1 to 25000 micrograms/L were employed for both glyphosate and AMPA. The concentration of 0.1 micrograms/L represents the permissible limit in water according to the European Union standards, while 500 micrograms/L is the permissible limit in Brazil. Cell proliferation was assessed using Sulforhodamine B (SRB) assay, which measures cellular protein content. Metabolic activity was determined using the MTT assay, which evaluates the mitochondrial activity of cells. Six experiment was conducted in triplicate to ensure statistical robustness.

The results revealed differential effects of glyphosate and AMPA on Sertoli cells. AMPA significantly reduced cell proliferation at concentrations of 0.1, 5, 30, 150, and 500 micrograms/L, while did not impact on cellular metabolic activity across all concentrations tested. Conversely, glyphosate inhibited cell proliferation at the concentration of 0.1 micrograms/L and did not affect cellular metabolic activity at the concentration tested. These findings suggest that AMPA may exert greater effects on cell proliferation in Sertoli cells compared to glyphosate. This inhibition of cell proliferation at environmentally relevant concentrations raises concerns about the potential reproductive toxicity of AMPA. Further studies elucidating the underlying mechanisms of glyphosate and AMPA toxicity on Sertoli cells are warranted to better understand their reproductive health implications.

Keywords: *Glyphosate; AMPA; Sertoli cells; Cell proliferation; Reproductive toxicity*

Acknowledgements. FCT; CAPES/PrInt; CNPq/Brazil

Functionalized Imidazolones as Luminescent Probes for Biological Imaging

Olga Lopes[†,⋆,1], João A. Pacheco[1], Inês da Silva Fonseca[1], Cátia I. Esteves[1], Raquel Nunes da Silva[1], João Rocha[2], Artur M. S. Silva[1], Luisa Helguero[3], Samuel Guieu [4]

1. LAQV-Requimte
2. CICECO
3. iBiMED
4. LAQV-Requimte e CICECO

⋆ Corresponding author; olgalopes@ua.pt; † Presenting author; Biochemistry.

Abstract. Since its discovery, the Green Fluorescent Protein (GFP) has gained much attention, especially in biological imaging.[1] The fluorophore responsible for the photophysical proprieties of the GFP is an imidazolone functionalized with a benzylidene.[2,3] The synthetic analogues of this fluorophore are not very emissive in solution, due to the isomerization of the carbon-carbon double bond. But restricting the double bond isomerization can considerably enhance the emission intensity, a particular case of Aggregation-Induced Emission Enhancement, which has been proven by inserting the compound in a -barrel, in the solid state, in a solid matrix and by interaction with biomacromolecules, increasing its potential as luminescent probe for bio-imaging.[4] Using chemical modifications to restrict the double bond isomerization, such as cyclization and complexation, the emission intensity of the analogues can also be restored.[5]Investigation on this topic has shown that the benzylidene substituents influence the photophysical proprieties of the GFP analogues, while adding substituents on the nitrogen can modify other proprieties, such as solubility. Here, we have been using different substituents on different positions to enhance the emission intensity of these compounds and target specific cellular components. The usability of these novel probes for use as specific cellular markers for bio-imaging will be discussed in relation to their uptake by living cells and effects on their viability.

Keywords: *Cellular Testing; Lumnescence; Biological Imaging; Imidazolones*

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Cisplatin and Pd2Spermine impact on spleen The neglected organ

Tatiana J. Carneiro[†,⋆,1], Martin Vojtek[2], Salomé Gonçalves-Monteiro[2], Ana L.M. Batista de Carvalho[3], Maria Paula M. Marques[3], Carmen Diniz[2], Ana M. Gil[1]

1. Department of Chemistry CICECO-Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
2. LAQV/REQUIMTE, Department of Drug Sciences, Laboratory of Pharmacology, Faculty of Pharmacy, University of Porto, 4150-755 Porto, Portugal
3. Química-Física Molecular, Department of Chemistry Department of Life Sciences, Faculty of Science and Technology, University of Coimbra, 3004-535 Coimbra, Portugal

⋆ Corresponding author; tatiana.joao@ua.pt; † Presenting author; Biochemistry.

Abstract. The palladium(II)-complex with the biogenic amine spermine, Pd2Spm, has been studied as an alternative to cisplatin (cDDP), potentially overcoming acquired resistance and high toxicity of the latter, particularly on TNBC [1,2]. The cDDP side-effects have been described in kidney, liver and heart, while the effect on spleen is poorly characterized [3].
The present work reports an NMR metabolomics study of the polar metabolome and lipidome of the spleen of a cell-derived xenograft mouse model of TNBC treated with either Pd2Spm or cDDP.
Results revealed a stronger impact of cDDP on polar metabolism of spleen compared to that of Pd2Spm, whereas the lipidome was insensitive to both agents. The cDDP signature comprised increases in levels of glycine and isoleucine suggesting impairments in spleen function of mediate immune response or recycle red blood cells, in tandem with increases in levels of UDP-N-acetylglucosamine and trimethylamine-N-oxide reflecting a pro-inflammatory profile. Additionally, increases in levels of purines- and pyrimidines-derived compounds indicate an enhanced salvage pathway possibly to recycle nucleotide bases derived from DNA damage. Interestingly, Pd2Spm exposure barely impacted the metabolism of mice's spleen. Nonetheless, increases in levels of hypoxanthine and NAD+ may suggest some extension of oxidative stress, despite the absence of variations in other antioxidant markers.
This work demonstrates the usefulness of untargeted metabolomics in evaluating drug impact on the mice organs, supporting Pd2Spm as a promising alternative to cDDP due to the lower toxicity in the spleen.

Keywords: *NMR, Palladium(II), Cisplatin, Triple-negative breast cancer, Mice, Spleen*

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DIET-INDUCED CHANGES IN KLEPTOPLASTIC SEA SLUG LIPIDOME DYNAMICS FOLLOWING PHOTOSYNTHETIC ACTIVITY DECLINE

Carlos Paya[†,⋆,1], João Pereira[1], Felisa Rey[2], Paulo Cartaxana[3], Rosário Domingues[4], Sónia Marisa Gonçalves da Cruz[1]

1. CESAM
2. CESAM Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal and
3. Universidade de Aveiro
4. University of Aveiro, Santiago University Campus, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Biochemistry.

Abstract. Sacoglossan sea slugs, such as Elysia viridis and Elysia crispata, demonstrate a fascinating ability known as kleptoplasty (Cruz & Cartaxana, 2022), where they incorporate chloroplasts from algal prey into their digestive system cells retaining them functional. This adaptation allows them to utilize solar energy to synthesize vital biological molecules (Cruz et al., 2020, Cartaxana et al., 2021). Lipids are essential components of cellular membranes; they play signaling roles and represent a source of metabolic energy (Parrish, 2013). Hence, it is likely that lipids play a role in chloroplast retention, as chloroplast membranes interact with the host cells to allow the retention of these organelles (Pelletreau et al., 2014). This study investigates how changes in photosynthetic activity, promoted by starvation, impact the lipid composition of these sea slugs. Utilizing high-resolution lipidomic techniques (C18-LC-HR-MS & MS/MS) alongside bioinformatics tools, we analyzed the lipidomes of sea slugs fed on different algal sources (E. viridis fed on Codium tomentosum, E. crispata fed on Bryopsis plumosa and E. crispata fed on B. plumosa) across different levels of photosynthetic activity, ranging from 100% to less than 20%. Glycolipids and sterols were the lipid species that contributed more to discriminate groups with different photosynthetic activity. Glycolipids, exclusive molecules of chloroplasts (Hölzl & Dörmann, 2007), decreased progressively in E. viridis fed on C. tomentosum and E. crispata fed on B. plumosa. Conversely, a rapid depletion was observed in E. viridis consuming B. plumosa. Additionally, a notable increase in sterols was observed in specimens with diminished photosynthetic activity. This rise in phytosterols is likely due to the breakdown of chloroplast membranes and lipid reserves, whereas animal-derived sterols were synthesized in response to abiotic stress. The distinct patterns of lipidomic profiles associated with different levels of photosynthetic activity emphasize the impact of photosynthetic activity loss on sea slugs lipidome.

Keywords: *Elysia viridis, Elysia crispata, Lipidomics, Photosynthetic activity, Sacoglossa, Starvation tolerance*

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Acknowledgements. This project (KleptoSlug) has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (Grant agreement no. 949880; DOI: 10.3030/949880). Felisa Rey, Paulo Cartaxana and Sónia Cruz thank Fundação para a Ciência e Tecnologia their researcher contracts (CEECIND/00580/2017, DOI:10.54499/CEECIND/00580/2017/CP1459/CT0005 to Felisa Rey; CEECIND/01434/2018, DOI: 10.54499/CEECIND/01434/2018/CP1559/CT0003 to Paulo Cartaxana, 2020.03278.CEECIND, DOI:10.54499/2020.03278.CEECIND/CP1589/CT0012 to Sónia Cruz).

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Unlocking bioaccessible and bioavailable algae lipids as functional ingredients for sustainable and healthy diets

Rita Pais[†,⋆,1], Ana Maria Gomes[2], Ralph Urbatzka[3], Rosário Domingues[1], Tânia Melo [1]

1. University of Aveiro, Santiago University Campus, 3810-193 Aveiro, Portugal
2. Universidade Católica Portuguesa, Rua Diogo Botelho 1327, 4169-005 Porto, Portugal
3. University of Porto, 4450-208 Matosinhos, Portugal

⋆ Corresponding author; ana.s.pais@ua.pt; † Presenting author; Biochemistry.

Abstract. Unhealthy dietary habits such as the high intake of saturated fats and trans fatty acids (FA) are associated with metabolic changes, imbalanced redox status, inflammation, and increased risk of non-communicable diseases (NCDs), including cardiovascular diseases and diabetes, which contribute to the occurrence of metabolic syndrome (MetS). This is a cluster of several disorders including central obesity, diabetes, dyslipidemia, and hypertension, which has increased worldwide and is considered a major public health (Cano-Ibáñez et al., 2019). Omega-3 polyunsaturated fatty acids (PUFA), with recognized nutritional and health-promoting properties, are discussed for eventually preventing MetS, mostly relying on their anti-inflammatory, anti-diabetic, and anti-obesity effects (Mayer et al., 2021).
Microalgae are gaining attention as alternative sources of these PUFA, being polar lipids their main carriers. However, to exert any health beneficial effect, polar lipids from microalgae must be digestible and capable of being absorbed by the human body, in order to access the circulation system and to reach the target location, which is strongly influenced by bioaccessibility and bioavailability factors (Demarco et al., 2022). However, these characteristics omega-3 polar lipids from microalgae are far from being unveiled, precluding its functional claims. Therefore, this study aims to advance the bioprospecting of microalgae lipids as sources of lipid reducing, antidiabetic, and anti-inflammatory agents, in chemico, in vitro and in vivo, and to evaluate the bioaccessibility and bioavailability of omega-3 polar lipids from the most promising bioactive lipid extracts and corresponding biomass, using in vitro (cell-based assays and static digestion model) and in vivo (zebrafish model) approaches. These samples will also be characterized by lipidomics to identify their composition as sources of valuable lipids, and eventually the putative bioactive compounds. Results will highlight microalgae as sustainable sources of functional foods and health-promoting ingredients to reduce MetS.

Keywords: *Omega-3 lipids; bioactive compounds; bioprospecting; digestion; absorption, lipidomics*

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Acknowledgements. We acknowledge financial support to the University of Aveiro and to PT national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) through the projects UIDB/50006/2020 and UIDP/50006/2020, to the research unit CESAM (UIDB/50017/2020+UIDP/50017/2020+LA/P/0094/2020) through national funds and, where applicable, co-financed by the FEDER, within the PT2020. Tânia Melo thanks the Junior Researcher contract in the scope of the Individual Call to Scientific Employment Stimulus 2020 (https://doi.org/10.54499/2020.01578.CEECIND/CP1589/CT0010). This work is part of project Pacto da Bioeconomia Azul (C644915664-00000026) supported by PRR Plano de Recuperação e Resiliência and the Next Generation EU European Funds.

BRI2 protein modulation as a Promising Therapeutic Target for Alzheimer's Disease Treatment

Mariana Vassal[†,1], Filipa Martins[1], Simone Tambaro[1], Sandra Rebelo[1]

1.

* Corresponding author; † Presenting author; Biochemistry.

Abstract. The study of neurogenesis and neuronal differentiation is crucial for addressing neuronal loss and synaptic degeneration, which is one of the hallmarks of Alzheimer's disease (AD). Despite progress, effective pro-neurogenic therapies remain challenging, which calls for a better understanding of neurogenic factors. In this context, previous teamwork has revealed BRI2 as a potential neuronal differentiation modulator, thus, its study may offer insights into the therapeutic potential for neurological disorders marked by neuronal degeneration. BRI2 is a transmembrane protein that is cleaved by different proteases which results in different BRI2 fragments (Martins et al. 2021). To clarify their role in neuronal differentiation we assessed BRI2 protein levels and its proteolytic fragments throughout the differentiation of SH-SY5Y cells and in primary neuronal cultures (PNC). Results demonstrate that BRI2 protein and its proteolytic processing increases throughout the differentiation of SH-SY5Y cells, and it is higher at the early stages of differentiation of PNCs. Future work with pharmacological inhibitors of BRI2s proteases will help enlighten the contribution of its processing to neuronal differentiation and, ultimately it will help clarify BRI2's therapeutic potential for neurological disorders characterized by neuronal loss.

Keywords: *Neurogenesis, neuronal differentiation, proteolytic processing, BRI2*

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Impact of chromium picolinate on Leydig cell steroidogenesis and antioxidant balance using an in vitro insulin resistance model

Rúben Moreira[†,1], Ana Martins1[1], Rita Ferreira[1], Marco G. Alves3[2], Maria de Lourdes Pereira[3], Pedro F. Oliveira[⋆,1]

1. Department of Chemistry
2. iBiMED-Institute of Biomedicine, Department of Medical Sciences,
3. Department of Medical Sciences

⋆ Corresponding author; p.foliveira@ua.pt; † Presenting author; Biochemistry.

Abstract. Leydig cells (LCs) produce 95% of testosterone, playing a critical role in male fertility (1). Chromium (III) picolinate (CrPic3) is used as a supplement with antidiabetic and antioxidant properties (2), although there are raising concerns regarding its safety for male reproductive health (3). Using a rodent LC line, we investigated the cytotoxicity of increasing CrPic3 doses. Exposing this cell line to palmitate (PA), we established an insulin resistance (IR) model, after which we exposed the LC to varying concentrations CrPic3 to assess its antioxidant/antidiabetic effects. The exometabolome was analyzed using 1H-NMR, mitochondrial function and oxidative stress were evaluated via immunoblot, and steroidogenesis was assessed by quantifying androstenedione through ELISA. Our results uncover toxic effects of CrPic3 on LCs even at low doses under IR conditions. Furthermore, CrPic3 failed to enhance glucose uptake, but restored the expression of mitochondrial complexes CII and CIII, which alleviated oxidative stress in LCs, specifically by normalizing lipid peroxidation. While baseline androgen production remained unaffected, CrPic3 promoted androstenedione production in LCs in the presence of PA, suggesting that it promotes cholesterol conversion into androgenic intermediates in this context. With this study, we provide valuable insights into LCs metabolism and antioxidant defenses, shedding light on benefits and risks of CrPic3, particularly in IR conditions. Given the results, we recommend anyone contemplating the use of CrPic3 as a nutritional supplement to exercise caution.

Keywords: *Chromium picolinate; trivalent chromium; Leydig cells; steroidogenesis; reactive oxygen species; antioxidants.*

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Acknowledgements. Funding
This research was funded by Fundação para a Ciência e a TecnologiaFCTto LAQVREQUIMTE (UIDB/50006/2020), IBIMED (UIDP/04501/2020 and UIDB/04501/2020), and CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020, and LA/P/0006/2020, financed by national funds through the FCT/MEC (PIDDAC). Pedro F. Oliveira (CEECINST/00026/2018) and Ana D. Martins (2022.05444.CEECIND) were funded by national funds through FCTFundação para a Ciência e a Tecnologia, I.P.under the Scientific Employment Stimulus. The work was co-funded by FEDER through the COMPETE/QREN, FSE/POPH, and POCICOMPETE 2020 (POCI-01-0145-FEDER-007491) funds.

Development of a Barcode for Protected Designation of Origin (PDO) "Pera Rocha do Oeste"

Ana M.S. Costa[†,⋆,1], Elisabete Coelho[1], Carina Costa[1], Sílvia M. Rocha[1], Manuel A. Coimbra[1]

1. University of Aveiro, Campus Universitário de Santiago, Aveiro 3810-193, Portugal

⋆ Corresponding author; anamariacosta@ua.pt; † Presenting author; Biochemistry.

Abstract. The characteristic aroma of "Pera Rocha do Oeste,"a significant Portuguese Protected Designation of Origin (PDO) product [1], adds considerable economic value to its authenticity. The aroma of PDO fruit holds economic importance, aiding in their recognition. These fragrances, stemming from volatile organic compounds (VOC), derive from metabolic pathways such as lipoxygenase, -oxidation, and acetate-mevalonate pathways, which exhibit variances based on cultivar types [2]. To identify the specific volatile profile of PDO "Rocha"pears, it is essential to select varietal compounds that remain consistent regardless of orchard origin, storage conditions, or harvest year [3,4]. The objective of the study was to establish a unique volatile fingerprint for PDO "Pera Rocha do Oeste"pears. Analysis involved PDO pears from various orchards, subject to different storage atmospheres, and harvested over two consecutive years. A methodology employing headspace solid-phase microextraction (HS-SPME) combined with comprehensive two-dimensional gas chromatography-mass spectrometry with time-of-flight analyzer (GCŒGC-ToFMS) was used. Out of the 130 identified VOC, compounds that do not have a fruit or pear odor descriptor were excluded, allowing the reduction of the dataset to 66 compounds. The dataset was further reduced to 15 compounds, 2 alcohols, 12 esters, 1 sesquiterpene, taking into consideration only those that presented a low biosynthetic variability induced by edaphoclimatic conditions, ripening stage, and anoxia storage environment. The volatile compounds selected, responsible for the characteristic aroma of PDO pears, when normalized by total soluble solids, mass weight, and surface area, presented normalized chromatographic areas independent of the harvesting year, ripening stage, and storage conditions. These markers formed the foundation of a volatile signature, translated into a barcode visually distinctive to PDO pear. This barcode serves as a supplementary tool for authentication of the PDO "Pera Rocha do Oeste,"highlighting its origin and ensuring its uniqueness.

Keywords: *Pyrus communis; Pera Rocha do Oeste; Volatile marker; GCxGC-ToFMS; Authenticity*

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Acknowledgements. This work was funded by the project MobFood Mobilizing scientific and technological knowledge in response to the challenges of the agri-food market [POCI-01-0247-FEDER-024524], by MobFood Consortium, and financed by European Regional Development Fund (ERDF), through the Incentive System to Research and Technological development, within the Portugal2020 Competitiveness and Internationalization Operational Program. Thanks to FCT/MEC for the financial support to the research unit LAQV/REQUIMTE [LA/P/0008/2020 DOI 10.54499/LA/P/0008/2020, UIDP/50006/2020 DOI 10.54499/UIDP/50006/2020 and UIDB/50006/2020 DOI 10.54499/UIDB/50006/2020] through national funds and FEDER, within the PT2020 Partnership Agreement. Elisabete Coelho Research contract [CDL-CTTRI-88-ARH/2018 REF. 049-88-ARH/2018] was also funded by national funds (OE), through FCT, in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of the article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19. Ana M.S. Costa thanks the PhD grant from Fundação para a Ciência e Tecnologia (FCT) [2021.08633.BD] (https://doi.org/10.54499/2021.08633.BD). The authors also thank SONAE MC and Frutalvor, Central Fruteira CRL, for providing the commercial fruit used in this work.

Empowering seaweeds as sources of high-value lipids for premium and sustainable ingredients for nutricosmeceuticals

Joana Batista[†,⋆,1], Hugo Pereira[2], Rosário Domingues[3], Tânia Melo[3]

1. CESAM - Centre for Environmental and Marine Studies, Department of Chemistry, University of Aveiro, Santiago University Campus, 3810-193 Aveiro, Portugal and Mass Spectrometry Centre, LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, Santiago University Campus, 3810-193 Aveiro, Portugal and GreenCoLab - Associação Oceano Verde, Universidade do Algarve, Campus de Gambelas, 8005-139 Faro, Portugal
2. GreenCoLab - Associação Oceano Verde, University of Algarve, Campus de Gambelas, 8005-139, Faro, Portugal
3. CESAM, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal andMass Spectrometry Center, REQUIMTE-LAQV, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; joanabatista28@ua.pt; † Presenting author; Biochemistry.

Abstract. Inflammatory skin diseases (ISD), including psoriasis, atopic dermatitis, or acne, are associated with oxidative stress, overproduction of reactive species, and pro-inflammatory cytokines (Naidoo & Birch-Machin, 2017). Current treatments and drugs are ineffective and inappropriate, showing low therapeutical efficacy or even significant side effects (Zaid et al., 2022). Lipids and their derivatives play an important role in maintaining healthy skin as they form a protective barrier in the skin by preventing water loss, helping to keep the skin hydrated, and blocking the entry of external elements (De Luca et al., 2021). Polar lipids, such as phospholipids and glycolipids from seaweeds bearing omega-3 polyunsaturated fatty acids (PUFA), display antioxidant, anti-microbial, and anti-inflammatory activities (Lopes et al., 2021), thus with potential to be explored as new therapeutical agents to prevent or treat ISD (Conde et al., 2022). Despite being a highly attractive topic, it remains scarcely explored. Therefore, this PhD thesis will use high throughput mass spectrometry-based lipidomic approaches as well as in chemico and in vitro models aiming at bioprospecting of polar lipids bearing omega-3 PUFA from distinctly farmed seaweeds, known to have dissimilar lipid signatures and bioactive potentialities, as sources of antioxidant, anti-inflammatory and anti-microbial agents. Outcomes will highlight the polar lipids from cultivated seaweeds and rich in omega-3 PUFA as sources of sustainable and premium ingredients, fostering new products and applications in cosmetic and cosmeceutical industries.

Keywords: *Macroalgae; bioactive lipids; bioprospecting; skin disease; lipidomics*

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Acknowledgements. Thanks are due for the financial support to the University of Aveiro and to PT national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) through the projects UIDB/50006/2020 and UIDP/50006/2020, to the research unit CESAM (UIDB/50017/2020+UIDP/50017/2020+LA/P/0094/2020) through national funds and, where applicable, co-financed by the FEDER, within the PT2020. Tânia Melo thanks the Junior Researcher contract in the scope of the Individual Call to Scientific Employment Stimulus 2020 (https://doi.org/10.54499/2020.01578.CEECIND/CP1589/CT0010). This work was financially supported by Pacto da Bioeconomia azul (Project No. C644915664-00000026) within the WP5 Algae Vertical, funded by Next Generation EU European Fund and the Portuguese Recovery and Resilience Plan (PRR), under the scope of the incentive line Agendas for Business Innovation through the funding scheme C5 - Capitalization and Business Innovation.

Red algae sulfated polysaccharides and their interaction with edible insect protein for alternative protein-rich foods.

Kayane S. Oliveira[†,⋆,1], Manuel A. Coimbra[2], Cláudia Nunes[3]

1. LAQV/REQUIMTE, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal.
2. LAQV/REQUIMTE, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
3. CICECOAveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; kayane@ua.pt; † Presenting author; Biochemistry.

Abstract. A range of protein-rich products is being developed as substitutes for meat to fulfill market demand. Achieving desirable texture, aroma, and color in these alternative protein products is crucial. Polysaccharides constitute the principal hydrocolloids used as texturizing agents in food matrices. Also, sulfated polysaccharides from red algae, due to their negative charges, have been identified to exhibit functionalities in terms of gelatinization and viscosity (Bernaerts et al., 2018). In response to the increasing demand for protein sources, the Food and Agriculture Organization (FAO) has highlighted insects as a viable solution. The European Union's recently approved the commercial utilization and consumption of insects. The yellow mealworm (Tenebrio molitor larva) flour, with 54% protein content and composed of all essential amino acids, offers nutritional promise. However, challenges arise regarding their digestibility, influenced by factors such as fat content and the presence of chitin in the exoskeleton (Yi et al., 2016). This doctoral research focuses on investigating the textural potential of red algae polysaccharides, particularly those from Gelidium (macroalgae) and, Porphyridium cruentum (microalgae), through interactions with Tenebrio molitor protein. It is hypothesized that the gel-forming and viscosity properties of sulfated polysaccharides can be used as binders in alternative protein-rich foods to modulate their texture. Understanding how these components interact, the project seeks to enable the potential applications of these sustainable novel matrices

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Keywords: *Protein-polysaccharides; Texturizing agents; Exopolysaccharides; Mealworm; Microalgae; Seaweed*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials (UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020) and LAQV-REQUIMTE (UIDB/50006/2020, UIDP/50006/2020), financed by national funds through the FCT/MCTES (PIDDAC).This work is also supported by Pacto da Bioeconomia Azul, within Algae Vertical, funded by the NextGeneration EU European Fund and the Portuguese Recovery and Resilience Plan (PRR), under the scope of the incentive line Agendas for Business Innovation through the funding scheme C5 Capitalization and Business Innovation.

Nanocomposite biopolymeric hydrogel bioinks for advanced 3D bioprinting

João P F Carvalho[†,⋆,1], Helena Oliveira[2], Carla Vilela[1], Carmen S. R. Freire[1]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. CESAM Centre for Environmental and Marine Studies, Department of Biology, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; joao.pedro.carvalho@ua.pt; † Presenting author; Biochemistry.

Abstract. 3D bioprinting, the biological branch of 3D printing techniques, focuses on the biofabrication of living structures that resemble native tissues, which can be used for diverse biomedical applications like tissue engineering, drug development or diseases research. To achieve this, bioinks composed of cells and biomaterials are deposited in a layer-by-layer computer-controlled way originating 3D constructs where cells survive and proliferate (Hull et al., 2022). Understandably, the performance of the bioinks will deeply affect the outcome of 3D bioprinting process, and the characteristics of the final living tissue analogues (Bom et al., 2022). Multiple types of bioinks have been developed, but hydrogel-based options are in the spotlight, with biopolymeric hydrogels constituting a very relevant group of materials for these applications, given their resemblance to the extracellular microenvironment, biocompatibility, and facile crosslinking (Teixeira et al., 2022). In order to improve the characteristics of such hydrogels (e.g., their biological, mechanical or rheological properties), they are often combined with nano- and microstructures, originating composite formulations with enhanced features or new functionalities (Cai et al., 2022).This presentation summarizes the development of three composite bioinks by combining different biopolymers (alginate, cellulose and gellan gum) with biobased nano- and microstructures. Specifically, the combination of alginate with curcumin-loaded cellulose ester particles and HaCaT (keratinocyte) cells originated bioinks with drug-delivery ability that constitute a new approach for skin tissue regeneration (Carvalho et al., 2023). On a different approach, the addition of nanofibrillated cellulose to a carboxymethyl cellulose hydrogel enhanced the stability and printability of the all-cellulose formulations, showing promising results for the 3D bioprinting of different cell lines. Finally, the addition of a nanohybrid composed of lysozyme nanofibrils and gold nanoparticles granted a gellan gum hydrogel with conductive properties and high printability, that has potential to be used for the bioprinting of 3D-cardiac tissue analogues.

Keywords: *3D bioprinting; Composite hydrogel bioinks; Polysaccharides; Living constructs*

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Acknowledgements. This work was developed within the scope of the projects CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020) and CESAM (UIDP/50017/2020 & UIDB/50017/2020 & LA/P/0094/2020), financed by national funds through the FCT/MCTES (PIDDAC), and financially supported by the project I&D NANOBIOINKS-

Engineering bio-based nanofibers for the development of high-performance nanostructured bioinks for 3-D bioprinting, CENTRO-01-0145-FEDER-031289 funded by the Operational Program of the Center Region, in its FEDER/FNR component, and by national funds (OE), through FCT/MCTES. FCT is acknowledged for the doctoral grants to J.P.F.C (2020.09018.BD, DOI 10.54499/2020.09018.BD) and the research contracts under Scientific Employment Stimulus to C.S.R.F. (DOI 10.54499/CEECIND/00464/2017/CP1459/CT0033), C.V. (DOI 10.54499/2021.01571.CEECIND/CP1659/CT0024) and H.O. (DOI 10.54499/CEECIND/04050/2017/CP1459/CT0023).

Effects of carbamazepine on testicular lipids and fatty acids in BLTK-1 mice Leydig tumor cell line

Inês Nobre[†,*,1], Inês Guerra[1], Marisa Pinho[1], Ana Martins[1], Pedro F. Oliveira[1], Pedro Domingues[1], Artur Paiva[2], M.Rosário Domingues [1]

1. Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. Centro Hospitalar e Universitário de Coimbra - Hospital da Universidade, Praceta Professor Mota Pinto, 3004-561 Coimbra

* Corresponding author; ines.nobre@ua.pt; † Presenting author; Biochemistry.

Abstract. Leydig cells are reliant on lipids and fatty acids for crucial functions such as structural integrity, energy metabolism and steroid hormone synthesis, including testosterone production (Zirkin & Papadopoulos, 2018). Some drugs, such as the case of carbamazepine (CBZ) primarily used for its anticonvulsant effects, may impact Leydig cell lipid metabolism and profiles potentially and thus affecting it function and testosterone production (Gurcu, Sinem; Uncu, Ali; Uncu, 2023; Yamamoto, Terada, Takahashi, & Imai, 2016). Understanding these interactions is pivotal for optimizing the management of conditions requiring CBZ therapy while mitigating potential adverse effects on male reproductive health (A.Vermeulen, 1982; Abd-Ali Sabr, Zainab; Karim, 2023). Thus in this study we aimed to assess the effects of CBZ on the lipidome and fatty acid profile of the BLTK-1 mice Leydig tumor cell line. The plasticity of lipid composition was evaluated using LC-MS and GC-MS approaches. Our findings revealed significant differences in the lipid profile between Leydig cells treated with CBZ and untreated cells. Regarding fatty acids there was a notable change in FA 22:6 n-3, that was decreasing with increasing CBZ concentrations. Also an increase of the n6/n3 ratio was noticed with CBZ concentration. Our results also indicate that CBZ exerts a significant effect on Leydig cell lipids. Major difference were seen in the lipid species from the phosphatidylethanolamine (PE), triglycerides (TG), phosphatidylcholine (PC), lysophosphatidylcholine (LPC), phosphatidylserine (PS), phosphatidylglycerol (PG) and sphingomyelin (SM) classes. Some PE and TG lipid species exhibited significantly higher levels in Leydig cells treated with 200uM CBZ compared to controls. LPC, PS, PG and SM species showed decreased levels in Leydig cells treated with 200uM CBZ. The phospholipids with the lowest p-values, were PG 40:4, PG 34:1, PC O-32:1, PC 32:2 and PE P-38:6. These findings suggest that these phospholipids may serve as potential biomarkers for clinical applications assessing the effects of CBZ on Leydig cells.

Keywords: *Leydig cells; lipidomic; fatty acids; mass spectrometry; lipid profile; carbamazepine.*

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Acknowledgements. Thanks are due for the financial support to the University of Aveiro and to PT national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e

Ensino Superior) through the projects UIDB/50006/2020 and UIDP/50006/2020, to the research unit CESAM (UIDB/50017/2020+UIDP/50017/2020+LA/P/0094/2020) and to RNEM, Portuguese Mass Spectrometry Network (LISBOA-01-0145-FEDER-402-022125) through national funds and, where applicable, co-financed by the FEDER, within the PT2020.

Biology

Upconversion nanoparticles for multimodal therapy of melanoma

Párástu Oskoei[†,⋆,1], Helena Oliveira[1], Ana Daniel-da-Silva[2], Manuela Gaspar[3]

1. CESAM
2. CICECO
3. iMed

⋆ Corresponding author; † Presenting author; Biology.

Abstract. The deadliest form of skin cancer is malignant melanoma (Menezes et al., 2016) and it is increasing worldwide (Garbe et al., 2016; Lopes et al., 2022). Tumour resection combined with radiation and chemotherapy are part of the conventional clinical treatment. However, these approaches have several limitations leading to failure in complete tumour eradication. Therefore, new therapeutic approaches are needed (Siegel et al., 2016; Mishra et al., 2018; Tang et al., 2017). The main goal was therefore to develop multimodal nanoplatforms for melanoma skin cancer treatment. The novelty of the present work is centred on the development of nanoplatforms formed by upconversion nanoparticles (UCNPs) with a mesoporous silica shell (mSiO2) to allow the loading of photosensitisers and anticancer drugs that, under NIR excitation will produce photodynamic therapy, release of anticancer drug (chemotherapy) and plasmonic hyperthermia (photothermal therapy). For the targeted drug release, mSiO2UCNPs functionalized with folic acid and mSiO2UCNPs with a retro-Diels-Alder-activated nanovalve, were developed. The systems were afterwards loaded with doxorubicin and respective loading efficiency and release were then evaluated as well as its cytotoxic effect on different melanoma cells lines. Results are not yet optimized, but more experiments will be performed to improve the cells response.

Keywords: *melanoma, upconversion nanoparticles, photodynamic therapy, photothermal therapy, chemotherapy*

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Acknowledgements. This work was supported by the Portuguese Foundation for Science and Technology (FCT) for funding the PhD grant 2022.11644.BD. This work was supported by HOTsPOT project (PTDC/BTM-MAT/31794/2017). The authors are also grateful for the financial support to CESAM (UIDP/50017/2020 & UIDB/50017/2020 & LA/P/0094/2020), to FCT/MCTES through national funds, and the co-funding by the FEDER, within the PT2020 Partnership Agreement and Compete 2020. This work was developed within the scope of the project CICECO-Aveiro Institute of

Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC).

Photoinativation of Staphylococcus aureus biofilms by Tri-Py+-Me-PF

Lucia Marciel[†,1], Lúcia Marciel[⋆,1], Maria Adelaide Almeida [2], Maria Amparo Faustino [2]

1. Estudante
2.

⋆ Corresponding author; luciamarciel@ua.pt; † Presenting author; Biology.

Abstract. Presently, there is no approved disinfection protocol for red blood cells (RBC) due to the collateral damages. Antimicrobial photodynamic therapy (aPDT) can be an alternative method with promising outcomes. This approach refers to the combination of light, oxygen and a photosensitizer (PS) to induce microbial inactivation through the prodution of reactive oxygen species (ROS). Previous results of our group, using cationic porphyrin [5-(pentafluorophenyl)-10,15,20-tris(1-methylpyridinium-4-yl)porphyrin tri-iodide] (Py+-Me-PF), have demonstrated a remarkable antimicrobial activity for blood disinfection through the photodynamic process. Staphylococcus aureus is one of the most important microorganisms isolated from the blood and biofilm production by S. aureus is one of the most significant virulence factors of this bacterium as it prevents the penetration of antibiotics. In this study, it was evaluated the effectiveness of Tri-Py+-Me-PF, in S. aureus biofilms. Results: The results show that the Tri-Py+-Me-PF, in PBS, causes significant inactivation of the S. aureus in biofilms form (4.3 log), although the susceptibility was attenuated in relation to planktonic cells. Conclusion: Effective reduction of Gram-positive bacteria biofilms provided promised indications for its use in blood disinfection.

Keywords: *Antimicrobial photodynamic therapy; Blood disinfection; Staphylococcus aureus biofilms.*

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Misleading DNA evidence in criminal cases: guilty or innocent?

Lisa Andrade Sampaio[†,⋆,1], Mónica Carvalho[2], Luís Souto[3]

1. Instituto Nacional de Medicina Legal e Ciências Forenses, Serviço de Genética e Biologia Forenses, Polo das Ciências da Saúde (Polo III), Azinhaga de Santa Comba, 3000-548 Coimbra, Portugal
2. Instituto Nacional de Medicina Legal e Ciências Forenses, Serviço de Genética e Biologia Forenses, R. Manuel Bento de Sousa 3, 1169-201 Lisboa, Portugal
3. Universidade de Aveiro, Departamento de Biologia, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; lisa.a.sampaio@ua.pt; † Presenting author; Biology.

Abstract. DNA analysis has a major impact on court decisions in many countries, allowing to infer the identity of the perpetrator of crime: incriminate a guilty person and/or exonerate an innocent person. However, courts should never base their decision solely on DNA results, being DNA evidence fallible and having its own limitations [1].

Forensic DNA analyses are very sensitive, generating DNA profiles even from minute amounts of cellular material and detecting DNA on trace material.

DNA profiles have a hidden side: artefacts, errors end uncertain evidence [2]. The high complexity of the genetic analysis of crime scene samples is mainly related to the unknown number of contributors, low DNA quantity and quality and associated stochastic effects.

It is becoming increasingly relevant to address activity level issues relating to mechanisms explaining how DNA became located at the collection site: transfer, persistence, prevalence and recovery. Any contact can influence the gain/loss of DNA [3].

Quality assurance (accredited formats and certified reporting competence) is a pre-requisite for forensic genetic laboratories. It is important to provide means that ensure that forensic scientists conclusions are as justifiable as their analytical methods [4]. Laboratories conform to ISO/IEC 17025:2017 reduce the risk of quality failures.

Forensic experts must be trained to calculate and communicate the value of the DNA results, avoiding prosecutor and defense fallacies, misunderstandings with the meaning of the likelihood ratio (LR) and incorrect integration of the value of DNA evidence with other evidence [5].

Scientists have an ethical responsibility to assist non-scientists to understand their findings and expert opinions. The communication of scientific expert opinion through expert reports is an important but under-researched issue. It is important to assure that forensic science do not lead to wrongful convictions. The aim of this investigation is to highlight this problem, explaining the main reasons of miscarriages of justice, so that they can be minimised, and the reliability of forensic science evidence can be improved.

Keywords: *DNA evidence, DNA profile, quality assurance, likelihood ratio (LR), miscarriages of justice*

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Acknowledgements. This work has no financial support. The first author, Lisa Andrade Sampaio, gratefully acknowledge her supervisor, Professor Luis Souto, for his consistent support and guidance during this investigation, and National Institute of Legal Medicine and Forensic Sciences (Portugal) for having granted her the equivalent status to scholarship holder.

Phage potential against foodborne bacteria in different food matrices

Márcia Braz[†,⋆,1], Carla Pereira[1], Pedro Costa[1], Carmen S R Freire[2], Adelaide Almeida[1]

1. Department of Biology CESAM, University of Aveiro, 3810-193 Aveiro, Portugal
2. CICECO-Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Biology.

Abstract. Foodborne diseases are a serious health problem worldwide, particularly due to bacterial resistance to antibiotics. Escherichia coli and Salmonella spp. are among the most commonly reported bacteria in food outbreaks in various food matrices, including milk, meat and eggs (Ot'Sullivan et al., 2019). Despite the available decontamination methods (Chacha et al., 2021), bacterial food contamination continues to occur. Phages, viruses that only infect bacteria, have proved to be an effective alternative to conventional methods to inactivate foodborne bacteria (Deka et al., 2021; Endersen & Coffey, 2020; Ot'Sullivan et al., 2019) . Thus, this study aimed to evaluate phage potential against E. coli (phage phT4A), in milk and ham, S. enterica serovar Typhimurium (phage phSE-5) in milk, liquid whole egg and eggshell, and S. enterica serovar Enteritidis (phage phSE-P1) in liquid whole egg, at 25 C. The results showed that phage phT4A was effective in reducing E. coli in milk and ham with a maximum reduction of approximately 4 and 2 log CFU/mL, respectively. Phage phSE-5 also led to a significant reduction of S. Typhimurium in milk (4 log CFU/mL), liquid whole egg (2 log CFU/mL) and eggshell (1 log CFU/mL). A maximum reduction of around 6 log CFU/mL in S. Enteritidis concentration was obtained with phage phSE-P1 in liquid whole egg. Phage efficacy was matrix-dependent, with better results in liquid than in solid matrices. In solid matrices the protocol can be optimized in order to improve bacterial inactivation. However, the obtained results highlight the potential of phages to be applied in food to improve food safety and thus prevent infectious diseases that can arise from the ingestion of contaminated food.

Keywords: *foodborne bacteria, inactivation, phage biocontrol, food safety.*

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Use of geochemical tools to trace the geographic origin of two commercially important clams (Ruditapes decussatus and Ruditapes philippinarum) and socioeconomic impacts of its certification of origin

Andreia Santos[†,⋆,1], Carla Patinha[2], Sebastian Villasante[3], Fernando Ricardo[1], Ricardo Calado[1]

1. ECOMARE CESAM Departamento de Biologia, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, Portugal
2. GEOBIOTEC Departamento de Geociências, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, Portugal
3. EqualSea Lab - CRETUS Department of Applied Economics, University of Santiago de Compostela, Campus Sur, Santiago de Compostela, A Coruna, Spain

⋆ Corresponding author; andreia.lourenco@ua.pt; † Presenting author; Biology.

Abstract. The production of bivalves has continued to increase over recent years, with Ruditapes decussatus and R. philippinarum being among the most explored bivalves in Portugal (Maia et al., 2021). Clams are filter feeders and, as such, can concentrate contaminants from surrounding waters or sediments, including chemical compounds and/or microorganisms that can cause multiple hazards to human health (Zannella et al., 2017). Therefore, knowing the exact location where the harvesting of bivalves is extremely important to safeguard public health. The analysis of the inorganic composition of shells using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) is one of the most promising geochemical tools for the traceability of geographic origin of seafood using elemental fingerprints (EF) as natural barcodes (Santos et al., 2023). This tool has already revealed high levels of accuracy, but further studies are still necessary to confirm its potential at smaller spatial scales (e.g., within the same ecosystem) and identify how annual and/or seasonal variations can constrain the optimization of routine protocols used for the traceability of marine bivalves. The present study uses EF of the shells of R. decussatus to confirm their geographic origin at two different spatial scales: among different ecosystems along the Atlantic NW, W, and SW Iberian coast, and within the same ecosystem (Ria Formosa). The temporal variation of EF was also determined, comparing the EF of the shells of R. philippinarum harvested along the Atlantic NW, W, and SW Iberian coast at intervals of 6 months and 1 year. Overall, our findings confirmed that the EF of R. decussatus are significantly different, even between contiguous harvesting locations and temporal variations on EF do change significantly at a seasonal and annual time-frame.

Keywords: *Traceability, Origin validation, Seafood, Food safety, ICP-MS, Added value*

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Acknowledgements. This work was financially supported by project CITAQUA, Desenvolvimento do Projeto de Reforço do Polo de Aveiro (H4), framed within Measure 10 of Investment TC-C10-i01 - Hub Azul - Rede de Infraestruturas para a Economia Azul, financed by the Recovery and Resilience Plan (PRR) and supported by Fundo Azul of the Portuguese Government. The authors acknowledge the University of Aveiro, Fundação para a Ciência e a Tecnologia (FCT, Portugal) and Ministério da Ciência e Tecnologia (MCT) for the financial support for the research units CESAM (UIDP/50017/2020 + UIDB/50017/2020+

LA/P/0094/2020) and GEOBIOTEC (UID/GEO/04035/2020). We are also thankful to FCT for the financial support through a Ph.D. grant attributed to Andreia Santos (2021.05127.BD).

Particulate matter from residential coal combustion: potential toxicological effects

Daniela Figueiredo[†,⋆,1], Célia A. Alves[2], Helena Oliveira[3]

1. CESAM- Centre for Environmental and Marine Studies, Department of Biology and Department of Environment and Planning
2. CESAM- Centre for Environmental and Marine Studies, and Department of Environment and Planning
3. CESAM- Centre for Environmental and Marine Studies, and Department of Biology

⋆ Corresponding author; d.figueiredo@ua.pt; † Presenting author; Biology.

Abstract. Residential coal combustion is a significant source of airborne particulate matter (PM) pollution (Zhou et al., 2020) and has been linked to cytotoxicity, oxidative stress, genotoxicity, and inflammation in different cell lines (Huang et al., 2023; Ihantola et al., 2022). This study aimed to evaluate the toxicity in human alveolar epithelial cells (A549) of indoor PM samples lower than 10 ţm (PM10) from residential coal combustion in a European household that uses coal for heating and cooking. Experiments were conducted for a week in a rural seaside house using a small-scale stove in an open kitchen/living area. PM10 samples were collected indoors with and without (background air) coal combustion, as well as outdoors. The MTT assay was employed to assess the cytotoxicity of the PM10 total organic extracts, and production of reactive oxygen species (ROS) was analysed by the fluorometric intracellular ROS assay kit. The interference in cell cycle dynamics and apoptosis were evaluated by flow cytometry. The results showed a dose-dependent significant reduction of the metabolic activity of A549 cells, with more expressive responses indoors during coal burning. ROS levels were elevated indoors during coal burning on days 1 and 4 at the concentrations of IC10 and IC20, as well as indoors on day 3, background and outdoor air, but only at the concentration of IC20. Cell cycle analysis revealed disruptions in cell cycle dynamics, with a significant increase in G1 and S phases. Additionally, a significant decline in viable cells was observed indoors on day 3, with a significant increase in necrosis and late apoptosis. A significant increase in necrotic cells was observed indoors on days 1, 3, and 4 during stove operation, as well as in the background air sample. In conclusion, these findings demonstrate the significant influence of PM10 from coal combustion on A549 cells, highlighting its relevance for public health and the need of implementing environmental action plans.

Keywords: *Particulate matter, A549 cell line, cytotoxicity, ROS, cell cycle, coal combustion*

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Acknowledgements. This work was supported by the Junta de Castilla y Leon, co-financed with European FEDER funds (Grant LE025P20), the AEROHEALTH project (Ministry of Science and Innovation, co-financed with European FEDER funds, Grant PID2019-106164RBI00), the project TED2021-132292B-I00 (funded by MCIN/AEI/10.13039/501100011033 and by the European Union NextGenerationEU/PRTR) and by the Portuguese Foundation for Science and Technology (FCT) through the project "Air Pollution in an African Megacity: Source Apportionment and Health Implications"(APAM, DOI: 10.54499/2022.04240.PTDC), financially supported by national funds (OE), through FCT/MCTES. The financial support to CESAM by FCT/MCTES (UIDP/50017/2020 + UIDB/50017/2020 + LA/P/0094/2020), through national funds, is also acknowledged. In addition, FCT is acknowledged for the research contract under Scientific Employment Stimulus to Estela D. Vicente (DOI: 10.54499/2022.00399.CEECIND/CP1720/CT0012) and Helena Oliveira (DOI 10.54499/CEE-CIND/04050/2017/CP1459/CT0023). D. Figueiredo is grateful for the grant from FCT (DOI:10.54499/2020.06414.BD).

Biology and ecology of global changes

Stress physiology of a shallow water shrimp when facing extreme weather events

Madalena Missionário[†,⋆,1], Réka Bertalan[1], Ricardo Calado[1], Sam Dupont[2], Pedro M. Costa[3], Catarina Vinagre[4], Diana Madeira[1]

1. ECOMARE Laboratory for Innovation and Sustainability of Marine Biological Resources, CESAM-Centre for Environmental and Marine Studies, Department of Biology, University of Aveiro, Estrada do Porto de Pesca Costeira, 3830-565 Gafanha da Nazaré, Portugal
2. Department of Marine Ecology- Goteborg University, The Sven Lov Í en Centre for Marine Sciences, Kristineberg, Sweden
3. Associate Laboratory i4HB - Institute for Health and Bioeconomy, UCIBIO Applied Molecular Biosciences Unit, Department of Life Sciences, NOVA School of Science and Technology, NOVA University Lisbon, 2819-516 Caparica, Portugal
4. CCMARCentre of Marine Sciences, University of Algarve, Faro, 8005, Portugal

⋆ Corresponding author; † Presenting author; Biology and ecology of global changes.

Abstract. Saltpans are man-made habitats that nowadays harbour a considerable amount of biodiversity (Chefaoui, 2021). Extreme weather events, such as heatwaves and extreme rainfalls, are becoming more severe as a result of climate change, raising major alarms about the resilience and biodiversity conservation of shallow marine environments (Caputi et al., 2016; Ummenhofer & Meehl, 2017). The acclimation capacity and physiology of the ditch shrimp Palaemon varians from Ria de Aveiro saltpans were studied when facing extreme weather events, with thermal modulation and sex also taken into consideration. First, experiments were performed to assess the type of response triggered by temperature (10, 15, 20, 30žC) and salinity (10, 20, 30, 40) through single driver experiments. Subsequently, marine heatwave (T: 30 vs 20žC; S: 40 vs 30) and extreme rainfall (T: 15 vs 20žC; S: 10 vs 30) scenarios were simulated through combinations of these stressors. After 15 days of exposure to each treatment, the critical thermal limit and routine metabolic rate were determined, with male and female shrimps distinguished.
Results indicate that this species is particularly vulnerable to temperature variations, with salinity triggering no stress response. A considerable acclimation capacity was observed, as organisms exposed to higher temperatures for some time exhibited greater resilience to high temperatures. Metabolic requirements remained stable in all scenarios tested, indicating that the conditions established were not stressful enough to trigger an increase in metabolic rate. No differences between sexes were detected either. The maximum critical thermal limit for P. varians was 39žC, while the maximum temperature detected at the sampling site so far was 34žC, indicating a thermal safety margin of 5žC. Although this species appears to have some acclimation capacity, this may not be sufficient for them to thrive in Ria de Aveiro saltpans in the years to come.

Keywords: *Extreme weather events; Shrimps; Marine heatwave; Extreme Rainfall; Saltpans*

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Acknowledgements. This work was supported by national funds i) UIDP/04378/2020 and UIDB/04378/2020 (UCIBIO), ii) LA/P/0140/2020 (i4HB), iii) UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020 (CESAM), iv) UIDB/04326/2020, UIDP/04326/2020 and LA/P/0101/2020 (CCMAR), v)UIDB/04292/2020 MARE. Portuguese Foundation for Science and Technology (FCT) is acknowledged for the grants 2022.10575.BD awarded to M.M. and CEECIND/01250/2018 and 2022.00153.CEECIND awarded do D.M.

Toxicokinetic evaluation of metals and PAHs in black soldier fly larvae: implications for insect feed regulations and insect production

Amid Mostafaie[†,⋆,1], Diogo N. Cardoso[1], Susana Loureiro[1]

1. CESAM and Department of Biology, Campus Universitário de Santiago, University of Aveiro, 3810-193 Aveiro, Portugal.

⋆ Corresponding author; amid.mostafaie@ua.pt; † Presenting author; Biology and ecology of global changes.

Abstract. Addressing the pressing global challenge of increased food production, population growth, resource limitations, and environmental concerns requires innovative solutions (Godfray et al., 2010). The use of edible insects has gained attention for its multifaceted benefits, including nutritional value, efficient food conversion, and environmental sustainability (van Huis & Oonincx, 2017). Particularly, the black soldier fly (BSF), recognized for its high-quality protein production and organic waste conversion, emerges as a promising candidate for circularity in feed production. However, as the insect market expands rapidly, a comprehensive understanding of potential hazards associated with insect-derived products becomes imperative.
This study focuses on Hermetia illucens (BSF larvae), which have been approved for use in livestock feed and aquaculture by the European Commission ((EU) 2017/ 893)(Regulation 2017/893/EC, 2017). Their capacity to convert organic waste into nutrient-rich biomass presents opportunities for waste management, with circular protein production. Yet, the bioaccumulation and elimination of contaminants from organic substrates into insect-derived products needs further investigation.
Current regulations primarily address metals in animal feed, while the presence of polycyclic aromatic hydrocarbons (PAHs) in insect feed remains unregulated. Insects can act as bioconverters and understanding the potential accumulation of PAHs is critical. Previous research indicates the accumulation of metals in insect larvae (Purschke et al., 2017), however, their residence time and elimination in the organisms are still unknown. This study aims to understand the accumulation and elimination of metals (As, Cd, Pb) and PAHs (benzo (a) pyrene, benz (a) anthracene, benzo (b) fluoranthene, chrysene) by BSF larvae during exposure to contaminated substrates. A toxicokinetic evaluation can provide valuable insights into the accumulation and elimination of contaminants, which can inform the redefinition of maximum contaminant levels in insect feed or substrate. This information is crucial for producers and legislators to understand the residence time of contaminants in insects, enabling the establishment of a safe depuration period when insects are reared on less well-characterized substrates.
Our findings reveal that metals accumulated as anticipated, however, a fast elimination process was observed. Among the PAHs, only benz (a)anthracene showed accumulation and rapid elimination similar to metals. Toxicokinetic modeling demonstrated the rapid elimination of all accumulated contaminants (DT50 < 1), underscoring the efficient removal of contaminants in BSF larvae.

Keywords: *Toxicokinetic modelling, Hermetia illucens larvae, Insect-derived protein, Contaminant bioaccumulation*

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Characterization of the bioecology of Drosophila suzukii in fruit orchards in Central Portugal and of the potential of pyrolysis liquids to for its biocontrol.

RAYEN KARKAR [†,1], OLGA AMEIXA [⋆,2], ISABEL LOPES [2]

1. BIOLOGY AND ECOLOGY OF GLOBAL CHANGES
2. BIOLOGY

⋆ Corresponding author; † Presenting author; Biology and ecology of global changes.

Abstract. Drosophila suzukii (Matsumura), the spotted wing drosophila, is an invasive crop pest affecting fruit orchards globally, including blueberries. Its rapid adaptation allows it to thrive in new environments, causing extensive damage by laying eggs in soft fruits.The larvae consume the fruit tissue, leading to yield losses up to 100%. Each female can lay about 500 eggs, and a new generation can complete a life cycle in 9-11 days, enabling up to 13 generations per season, depending on environmental conditions. Current control methods rely heavily on the use of insecticides, but this is challenging due to many host plants and limited knowledge of D. suzukii biology and ecology in Europe. The municipality of Sever do Vouga (Portugal) local economy relies heavily on blueberry production, which contributes nearly 80% of its agricultural output. For this reason, D. suzukii poses a severe threat to this agricultural activity. This study aims to unravel D. suzukii bioecology in Sever do Vouga region through detailed monitoring of its population dynamics, and environmental interactions, including its natural enemies. This approach aims to enhance early pest detection and adopt efficient management strategies. Further it will explore the development of integrated management strategies using pyrolysis bio-oils derived from the blueberrys orchards wood cuttings under a circular economy perspective. Larvae and adults will be exposed to different concentrations of bio-oils from pyrolyzed blueberry cuttings. Toxicity will be evaluated through direct contact and ingestion. The study will monitor the following endpoints: mortality, pupation, pupal mortality, and adult deformity, that will allow calculating LCx and LTx. It will also investigate how environmental factors like humidity and temperature affect oil toxicity. This research aims to advance understanding of D. suzukii bioecology and assess the bioactivity of pyrolysis oils for biocontrol. Expected outcomes include insights into oil toxicity and environmental effects, informing future pest management strategies for Central Portugal's blueberry orchards. Offering more sustainable solutions for pest management, protecting human and animal health and preserving orchard ecosystems.

Keywords: *Spotted Wing Drosophila, vinegar fly, invasive pest, biopesticides, pyrolysis, crop protection*

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Interpopulational variation in the sensitivity of marine mussels to cosmetic chemicals under different climate change scenarios

Diana Bordalo[†,⋆,1], Rosa Freitas [2], Carlo Pretti[1], Inna Sokolova[3]

1. Department of Biology, University of Aveiro, 3810-193 Aveiro, Portugal
2. Centre for Environmental and Marine Studies (CESAM), University of Aveiro, 3810-193 Aveiro, Portugal
3. Department of Veterinary Sciences, University of Pisa, 56122, San Piero a Grado (PI), Italy
4. Interuniversity Consortium of Marine Biology and Applied Ecology G. Bacci, 57128 Livorno, Italy
5. Department of Marine Biology, Institute of Biological Sciences, University of Rostock, Rostock, Germany
6. Department of Maritime Systems, Interdisciplinary Faculty, University of Rostock, Rostock, Germany

⋆ Corresponding author; dianabordalo@ua.pt; † Presenting author; Biology and ecology of global changes.

Abstract. Ultraviolet (UV) solar radiation imposes detrimental effects on humans, namely skin damage, early photoaging, inflammation and cancer, leading to an increasing use of personal care products (PCPs) (Rajamohan et al., 2023). PCPs contain organic UV filters, and/or inorganic physical UV filters that minimize solar damages (Giokas et al., 2007). Formulations of PCPs include preservatives, such as parabens, preventing microorganisms growth and providing a long-term conservation (Jyoti & Sinha, 2023). Nevertheless, these enter environmental compartments directly through recreational activities or indirectly as result of inefficient removal by wastewater treatment plants (Giokas et al., 2007). Thus, owing to their environmental persistence and lipophilic properties, chemicals can be bioaccumulated and biomagnified along trophic levels (Jyoti & Sinha, 2023). Additionally, these may lead to biochemical, morphophysiological and histopathological impairments and behavioural alterations in biota (Bordalo et al., 2023).
Moreover, crescent greenhouse gas emissions are contributing to climate change-related factors in marine ecosystems, namely warming, acidification, deoxygenation of oceans (IPCC, 2023). Shifts of salinity are derived from precipitation events and evaporation aggravated by anthropogenic activity (IPCC, 2023). Such factors impact negatively marine species, being imperative effective measures to mitigate anthropogenic emissions. Furthermore, few publications have integrated the co-occurrence of climate change-related factors and chemicals to predict early signs of stress. However, some demonstrated that when combined, biota responses may be altered (Bordalo et al., 2023).
This PhD project aims to study ecotoxicological effects of single and combined exposure to multiple-stressors, UV filters (2-ethylhexyl 4-methoxycinnamate, octocrylene, ecamsule) and parabens (propylparaben, methylparaben), at environmentally relevant concentrations and understand how climate change-related factors affect the responses of Mytilus galloprovincialis and Mytilus edulis. The scientific outcomes will strengthen regulatory guidelines and strategies of chemicals mitigation to conserve marine ecosystems.

Keywords: *UV filters, Parabens, Climate change, Ecotoxicology*

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Acknowledgements. Diana Bordalo acknowledges her Ph.D. grant (2023.01230.BD) by the National Funds through the Portuguese Science Foundation (Fundação para a Ciência e a Tecnologia, FCT).

Biochar addition to soil improves aboveground productivity without negative impacts on community composition and structure in sown biodiverse annual pastures

Antun Jelini[†,⋆,1], Liliana Simões[1], Marjan Jongen[1], Patricia Silva[1], Vasco Santos[1], Frank Verheijen[1], Ana Catarina Bastos[1]

1.

⋆ Corresponding author; † Presenting author; Biology and ecology of global changes.

Abstract. Biochar addition to soil has been shown to have a positive impact on multiple soil functions, while at the same time increasing plant productivity. Increases in crop yield in biochar-amended soils have been long recognized, however, its effect on community composition of grasslands have not been studied in detail. Many interventions to soil in grasslands that aim to increase productivity come with trade-offs between yield improvement and composition of local plant communities. These negative effects mainly include decrease in abundance of local species, alterations of diversity, or even a complete turnover of local plant communities. Application of N-containing fertilizers in species-rich grasslands inevitably decreases the species richness. Liming in acid soils can reduce Al and Mn toxicity, but at the expense of local acidophilus species. Biochar affects both physical (increased water retention, total porosity, and reduced bulk density) and chemical (increased pH and nutrient status) soil properties, but the trade-off between yield-improvement and changes in local communities composition are unknown. We assessed community changes of annual biodiverse pasture in a field-plot experiment in Central Portugal in the 1st growing season in biochar-amended granite soil (4% application rate). Our results indicate that while biochar increased total aboveground biomass by 2-3 t/ha compared to control soils, as well as total grass and total legume biomass, it did not exhibit any drastic negative effects on abundance and biomass of local species. Biochar addition increased the biomass and abundance of grasses and legumes from the seed mixture, while decreasing that of competing grass Vulpia bromoides, but not that of Agrostis sp. Aboveground biomass of local forbs was not significantly decreased by biochar application.This indicates that compared to other measures aiming to improve productivity, biochar has a potential to preserve soil functions and increase grassland productivity without drastic negative effects on local community composition.

Keywords: *biodiverse grasslands, drought limitation, hardsetting soils*

Acknowledgements. We acknowledge La Caixa Foundation in collaboration with CESAM for the funding of A. Jelincic through the Incoming Doctoral INPhINIT fellowship PASTURE+ (LCF/BQ/DI22/11940011). We also acknowledge FCT/MCTES for the funding of project POLLINATE (https://doi.org/10.54499/PTDC/EAM-AMB/1509/2021), of L. Simões (2022.09866.BD), of F. Verheijen (https://doi.org/10.54499/CEECIND/02509/2018/CP1559/CT0004), as well as of CESAM (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020) through national (OE) funds. A.C. Bastos was funded by OE, through FCT in the scope of the framework contract foreseen in art. 23ž DL57/2016 (numbers 4, 5, 6) of August 29th August, amended by Law 57/2017 of July 19th July (https://doi.org/10.54499/DL57/2016/CP1482/CT0006).

Exploring the tourism-environment nexus

Francisca Santos[†,⋆,1], Ana Miranda[2]

1. Centre for Environmental and Marine Studies, University of Aveiro, Campus Universitario de Santiago, 3810-193 Aveiro, Portugal
2. Centre for Environmental and Marine Studies, Department of Environment and Planning, University of Aveiro, Campus Universitario de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Biology and ecology of global changes.

Abstract.
Tourism drives economies globally, contributing significantly to their growth (World Tourism Organization, 2023; World Tourism Organization (WTO), 1993). In 2019, it directly contributed to 3.3% of the global GDP and supported over 330 million jobs (World Travel & Tourism Council, 2023). However, the industry's benefits often come at an environmental cost.
This work aims to evaluate the environmental sustainability of tourism through the lens of environmental indicators.
Preliminary findings suggest that while tourism contributes significantly to economic growth, it often exerts considerable pressure on natural resources and ecosystems. For instance, tourism accounts for about 8% of global greenhouse gas emissions, with transportation being a major contributor (Intergovernmental Panel on Climate Change (IPCC), 2023). Moreover, tourism activities can lead to habitat destruction, pollution, and strain on local water resources (Buckley, 2004). However, there are notable examples of destinations implementing innovative strategies to minimize environmental impacts and maximize sustainability benefits, contributing to achieving Sustainable Development Goals (SDGs).
It is intended to utilize a mixed-methods approach. This includes quantitative data analysis and qualitative case studies. Quantitative analysis involves indicators assessing, for example, air quality, carbon footprint, water usage, waste management, and biodiversity impact. Qualitative case studies examine challenges, best practices, policy implementation, and stakeholder engagement for promoting environmental sustainability.
By analyzing baseline environmental indicators and considering factors like the limits of acceptable change and carrying capacity, we can better understand the implications of tourism on the environment and develop strategies that apply fit-to-case indicators that allow us to mitigate negative impacts while maximizing tourism benefits for communities and ecosystems.

Keywords: *Sustainable tourism development; Sustainability; Environmental indicators; Resilience; Tourism Management*

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Acknowledgements. This study was supported by the PRR Plano de Recuperação e Resiliência and by the NextGenerationEU funds at Universidade de Aveiro, through the scope of the Agenda for Business Innovation ATT Agenda Mobilizadora Acelerar e Transformar o Turismo (Project no. 47 with the application C645192610-00000060).

Ecotoxicological impacts induced by emerging pollutants in marine species exposed to different climate change scenarios

Carla Leite[†,⋆,1], Rosa Freitas[1], Eduarda Pereira[2], Carlo Pretti[3]

1. Department of Biology and CESAM, University of Aveiro 3810-193, Aveiro, Portugal
2. Department of Chemistry and LAQV-REQUIMTE, University of Aveiro, 3810-193 Aveiro, Portugal
3. Department of Veterinary Sciences, University of Pisa, San Piero a Grado, 56122 Pisa, Italy

⋆ Corresponding author; carlapleite@ua.pt; † Presenting author; Biology and ecology of global changes.

Abstract. The growing demand for clean energies and high-tech applications has led to the increased use of rare earth elements (REEs) (Balaram, 2019). Nowadays, REEs are considered critical raw materials due to their significant economic importance and considerable supply risk. This rising use of REEs over the past few decades contributed to the enrichment of anthropogenic REEs in aquatic environments (Gomes et al., 2022), posing potential threats to aquatic organisms. Moreover, climate change-related factors have reached alarming levels. Carbon dioxide (CO2) emissions are the primary contributors to global warming (IPCC, 2023), while global rainfall and evaporation cycles are inducing alterations in salinity levels (Durack et al., 2015). Both events have been increasing, with adverse impacts already observed on several aquatic organisms (e.g., Andrade et al., 2024). Since climate change-related factors may change the effects of REEs on organisms, this work aimed to evaluate the toxic impacts of REEs, such as neodymium (Nd), dysprosium (Dy), praseodymium (Pr), and europium (Eu), both individually and in combination, on the mussel species Mytilus galloprovincialis, under actual and predicted climate change-related factors (warming and salinity shifts). The impacts on adult mussels were assessed by analyzing biochemical and histopathological alterations, while the quality of M. galloprovincialis sperm was evaluated by measuring biochemical and physiological markers. The findings indicated that, overall, REEs cause adverse effects on both adult organisms and their sperm. Additionally, the combined impact with warming varies depending on the specific element. Concerning salinity shifts, a salinity level of 40 appeared to aggravate the effects of REEs in adult mussels, whereas a salinity of 20 intensified the impacts of REEs in sperm. These findings reinforce the importance of studying the impacts of these emergent contaminants in combination with climate change-related factors. Such research is essential to develop regulatory guidelines and practices aimed at protecting the coastal systems and maintaining the goods and services.

Keywords: *Rare earth elements, Climate change, Mussels, Ecotoxicity*

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Acknowledgements. Thanks are due for financial support to REQUIMTE (LA/P/0008/2020 DOI 10.54499/LA/P/0008/2020, UIDP/50006/2020 DOI 10.54499/UIDP/50006/2020 and UIDB/50006/2020 DOI 10.54499/UIDB/50006/2020) and CESAM (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020). Carla Leite acknowledges her Ph.D. grant (https://doi.org/10.54499/2020.05296.BD) by the National Funds through the Portuguese Science Foundation (Fundação para a Ciência e a Tecnologia, FCT).

EnVOC- rhizobacteria and volatile organic compounds microencapsulation: a methodology to increase bacterial survival, plant growth promotion and tolerance to drought

Tiago Soeiro Lopes[†,⋆,1], Etelvina Figueira[2], Paula A. A. P. Marques[3], Carmen Bedia Girbés[4]

1. CESAM - Centre for Environmental and Marine Studies
2. University of Aveiro, 3810-193 Aveiro, Portugal
3. TEMA Centro de Tecnologia Mecânica e Automação, Department of Mechanical Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
4. IDAEA- Institute of Environmental Assessment and Water Research

⋆ Corresponding author; tslopes@ua.pt; † Presenting author; Biology and ecology of global changes.

Abstract. Drought, a prominent consequence of climate change, is projected to escalate in frequency throughout the 21st century, posing a substantial threat to agricultural productivity and consequent food security (Du et al., 2018). This concern is amplified by the inherent sensitivity of most crops to drought conditions and their heavy reliance on adequate water availability (Meng et al., 2016). The utilization of Plant Growth Promoting Rhizobacteria (PGPR) presents a promising avenue to enhance water use efficiency, owing to their multifaceted characteristics such as the production of phytohormones, Plant Growth Promotion traits, and tolerance to abiotic stresses (Grobelak et al., 2015). Volatile Organic Compounds (VOCs) emitted by these bacteria exhibit diverse effects on plant growth and could significantly influence plant survival under various environmental pressures, both abiotic and biotic (Ryu et al., 2003). However, a significant challenge in the application of PGPRs lies in ensuring their survival upon introduction to soil. Encapsulation within polymeric matrices has garnered attention due to its numerous advantages, providing a protective environment against soil heterogeneity (Wu et al., 2011).
The objective of this study is to develop a novel methodology by encapsulating bacteria with plant growth promoting traits and high osmotolerance along with volatile compounds capable of effectively promoting plant growth and enhancing drought tolerance in crops. To achieve this, a selection of osmotolerant bacteria with demonstrated ability to promote plant growth and drought tolerance will be identified. Volatiles with potential to promote plant growth will be identified using Gas Chromatography x Gas Chromatography Mass Spectrometry (GCxGC-MS). Bacteria and VOCs will then be encapsulated, and different formulations will be tested to determine bacterial survival, release and metabolic capacities. Encapsulated VOCs will also be tested to assess loading efficiency and release using GC-GC-MS analysis. To verify the ability of both capsules to increase plant growth under drought, in vivo and field tests will be conducted to validate our methodology. Finally, the study aims to elucidate the biochemical, nutritional and metabolomic changes induced by bacteria and VOCs in plants.

Keywords: *Rhizobacteria, Bacterial volatile organic compounds (VOCs), plant tolerance to drought, encapsulation*

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Acknowledgements. We acknowledge funding by Foundation for Science and Technology (FCT) through PhD scholarship of Tiago Lopes (2023.01311.BD).

Artificial light at night and aquatic insects: life-history responses under multistressor scenarios

Joana Carmo[†,⋆,1], Bruna Silva[1], Diana Campos[1], Ana L. Machado[1], Andreia Rodrigues[1], Robby Stoks[2], João. L.T. Pestana[1]

1. CESAM Department of Biology, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. Laboratory of Evolutionary Stress Ecology and Ecotoxicology, University of Leuven, Charles Deberiotstraat 32, Leuven, Belgium

⋆ Corresponding author; joana.m.s.carmo@ua.pt; † Presenting author; Biology and ecology of global changes.

Abstract. The rapid development of urbanization has increased light pollution levels worldwide. Light pollution, resulting from artificial light at night (ALAN), affects the physiology, behaviour and ecology of organisms living in urban environments and has been suggested as a major driver of insect decline. Besides ALAN, urban aquatic ecosystems are also exposed to several other stressors namely pesticide exposure, increased temperatures, and salinisation. Effects of ALAN on aquatic invertebrates are seldomly evaluated and mostly in isolation, i.e., without considering multi-stressor scenarios that are relevant for urban ecosystems.Here we report data from laboratory assays aiming to evaluate the life-history responses (larval length, time of emergence, percentage of emergence and body weight of midges adults) of Chironomus riparius to environmentally relevant levels of ALAN (1 and 10 lux during nighttime) combined with other urban stressors, such as salinity, temperature, and pesticide exposure. Our results show that exposure to ALAN reduced the time to emergence and reduce thermal tolerance of C. riparius larvae acting additively or mediating the responses to other stressors that are relevant for urban aquatic ecosystems. Ongoing work is evaluating whether exposure to ALAN alters the sensitivity of C. riparius to pesticide exposure and to increased temperatures. These findings add important data on physiological and life-history responses of insects to ALAN and are discussed considering the pervasiveness of this stressor and its potential fitness impacts and ecological consequences for aquatic invertebrates living in urban environments.

Keywords: *Light pollution; aquatic invertebrates; pesticide exposure; warming; salinisation.*

Acknowledgements. The author gratefully acknowledges the financial support of the Portuguese Foundation for Science and Technology (FCT) through a doctoral grant (2023.03420.BD).Through national funds, we acknowledge financial support to CESAM by FCT/MCTES (UIDP/50017/2020+UIDB/50017/2020+ LA/P/0094/2020). The author is thankful for the financial support by the project SLEEP- Shedding light on freshwater ecosystems under environmental change and pollution reference PTDC/CTA-AMB/2518/2020. DOI: 10.54499/PTDC/CTA-AMB/2518/2020, also financed by FCT through national funds (OE).

Fortree: Foest management to enhance the recovery of recently burnt Pinus pinaster woodlands - Thesis plan

Diana Rodrigues[†,1], Bruna Oliveira[2], Paula Maia[3], Marco Ciolli[4]

1. Universidade de Aveiro, Campus de Santiago
2. Centre for Environmental and Marine Studies (CESAM), University of Aveiro
3. CESAM
4. Centre Agriculture Food Environment - C3A

⋆ Corresponding author; † Presenting author; Biology and ecology of global changes.

Abstract. Ecosystem restoration is a global priority, being 2021-2030 the United Nations (UN) Decade on Ecosystems Restoration. Also, Goals 12, 13 15 and 17 of the UN 2030 Agenda for Sustainable Development highlight the urgent need to restore degraded ecosystems, in fire-prone regions, fostering their resilience and enhancing their carbon sequestration potential.
Wildfires are natural phenomena that reshape the structure, composition, and functioning of ecosystems, being an important modeling agent, influencing the soil-vegetation system, the vegetation succession (1), and the above- and below-ground carbon storage of forests. Pinus pinaster is an ecologically versatile species, being present along a wide range of biogeographical regions, and presenting various ecological traits that confer resistance and adaptation to disturbances by fire (2).Fortree aims to implement, test, and communicate innovative restoration practices in post-fire scenarios in pinewood ecosystems, and the evaluation of the ecosystem services of those areas. For this, ecosystem regeneration in different regions (Csb with atlantic influece, Csa with continental influence) will be evaluated, the creation of prediction biomass equations and consequent carbon sink evaluation, test soil amendment measures, and evaluation of ecosystem services. These objectives are strongly aligned with societal and political demand for sustainable forestry practices, to contribute to UN SDGs. Furthermore, it also caters to the needs and interests of Portugal's pine sector. Through communication outreach, Fortree extends beyond academic boundaries by involving CentroPinus and ICNF as active consultants and promoters of its key outcomes.

Keywords: *Ecossystem restoration; Martime pine; Ecossystem dynamics; Wildfire Carbon sequestration; Mediterranean ecossystems*

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Acknowledgements. The authors gratefully acknowledge the financial support of the Portuguese Foundation for Science and Technology (FCT, I.P) to CESAM (UIDP/50017/2020 + UIDB/50017/2020 + LA/P/0094/2020) and the project ModelEco (PTDC/ASP-SIL/3504/2020). Bruna R. F. Oliveira is financed by FCT, I.P., FEDER and COMPETE 2020, through the stimulus for a scientific job (2021.00785.CEECIND). Diana Rodrigues is funded by FCT/ECIU (PRT/BD/154850/2023) in the form of a PhD grant in academic environment with a partneship with Trento University, Itlay.

Biomedical engineering

Microneedles fabrication via DLP for gingiva healing application: Dimensional control

L. M. Pereira[†,⋆,1], Catarina C. Lei[2], Sónia G. Patrício[3], Joana Mesquita-Guimarães[2], José M. Oliveira[3]

1. TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
2. Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
3. School of Design, Management and Production Technologies Northern Aveiro, Estrada do Cercal 449, Santiago da Riba-Ul, 3720-511, Portugal

⋆ Corresponding author; luis.m.pereira@ua.pt; † Presenting author; Biomedical engineering.

Abstract. Periodontal disease affects 50% of the global population and is the sixth most common pathology in the world. In Portugal, 3 out of 4 adults are affected by periodontal disease, including gingivitis. Current treatment strategies focus on the mechanical removal of bacterial biofilms, with systemic antibiotics having associated challenges such as drug resistance and adverse effects [1], [2].
Transdermal microneedles applied for gingival healing can be an excellent solution acting locally at marginal and attached gingiva areas; therefore, more precise and targeted therapies may enhance treatment effectiveness while minimizing side effects [3], [4].
This work has the main objective the development of microneedles (MNs) using a 3D printing technology consisting of a digital light processing (DLP), with anchor shape and internal channels will be tested for printability. Also, bulk anchor-shaped needles will be coated with acemannan solution.
Initially, conical MNs were produced to control the precision, resolution, and dimensions. This design provides a basic structure to evaluate the printability and characteristics obtained by DLP technology. Subsequently, a new design of microneedles with an anchored structure was implemented for better fixation and retention at the gingival site. Anchor shape modification aims to improve the effectiveness of MN adhesion.
The results obtained under this study are focused on the dimensional control of the CAD model to the printing part, the sintering shrinkage analysis, and relative density and porosity, also via Micro-CT and profilometry to total control of the dimensions of the needles. Also, the printability of the internal channel diameter/wall thickness was tested. Acemannan extraction was performed, and purity was determined.

Keywords: *Microneedles, Digital Light Processing, Drug delivery, Periodontal disease*

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Acknowledgements. This research had the financial support of the following projects UIDB/00481/2020 (https://doi.org/10.54499/UIDB/00481/2020) and UIDP/00481/2020 (https://doi.org/10.54499/UIDP/00481/2020) - FCT - Fundação para Ciência e Tecnologia; and CENTRO-01-0145-FEDER-022083 - Centro Portugal Regional Operational

Programme (Centro2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund.

Highly robust human-derived hydrogels for Tissue Engineering applications

J. Abreu Pereira[†,⋆,1], A. Sofia Silva[1], João F. Mano[1]

1. CICECO

⋆ Corresponding author; joaopereira38@ua.pt; † Presenting author; Biomedical engineering.

Abstract. Hydrogels have been widely explored in the field of Tissue Engineering and Regenerative Medicine due to their unique features that include i) high water content - which provides an ideal environment for cell survival; ii) the ability to maintain a distinct and biocompatible 3D structure - providing mechanical support for encapsulated cells; and iii) the ability to simulate the native extracellular matrix. Despite these advantages, hydrogels softness makes them prone to mechanical failure and brittleness, limiting their use in applications that require high levels of mechanical stability.[1] In this sense, tough double network (DN) hydrogels have been designed to address the mechanical limitations of soft hydrogels, making them less prone to failure under stress.[2] Still, the limited diffusion of nutrients through DN hydrogels may hinder cell survival and proliferation. Additionally, the lack of control over the degradation rate of these hydrogels can further affect nutrient diffusion and the viability of cells encapsulated.[3] In this sense, we propose the development of a human-derived DN hydrogel of methacryloyl platelet lysates (PLMA) and chitosan to yield a material with enhanced mechanical properties, but still, suitable for the cell survival of encapsulated cells. Human adipose-derived stem cells (hASCs) were seeded on top of the hydrogels showing very promising results along the first seven days once the vast majority of cells remained viable for all formulations. Also, owing the well described properties of PLMA we envision that this human-derived DN system may also promote cell proliferation and tissue formation within the hydrogel. We envision that this multimodal hydrogel could likely be used for the repair of load-bearing soft tissues or as an encapsulation platform for several biomedical applications, including disease modeling for the screening of new therapeutics in more mimetic environment.

Keywords: *Tough Hydrogels; Human-based materials; PLMA; Tissue Engineering*

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Biomedicine

Revisiting Multi-Omics Data to Unravel Galectins as Prognostic Factors in Head and Neck Squamous Cell Carcinoma

Oriana Barros[†,1], Vito Giuseppe DAgostino[2], Lucio Santos[3], Rita Ferreira[4], Rui Vitorino[⋆,5]

1. Department of Medical Sciences, Institute of Biomedicine iBiMED, University of Aveiro, 3810-193, Aveiro, Portugal$_x000B$
2. Department of Cellular, Computational and Integrative Biology (CIBIO), University of Trento, Via Sommarive 9, 38123 Trento, Italy
3. vito.dagostino@unitn.it
4. Experimental Pathology and Therapeutics Group, Research Center of IPO Porto (CI-IPOP)/RISE@CI-IPOP (Health Research Network), Surgical Department of Portuguese Oncology Institute of Porto (IPO Porto)/Porto Comprehensive Cancer Center (Porto. CCC), 4200-072 Porto, Portugal
5. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
6. Department of Medical Sciences, Institute of Biomedicine iBiMED, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; rvitorino@ua.pt; † Presenting author; Biomedicine.

Abstract. Head and Neck Squamous Cell Carcinoma (HNSCC) is a malignant cancer with a poor prognosis. Galectins (Gal) are glycan-binding proteins that have shown a high potential to be used as disease biomarkers. Gal have been the subject of intensive research, but the comparative prognostic value of each Gal type is not yet understood. Therefore, a literature search for evaluating galectins as prognostic biomarkers in HNSCC was conducted. The relationship between Gal expression in HNSCC with HPV and TP53 mutational status was assessed using the UALCAN database. The impact of these biomarkers on prognosis was analyzed using ToPP and CPPA web tools. The expression of galectins in the tumor microenvironment and the impact on prognosis depending on the cancer immune subtype were analyzed using single-cell RNA sequencing. Gal-1 and Gal-3BP were shown to be promising biomarkers with a triple function for the prediction of HPV and TP53 mutational status, stratification of the HNSCC prognosis, and prediction of the response to treatment based on results obtained from several bioinformatic tools (UALCAN, CPPA, ToPP, TISCH2 and GSCA). Analyzing the results from TISCH2, these two galectins have been shown to be most influenced by the tumor microenvironment of HNSCC. Gal-1 and Gal-3BP are the most promising galectins in HNSCC taking in account their potential as prognosis biomarkers. Furthermore, this study highlights the need for further studies to evaluate galectins in HNSCC and clarify the role of individual Gals in the patients stratification.

Keywords: *galectins; prognosis; multi-omics; head and neck squamous cell carcinoma*

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Acknowledgements. This work was supported by the Portuguese Foundation for Science and Technology (FCT), European Union, QREN, FEDER, and COMPETE for funding Institute of Biomedicine (iBiMED) (UIDB/04501/2020, POCI-01-0145-FEDER-007628), LAQV-REQUIMTE (UIDB/50006/2020), Instituto Português de Oncologia do Porto Francisco Gentil, EPE (CI-IPOP-134-2020), COST Action INTERCEPTOR and by an individual scholarship from Oriana Barros (University of Aveiro).

Clinical Reasoning in Neurological Physiotherapy: Why we do what we do? Preliminary findings of an Exploratory Qualitative Study.

Cláudia Sofia Marques[†,⋆,1], Julie Vaughan-Graham[2], Rui Costa[3], Daniela Figueiredo[4]

1. CINTESIS@RISE, IbiMED, Department of Medical Sciences
2. Department of Physical Therapy, Faculty of Medicine
3. IbiMED, School of Health Sciences
4. CINTESIS@RISE, School of Health Sciences

⋆ Corresponding author; † Presenting author; Biomedicine.

Abstract. Background: The Bobath concept is a widely used neuro-rehabilitation approach that addresses the person as a whole within their unique context. This inclusive, individualized, problem-solving approach focuses on movement analysis and motor recovery, and is specifically tailored to each individual's clinical presentation and personal goals.
Purpose: The aim of this study is to investigate the clinical reasoning process of experienced neurological physiotherapists, comparing those with and without certified training in the Bobath approach/NDT.
Methods: A qualitative interpretive description approach was employed, using stimulated recall through video-recorded treatment sessions and in-depth interviews with participants (physiotherapists) purposefully selected. The observation of participants occurred within their practices, specifically during a first contact-intervention session with a post-stroke individual. Immediate semi-structured interviews were conducted. These interviews were transcribed verbatim and the data analysis process was iterative, involving both deductive and inductive methods.
Results: Thirty-two Portuguese physiotherapists have participated, with a mean of 16.3 years of clinical experience and 14.1 years of neurological experience. Most of the participants worked at rehabilitation centers (43.75%), hospitals (25%) and private clinics (21.88%). In the Bobath group, four main themes emerged: i) Clinical practice structured around Bobath principles; ii) Clinical reasoning guided by (person-provider) movement; iii) Reasoning: a multi-dimensional process guided by a person-centered clinical reasoning; and, iv) Reasoning and decision-making influenced by contextual and organizational factors. Conversely, in the non-Bobath group, three distinct themes and one similar theme were identified: v) Clinical practice structured by Bobath and non-Bobath principles; vi) Clinical reasoning driven by task autonomy; vii) Reasoning: divergence between provider-centered and person-centered clinical reasoning; and, viii) Reasoning and decision-making constrained by contextual and organizational factors.
Conclusion: This study highlights the significant impact of interpersonal, clinical, and organizational factors on clinical reasoning in neurological physiotherapy. It reveals distinct differences in the reasoning processes of Bobath and non-Bobath trained therapists, influenced by their emphasis on movement and task autonomy, respectively. Recognizing these variations can enhance educational strategies, clinical practice, and research, ultimately improving person outcomes by aligning therapeutic approaches with specific reasoning patterns.

Keywords: *Qualitative study, Bobath concept, Neurodevelopmental Treatment, neurorehabilitation, clinical reasoning, movement.*

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Acknowledgements. CSM has a PhD grant (2022.12819.BD) financed by FCT (Fundação para a Ciência e Tecnologia) through FSE (Fundo Social Europeu).

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Characterization of tissue-specific and global proteomic signatures reveal shifts in abundance and solubility across the mammalian lifespan.

Stephany Marques Francisco [†,1], Margarida Ferreira [1], Ana Nobre [1], Cátia Santa [2], Vera Mendes [2], Filipa Martins [1], Fátima Camões [1], Sandra Rebelo [1], Gabriela Moura [1], Bruno Manadas [2], Manuel A.S. Santos [3], Ana R. Soares [⋆,1]

1. iBiMED - Institute for Biomedicine, Department of Medical Sciences, University of Aveiro, Agra do Crasto, 3810-193 Aveiro, Portugal
2. CNC-UC - Center for Neuroscience and Cell Biology, R. Larga - Faculdade de Medicina, University of Coimbra, 3004-504 Coimbra
3. MIA-Portugal - Multidisciplinary Institute of Ageing, R. Larga 2, University of Coimbra, 3000-370 Coimbra

⋆ Corresponding author; ana.r.soares@ua.pt; † Presenting author; Biomedicine.

Abstract. As cells age, protein homeostasis (proteostasis) progressively declines, leading to the widespread accumulation of misfolded proteins, a hallmark of age-related diseases1. We hypothesize that protein aggregation also occurs during natural tissue ageing due to an age-associated decline of proteostasis responses responsible for misfolded protein degradation. In this study, we performed SWATH mass spectrometry analysis to detect age-related shifts in protein abundance that occur in the total proteome, detergent-soluble and insoluble protein fractions of young, middle-aged, and old aged female C57BL/6J mice. Tissue-specific SWATH profiles were produced for the liver, skeletal muscle, and cortex. Our results reveal that the proteins present in the insoluble fractions across the tissues of middle- and old aged mouse groups are largely involved in peroxisomal transport, stress response, and proteasomal degradation while soluble proteins are involved in cell redox homeostasis and translation-related processes. Future studies will examine the eligibility of these proteins as targets for anti-aging therapeutic strategies.

Keywords: *Tissue aging, Protein aggregation, Proteostasis, Proteomics*

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The authors gratefully acknowledge the financial support under the following projects : POCI-01-0145-FEDER-029843; Centro-01-0145-FEDER-000003; Centro-08-5864-FSE-000039; CENTRO-01-01D2-FEDER-000001, SFRH/BD/148323/2019, CEECIND/00284/2018, UID/BIM/04501/2020, H2020-WIDESPREAD-2020-5ID-952373, MIA-Portugal is supported by Horizon2020 Grant Agreement Nž 857524

Spectroscopic Profile of Proteome Alterations in Neuronal Development

Idália Almeida[†,1], Filipa Martins[2], Brian J. Goodfellow[3], Sandra Rebelo[2], Alexandra Nunes[⋆,4]

1. iBiMED - Institute of Biomedicine Department of Medical Sciences, University of Aveiro Agra do Crasto, 3810-193 Aveiro, Portugal, CICECO - Aveiro Institute of Materials Complexo de Laboratórios Tecnológicos, University of Aveiro Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2.
3. CICECO, Departamento de Química, Campus de Santiago 3810-193 Aveiro
4. Institute of Biomedicine (iBiMED), Department of Medical Sciences, University of Aveiro (UA), Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Biomedicine.

Abstract.
Amyotrophic Lateral Sclerosis(ALS) is a neurological condition that affects motor neurons, with a molecular mechanism still largely unknown. Understanding neuronal differentiation is essential, and is possible using rat primary neuronal cultures(Martins et al., 2016). One hallmark of ALS is the accumulation of protein aggregates(PA) in motor neurons. To investigate proteomic profiles, including protein conformation and post-translational modifications during neuronal differentiation, vibrational-spectroscopy combined with multivariate analysis is invaluable(Magalhães et al., 2021). The ability of FTIR-spectroscopy to detect protein conformational changes will be relevant to identify and characterize the PA related to ALS.
Our goal was to validate the ability of FTIR-spectroscopy to study alterations in protein secondary structures and post-translational modifications throughout neuronal cell differentiation to, in the next stage of the work, apply the same methodology in identical cellular models with Optineurin mutations.
For FTIR analysis of the differentiation process, we cultured primary cortical neurons from rat embryos(Rattus norvegicus) for 14 days. Cells were harvested every two days and pellets were stored at -80řC. We acquired spectra from 35 cortical primary neuron samples (5 samples for each of the 7 timepoints), in triplicate, and analysed the spectroscopic profile, by PLS-R, in the 18001500cm-1 spectral region.
PLS-R analysis revealed a positive correlation between spectra and the cortical primary neurons differentiation process for 18001500cm-1 region (R = 0.93). Furthermore, PLS-R scores exhibited a clear discrimination between the samples before(2 DIV to 8 DIV) and after(10 DIV to 14 DIV) the point of neuronal maturation. Peak intensity analysis unveiled significant differences in conformational alterations in protein structures and post-translational modifications throughout the process of neuronal differentiation.
Our results show that it is possible to study proteome modifications during neuronal cell line differentiation and that this methodology could be applied to follow the PA in cellular models with Optineurin mutations.

Keywords: *FTIR, Spectroscopic Profile, Neuronal Development, Cortical Neurons, Proteomics*

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Acknowledgements. This work was supported by Fundação para a Ciência e Tecnologia (FCT) I.P. (PIDDAC), European Regional Development Fund (FEDER) (project numbers UIDB/04501/2020; UIDP/04501/2020; UIDB/50011/2020; UIDP/50011/2020 and 2021.07230.BD).

This work was also supported by the Project BRI2 role in neuronal differentiation and the underlying molecular mechanisms: towards an innovative regenerative therapy for Alzheimers Disease; PTDC/BTM-TEC/3792/2021).

Alzheimer's Pathophysiology: Investigating Retinoid Signalling for Cellular Resilience

José João M. Vitória[†,⋆,1], Diogo Trigo[1], Odete da Cruz e Silva[2]

1. Universidade de Aveiro
2. Neuroscience and Signalling Group, Department of Medical Sciences, Institute of Biomedicine (iBiMED), University of Aveiro (UA), 3810-193 Aveiro, Portugal

⋆ Corresponding author; josejoao@ua.pt; † Presenting author; Biomedicine.

Abstract. Alzheimers Disease (AD) is a neurodegenerative disorder characterized by the accumulation of amyloid beta (A) plaques and mitochondrial dysfunction, both of which contribute to progressive cognitive decline. Developing effective therapeutic interventions for AD necessitates a comprehensive understanding of the intricate molecular pathways underlying its pathology. This study investigates retinoid signalling as a potential therapeutic avenue for AD, focusing on its modulation of amyloid precursor protein (APP) processing and mitochondrial function. Using differentiated SH-SY5Y cell model, we explored the effects of retinoic acid receptor (RAR) agonists and antagonists, in an isoform-dependent manner, on APP cleavage and mitochondrial integrity. Our findings reveal that activation of RAR leads to a significant reduction in APP -cleavage, and activation of RAR, in a isoform-specific manner, intensifies this effect. These alterations in APP processing are associated with changes in secretase protein levels and mediated by phosphorylation-dependent mechanisms as well as potential protein interaction mechanisms.
Moreover, retinoid signalling exerts a protective effect on mitochondrial function for A-induced toxicity and oxidative stress. Live imaging confocal microscopy revealed that retinoid treatment mitigates A-induced mitochondrial dysfunction, preserving mitochondrial membrane potential and reducing reactive oxygen species production. Interestingly, this rescue appears to involve not only direct effects on mitostasis but also modulation of PDIA3/Erp57, a protein implicated in cellular stress responses.
These findings highlight the multifaceted impact of retinoids on cellular processes relevant to AD pathophysiology. By targeting both amyloid deposition and mitochondrial dysfunction, retinoid signalling emerges as a promising therapeutic strategy for promoting neuronal health in AD. However, further investigations are reasonable to fully elucidate the therapeutic potential of retinoid-based interventions.

Keywords: *Alzheimer's Disease; Retinoid Signalling; Amyloid Beta; Mitochondria*

Acknowledgements. This study was supported by grants from FCT EXPL/BTM-SAL/0902/2021, La Caixa Foundation CI21-00276, CENTRO-01-0145-FEDER-181255, 739572 and 2022.12945.BD.

The aging gut drives bacterial evolution toward pathoadaptation

Rita Melo-Miranda[†,1], Ana Pinto[1], Ana Sousa[⋆,1]

1. Institute of Biomedicine (iBiMED), Department of Medical Sciences, University of Aveiro, Campus Universitario de Santiago, Agra do Crasto Edificio 30, 3810-193 Aveiro

⋆ Corresponding author; amsousa@ua.pt; † Presenting author; Biomedicine.

Abstract. Laboratory-raised mice live approximately seven times longer and more healthy lives than their wild counterparts, primarily due to a standardized healthy diet and minimal exposure to environmental stressors.
Aging is associated with a rise in inflammation, gut permeability, and microbial dysbiosis, which may impact microbiota evolution and contribute to the pathobiont enrichment observed in old age. Alternatively, this could stem from a decline in colonization resistance, which is typical of old age, creating a favorable environment for pathobiont invasion.
Here we aimed to explore whether maintaining healthy conditions throughout aging, by limiting the opportunity for pathobiont invasion, could mitigate the emergence of age-related pathobionts.
We have colonized very old mice (25 months old) with a commensal strain of E. coli and tracked its adaptive evolution in the guts of very old mice (25 months old). For that, we collected fecal samples throughout the 24 days of experimental evolution, sequenced the whole genome of E. coli populations in each mouse, and used BRESEQ to identify the mutations it acquired when compared to the ancestral strain. We uncovered that E. coli evolving in very old mice acquired several mutations common to young mice (6-9 weeks old) that were absent in old animals (19 months old). Additionally, we characterized the intestinal microbiota by 16S rRNA gene sequencing and QIIME2 for taxonomic classification and observed an increase in Akkermansia muciniphila and Oscillospira sp. in very old mice, indicative of healthy aging.
However, mutations exclusive to old animals (19 and 25 months old) predominantly favored potentially pathogenic traits, including adjustments in metabolism to adapt to oxygen and iron availability, hypermotility (tested by an in vitro swarming motility assay), and enhanced fimbriae expression (tested by an in vitro agglutination assay), which are involved in adhesion to surfaces and biofilm formation.
In summary, although the evolution signature in the guts of very old mice shows youth-like features that may be associated with longevity, microbial evolution tends towards pathoadaptation with aging.

Keywords: *aging; microbial evolution; Escherichia coli; pathoadaptation*

Acknowledgements. This work was funded by Fundação para a Ciência e Tecnologia PTDC/BIA-EVL/30212/2017, and Programa Operacional Regional do Centro, through Fundo Europeu de Desenvolvimento Regional FEDER (CENTRO-01-0145-FEDER-030212), and by iBiMED (UID/BIM/04501/2019, project POCI-01-0145-FEDER-007628). R. Melo-Miranda was supported by the individual Grant 2020.05130.BD from FCT.

Exosomes profile in Alzheimers disease mimicking conditions

Margarida Vaz[†,⋆,1], Tânia Soares Martins[2], Alexandra Nunes[3], Odete da Cruz e Silva[1], Ana Gabriela Henriques[2]

1. Neuroscience and Signalling Group, Department of Medical Sciences, Institute of Biomedicine (iBiMED), University of Aveiro (UA), 3810-193 Aveiro, Portugal
2. Neuroscience and Signalling Group, Department of Medical Sciences, Institute of Biomedicine (iBiMED), University of Aveiro (UA), 3810-193, Aveiro, Portugal
3. Institute of Biomedicine (iBiMED), Department of Medical Sciences, University of Aveiro (UA), Aveiro, Portugal

⋆ Corresponding author; margaridavaz@ua.pt; † Presenting author; Biomedicine.

Abstract. Alzheimer's disease (AD) is the most prevalent form of dementia, globally affecting millions of people. As its intricate etiology remains incompletely understood, it is important to unravel new pathways that can contribute to understanding the disease pathology. Extracellular vesicles (EVs) are important mediators in intercellular communication and are known carriers of A and other relevant proteins in AD pathology.This work aimed to characterize EVs profiles under AD mimicking conditions employing two distinct approaches: i) analysing EVs metabolic profile in response to A and ii) assessing A impact on EVs proteome; and also to address EVs biogenesis and secretion in such conditions. Neuroblastoma cell line (N2a) was treated with the neurotoxin A peptide and EVs were isolated from cells conditioned media by ultracentrifugation. A control without treatment was also included. EVs were characterized by transmission electron microscopy, nanoparticle tracking analysis and western blot (WB). The metabolic profile of EVs was analysed by Fourier transform infrared spectroscopy (FTIR) and the EVs proteome by mass spectrometry (MS) analyses. Some proteins involved in EVs biogenesis and secretion were evaluated by WB under these experimental conditions.Regarding the FTIR analysis, differences were observed in the spectra regions between 1280 900 cm 1, assigned to carbohydrates, nucleic acids, lipids and protein phosphorylation, and between 1700 1500 cm 1 revealing alterations in protein conformation, when comparing to control. EVs proteome obtained by MS, revealed 651 proteins, with the majority involved in processes related to protein translation and metabolism. Additionally, differences in proteins involved in phosphorylation events were also observed between control and A treated groups. Further, WB analysis revealed a significant increase in the levels of Flotilin, involved in EVs biogenesis, and in two Rab proteins, implicated in EVs secretion.These findings support that A is able to modify EVs profiles across various domains, also impacting EVs biogenesis and secretion. Given EVs significance in intercellular communication, data highlight potential mechanisms by which A can contribute to AD pathogenesis.

Keywords: *Alzheimer's Disease, A, Extracellular vesicles, FTIR, Mass spectrometry*

Acknowledgements. This work was supported by Instituto de Biomedicine (iBiMED) under Grant UIDB/04501/2020 and UIDP/04501/2020; MV is supported by the individual PhD grant UI/BD/151354/2021 and TMS by the individual PhD grant SFRH/BD/145979/2019.

STING response and the effect of Endoplasmic Reticulum Stress

Fátima Leite-Pinheiro[†,⋆,1], Philippe Pierre[2], Catarina R. Almeida[3]

1. University of Aveiro, 3810-193 Aveiro, Portugal and 13288 Marseille cedex 9, France
2. University of Aveiro, 3810-193 Aveiro, Portugal and 13288 Marseille cedex 9, France and Shanghai Jiao Tong University School of Medicine, Shanghai 200025, PR China
3. University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Biomedicine.

Abstract. Innate immune responses are fundamental in the fight against bacterial and viral infections but can also trigger autoimmune diseases when dysregulated. Plasmacytoid Dendritic Cells (pDCs) are a subset of Dendritic Cells (DC) specialized in anti-viral responses due to their capacity to quickly secrete massive amounts of the anti-viral type I interferon (IFN-I). A pathway that allows recognition of viral or self-cytosolic DNA is the cGAS-Stimulator of Interferon Genes (STING) pathway. cGAS recognizes dsDNA and converts it into cGAMP that induces STING activation and leads to type-I interferon. STING is located in the Endoplasmic Reticulum (ER), an organelle that is prominent in highly secretory cells such as pDCs. The ER is responsible for the synthesis, folding and maturation of one third of all cellular proteins of the cell. Alterations in proteostasis of this organelle, such as during viral infection, trigger ER stress, accumulation of misfolded or unfolded proteins and the Unfolded Protein Response (UPR). However, the behavior of pDCs under ER stress and the impact of this on STING signaling remain unclear. In this work, we aim to characterize the impact of ER stress response in STING signaling in pDC. For that, CAL-1 cells, a pDC cell line, were stimulated with the ER stress inducer thapsigargin, for different time points, and STING signaling stimulated with cGAMP. Protein synthesis was measured by flow cytometry using the Sunset method, and the protein activation was evaluated by Western-blotting (protein phosphorylation) and RT-qPCR (IFN-beta expression). Thapsigargin treatment rapidly decreased protein synthesis and induced phosphorylation of PERK and eIF2. Two hours after stimulation, the levels of protein synthesis were reestablished followed with an increased expression of GADD34, however with a sustained phosphorylation of PERK. The stimulation of STING activation under conditions of ER stress induced a delay in shut down its response culminating in increased IFN-I production. These results will contribute to understanding the influence of ER stress in innate immune responses.

Keywords: *STING, Endoplasmic Reticulum, stress, IFN-I*

Acknowledgements. Supported by Fundação para a Ciência e a Tecnologia (national funds, OE) UIDB/04501/2020 UIDP/04501/2020, 2022.03217.PTDC, DOI 10.54499/2022.03217.PTDC; FLP is supported by FCT through an individual grant (2020.08489.BD, DOI 10.54499/2020.08489.BD).

Unfolding the interplay between viruses and cellular proteostasis

Alexandre Nunes[†,⋆,1], Ana Raquel Soares[1], Daniela Ribeiro[1]

1. Department of Medical Sciences

⋆ Corresponding author; ammnunes@ua.pt; † Presenting author; Biomedicine.

Abstract. During infection, viruses manipulate their host cells, including the translation machinery. Previous studies from our laboratory indicate that tRNA modifications are modulated upon influenza A virus (IAV) infection and have an impact on viral propagation. However, it is not yet clear whether this is related to the infection itself or the general host antiviral response. To elucidate this, we expanded our studies to another RNA respiratory virus, the human coronavirus 229E (hCoV-229E) that, similarly to IAV, has a biased codon usage. While the equilibrium between the abundance of tRNAs and the mRNA codon requirements is usually maintained within the cell, the IAV and hCoV-229E RNA genomes exhibit a preference for adenosine (A)- and uridine (U)-ending codons, which usually doesnt correlate with the hosts preferences. To clarify whether, despite this discrepancy in codon usage, the persistence in viral infection is due to the alteration of host tRNA modification dynamics upon infection, we characterized the mRNA expression of tRNA modifying enzymes (TMEs) upon hCoV-229E infection and found that specific TMEs were upregulated. By silencing those TMEs, using targeting siRNAs, prior to infection, a reduction in viral particle production via plaque assay was observed, seemingly accompanied by an increase in protein aggregation observed via confocal microscopy. These initial observations indicate that tRNA modifications play a crucial role in viral particle production and proteostasis and that targeting TMEs may constitute a novel host-based antiviral therapy.

Keywords: *Viruses, proteostasis, host-virus interplay, protein synthesis, translation, epitranscriptomics*

Manipulating peroxisome morphology alters the MAVS-dependent antiviral signaling pathway

Jéssica Sarabando[†,⋆,1], Michael Schrader[2], Daniela Ribeiro[3]

1. iBiMED
2. University of Exeter
3.

[⋆] Corresponding author; jessicasarabando@ua.pt; [†] Presenting author; Biomedicine.

Abstract. Upon viral infections, host cell organelles are explored by the virus and the cellular immune system. Peroxisomes, have recently emerged as important antiviral and pro-viral platforms during viral infections. Alongside mitochondria, peroxisomes play an important role in the establishment of the cellular antiviral immune response due to the presence of the mitochondrial antiviral signaling adaptor protein (MAVS) at the organelles membrane. During infection, cytosolic viral RNA is detected by the retinoic inducible gene-I (RIG-I)-like receptors (RLR), which interact with MAVS at both organelles, inducing its oligomerization and prompting a signaling cascade that culminates with the production of antiviral effectors such as interferons (IFN) and IFN-stimulated genes (ISGs).
Peroxisome dynamics have been shown to be modulated by different viruses to evade the cellular antiviral response and/or promote their propagation. Nevertheless, research in this field is still incomplete and mechanistic details are scarce. Viruses likely interact differently with peroxisomes at distinct stages in their infection cycle resulting in, e.g., the reduction of peroxisome biogenesis early in infection to inhibit antiviral signaling, and the stimulation of peroxisome metabolism and biogenesis in a later phase to increase lipid metabolism and support virus particle formation.
To unravel the importance of the peroxisomal biogenesis machinery for the antiviral defense against RNA viruses, we have manipulated the elongation and fission of peroxisomes in mammalian cells, through the modulation of the expression of proteins involved in both processes, by RNA silencing and overexpression, and/or using knock-out (KO) cells. The effect on the peroxisome-dependent antiviral response was analyzed upon stimulation with an RNA molecule that mimics viral RNA. Our results suggest that peroxisome elongation and fission play a pivotal role in modulating the peroxisomal antiviral immune response. Our preliminary data also indicates that peroxisome proliferation might be crucial for an effective antiviral immune response.
Our team has recently discovered that the interaction between the peroxisomes and the endoplasmic reticulum (ER), mediated by the acyl-CoA binding domain-containing protein 5 (ACBD5), is required for the establishment of a robust antiviral response. To investigate a possible interconnection between the modulation of the antiviral response exerted by the peroxisome-ER association and by peroxisomal proliferation processes, we have analyzed the peroxisomal-dependent antiviral response upon stimulation of the peroxisomal fission machinery in ACBD5-silenced cells. Our results strongly pinpoint an important role for the peroxisome-ER interaction in the antiviral defense induced by peroxisomal proliferation.

Keywords: *Peroxisomes; Antiviral signaling; MAVS*

Transcriptional profiling of azole-resistant hypermistranslating Candida albicans strains

Gonçalo Sousa[†,⋆,1], Rita Guimarães[1], Carla Oliveira[1], Ana Poim[1], Rafaela Beleza[2], Inês Sousa[1], Sofia Marques[1], Maria João Carvalho[2], Inês Correia [2], Gabriela Moura[3], Manuel Santos[4], Ana Rita Bezerra[1]

1. Institute of Biomedicine (iBiMED), Department of Medical Sciences, University of Aveiro, Aveiro, Portugal
2. Department of Medical Sciences, Institute of Biomedicine iBiMED, University of Aveiro, Portugal
3. iBiMED - Institute for Biomedicine, Department of Medical Sciences, University of Aveiro, Agra do Crasto, 3810-193 Aveiro, Portugal
4. Multidisciplinary Institute of Aging (MIA), Faculty of Medicine, University of Coimbra, Coimbra, Portugal

⋆ Corresponding author; † Presenting author; Biomedicine.

Abstract. Candida albicans is the major invasive fungal pathogen of humans, causing diseases ranging from superficial mucosal infections to disseminated, systemic infections. The emergence of antifungal resistance is becoming a major obstacle in its treatment. However, acquisition of resistance is still unclear due to the complex biology of C. albicans. This pathogen has a highly heterogeneous proteome that arises from a unique codon usage system where the CUG codon is translated as both Ser (97%) and Leu (3%). Previous studies showed that C. albicans responds to environmental cues by increasing Leu misincorporation levels. Also, synthetic increase of CUG-Leu misincorporation to 20% (T1) and 67% (T2) resulted in increased tolerance to antifungals. Using hypermistranslating strains T1 and T2, we combined experimental evolution and RNA sequencing to elucidate evolutionary paths leading to the emergence of resistance to polyenes and azoles. Results showed that hypermistranslation accelerates the acquisition of azole resistance, but not polyene resistance. Gene expression analyses suggest that hypermistranslating strains speed up the acquisition of azole resistance by upregulating drug efflux pumps in distinct ways. Increased drug efflux in T2 strain is mediated via the multidrug efflux pump encoded by MDR1, while T1 overexpresses the ABC superfamily transporter genes CDR1 and CDR2. Our observations support a pivotal role for mistranslation in the evolution of drug resistance in C. albicans.

Keywords: *Candida albicans, fungal infections, mistranslation, antifungal resistance, RNA Sequencing*

Acknowledgements. This work is supported by the Portuguese Foundation for Science and Technology (FCT) through projects FunResist - PTDC/BIA-MIC/1141/2021, VARCAL - 2022.01376.PTDC and grant (2022.11692.BD). The iBiMED research unit is supported by FCT funds under UIDB/4501/2020 and UIDP/4501/2020.

Inflammation through a microbiota point of view

Catarina Almeida Silva[†,1], Rita Melo-Miranda[1], Catarina R. Almeida[1], Ana Margarida Sousa[⋆,1]

1. Institute of Biomedicine (iBiMED), Department of Medical Sciences, University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Biomedicine.

Abstract. Low-grade inflammation (LGI) is a state of low, systemic and chronic inflammation found in several physiological and pathological conditions. The gut microbiota is a complex commensal ecosystem, affected by diet, metabolism, and immune function. Knowing that inflammation can also affect and be affected by the microbiota, we aimed at exploring the effect of LGI in microbial evolution in an animal model of gut colonization.
To induce LGI, mice received frequent intraperitoneal injections with low doses of lipopolysaccharide (LPS), a bacterial toxin that activates the immune system. Mice were then treated with streptomycin and colonized with a commensal strain of Escherichia coli. This allowed the study of microbial evolution and query the selection of pathoadaptive traits in gut commensal bacteria by sequencing the whole-genome of E. coli and identifying mutations using BRESEQ.
We found that LPS stimuli had no effect on chronic levels of inflammatory cytokines found in the plasma (IL-6, TNF- and IFN-, quantified with a LEGENDplexTM assay), despite an increase in these markers one hour after LPS treatment. Additionally, LPS delayed E. coli colonization in the gut as indicated by decreased total loads (CFU/g of feces) one day after colonization, aligned with a weaker effect of the antibiotic in reducing microbiota diversity. In addition, we followed the dynamics of the gat-negative phenotype, by serially diluting and culturing frozen fecal pellets in MacConkey agar supplemented with 0.4% of galactitol, which allowed us to estimate the frequency of gat-negative colonies; the quicker emergence of this phenotype in LPS treated mice further suggests that E. coli is under stronger selection in this environment than in the control group. Future work should continue to unravel how the presence of LPS shapes the adaptive pattern of the microbiota, ultimately shedding light on inflammation and hosts microbiota interplay.

Keywords: *Microbiota evolution, Low grade inflammation*

Acknowledgements. This study is integrated in "MicroAgeing - The role of microbiota in ageing", funded by Programa Operacional de Competitividade e Internacionalização (COMPETE), through Fundo Europeu de Desenvolvimento Regional (FEDER) (POCI-01-0145-FEDER-007628), Fundação para a Ciência e Tecnologia (FCT) (PTDC/BIA-EVL/30212/2017) and under the project UIDB/04501/2020. Catarina A. Silva was supported by the individual Grant UI/BD/152845/2022 from FCT.

Proteomic fractionation in pericardial fluid for discovery proteomics

Luís Perpétuo[†,⋆,1], Fábio Trindade[2], Adelino Leite-Moreira[2], Rui Vitorino[1]

1. Institute of Biomedicine (iBiMED), Department of Medical Sciences, University of Aveiro, Aveiro, Portugal
2. Cardiovascular RD Centre (UnIC@RISE), Department of Surgery and Physiology, Faculty of Medicine of the University of Porto, Porto, Portugal

⋆ Corresponding author; luisperpetuo@ua.pt; † Presenting author; Biomedicine.

Abstract. Background: Coronary artery disease (CAD) is the leading cause of cardiovascular mortality worldwide. Contemporary biomarkers are unspecific for atherosclerotic conditions. Despite the invasiveness of its collection and the high albumin (ALB) content, the anatomical proximity of pericardial fluid (PF), a plasma ultrafiltrate, to the coronaries makes it an attractive platform for the discovery of CAD-specific biomarkers.
Aim: To compare protocols for PF fractionation and assess the potential for discovery proteomics.
Methods: PF was processed using cationic exchange columns, centrifugal concentrators (10 and 30KDa), acetonitrile precipitation (ACN), and ALB/IgG depletion columns. The latter had an additional elution with glycine to obtain an ALB/IgG rich fraction. Protein quantification and SDS-PAGE band profile analysis assessed the yield and expected proteome diversity.
Results: SDS-PAGE gels showed 17 protein bands in centrifugal concentrators fractions (with and without prior ALB/IgG depletion column processing), a range of 0 to 10 bands in cationic exclusion columns fractions, 9 bands in the resulting supernatant from ACN precipitation, 21 bands in ALB poor fraction and 16 bands in ALB rich fraction. Among fractions with ALB, the ALB poor fraction was the one with the least relative ALB content.Conclusion: Despite the protein loss that occurs in the ALB/IgG depletion process (compared to the untreated PF), ALB poors gel band diversity highlights potential advantages in using ALB/IgG depletion columns to identify CAD biomarkers in PF. Furthermore, by ACN precipitation, we achieved a supernatant fraction without high molecular weight (HMW) proteins that had overall less diversity on lower molecular weight (LMW) proteins, but at the same time some bands were more intense in this fraction (60, 45, 40, 30 and lower than 20KDa). These factors might unlock the potential to identify LMW proteins and peptides.

Keywords: *Pericardial Fluid, Coronary Artery Disease (CAD), Fractionation, Proteomics, Peptidomics*

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Acknowledgements. Luís Perpétuo is supported by a doctoral fellowship by FCT (2022.10080.BD)

Biotechnology

Development of strategies towards the sustainable degradation of e-waste.

Diogo A. Ferreira-Filipe[†,⋆,1], Teresa Rocha-Santos[1], Ana L. Patrício-Silva[2]

1. Centre for Environmental and Marine Studies Department of Chemistry, Campus de Santiago, Aveiro
2. Centre for Environmental and Marine Studies Department of Biology, Campus de Santiago, Aveiro

⋆ Corresponding author; diogoaff@ua.pt ; † Presenting author; Biotechnology.

Abstract. Waste electrical and electronic equipment, or e-waste, represents the fastest-growing waste stream in the world, imposing great challenges to environmental sustainability1. This PhD project aims at implementing a stepwise, problem-oriented, innovative approach towards e-waste treatment, with resources recovery for valorisation. For this purpose, microorganisms able to degrade plastics and mobilize metals will be explored for the treatment a printed circuit board- PCB - one of the major challenges in e-waste treatment.As a first approach, we evaluated the biodegradation of PCB microplastics (1-2 mm in size) by the filamentous fungus Penicillium brevicompactum (a species previously found to have plastic biodegradation potential, including plastics used in electronics2. This biodegradation assay endured for 28 days. During this period, an increase in number and decrease in size of microplastic particles were observed, acompained by microplastic mass reductions of up to 75% in the first 14 days and the occurrence of chain scission and oxidation events (assessed through attenuated total reflectance Fourier-transform infrared (ATR-FTIR) spectroscopy). In addition, an increase in the absorption intensities in regions attributable to functional groups associated with carbohydrates (assessed through ATR-FTIR) signals the potential use of these microplastics as a carbon source for the fungus.These findings underline the promising role of fungi such as Penicillium brevicompactum in the biodegradation of e-waste-derived microplastics and represent a basis for research into broader and more sustainable e-waste bioremediation strategies.

Keywords: *e-waste, epoxy-based polymer, printed circuit boards (PCB), microplastics, bioremediation, fungi*

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Acknowledgements. This work was supported by the Portuguese Foundation for Science and Technology (FCT) [grant numbers 2022.11335.BD, CEECIND/01366/2018]; Centre for Environmental and Marine Studies by FCT and the Portuguese Ministry for Science, Technology and Higher Education (MCTES) [UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020]

Pinus pinea pine nut shells as eco-friendly solutions for soilless cultures

Élia Fogeiro[†,1], Conceição Santos[2], Sónia Silva[3], Dulcineia F Wessel[4], Susana M Cardoso[1]

1. LAQV-REQUIMTE, Departamento de Química, Universidade de Aveiro, 3810-193 Aveiro
2. iB2Lab Integrative Biology and Biotechnology Laboratory, Department of Biology, Faculty of Sciences, University of Porto, Rua do Campo Alegre s/n, 4169007 Porto, Portugal
3. LAQV-Requimte, Faculty of Sciences, University of Porto, Rua do Campo Alegre s/n, 4169007 Porto, Portugal.
4. LAQV-REQUIMTE
5. Escola Superior Agrária, Instituto Politécnico de Viseu, 3500-606 Viseu
6. CITAB, Universidade de Trás-os-Montes e Alto Douro, 5001-801 Vila Real

⋆ Corresponding author; † Presenting author; Biotechnology.

Abstract. Conventional agrochemicals such as fertilizers, pesticides, and plant-growth hormones have a recognized role in improving crop yield and quality. However, the impact they cause on the environment and human health is causing the market to shift towards bio-based agrochemicals, once their toxicity to non-target organisms is typically reduced and the risk of developing resistance is decreased. The use of by-products as source of compounds to be used in agriculture are not only environmentally friendly, but also provide economic benefits while creating opportunities for producers and consumers.Pinus pinea L. is a coniferous tree mostly valued for its seeds, ie pine nuts, a product with high market value. Nonetheless, this crop generates by-products that are essentially used to produce energy. These agroforestry by-products are rich in compounds of interest, namely phenolic compounds, terpenes, and sterols that possess bioactive properties with possible applications in plant disease management (Queirós et al., 2020).This work intends to explore P. pinea nut shell extracts to be used as an alternative to synthetic agrochemicals, particularly as antimicrobial agents against phytopathogenic bacteria, herbicides and plant growth promoters. To obtain isolated fractions rich in metabolites of interest, the pine nut shells were submitted to sequential extractions. First, terpenes and sterols were isolated (E1) and the resulting residue was re-extracted to obtain an extract rich in phytohormones and phenolic compounds (E2). The extracts were screened for the antimicrobial potential against bacterial pathogens with scientific and economic relevance. Also, E1 was screened for its potential to be used as a bio-based herbicide against common weeds. Considering that E2 is rich in compounds known to act as plant growth promoters, will be tested on tomato and wheat plants for its potential as biostimulants.Apart from that, aiming an integrated valorization of pine nut shell, the residue from the extractions will be studied as a potential substitute to conventional growing medias used in soilless cultures.

Keywords: *pine nut shell, by-product valorisation, bioactive properties, phytopathogenic bacteria, bio-based agrochemicals*

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Acknowledgements. Acknowledgements: Thanks are due to the Polytechnic University of Viseu, University of Aveiro, and to FCT/ MCTES for the financial support to CERNAS Research Centre, LAQV-, through national funds, and the co-funding by the FEDER, within the PT2020 Partnership Agreement and Compete 2020 and to PRIMA Programme and FCT for the financial support of the Project InovFarmer.MED (Grant Agreement No.1733, FCT/PRIMA/0005/2021). Susana M.Cardoso thanks FCT/MCTES for the labour contract under the Scientific Employment Stimulus Institutional Call. Sónia Silva and Élia Fogeiro thanks FCT for funding through program DL 57/2016 Norma transitória (Ref. DL 57/2016/CP1482/CT0093-DOI:10.54499/DL57/2016/CP1482/CT0093) and PhD grant Ref. 2021.08009.BD, respectively.

Reshaping Marine Collagen Recovery from Fish By-products with Deep Eutectic Solvents

Abolfazl Keshmirshekan[†,1], S.P.M. Ventura[⋆,2], J.A.P. Coutinho[2]

1. Industrial Biotechnology, Biorefinery
2. Biorefinery

⋆ Corresponding author; spventura@ua.pt; † Presenting author; Biotechnology.

Abstract. Collagen stands out as one of the most studied and valued macromolecules, obtained from diverse sources, boasting biocompatibility with minimal cell toxicity, and possessing a remarkable capacity for water absorption which make collagen and its derivatives appealing biomolecules across cosmetic, nutraceutical, and biomedical sectors. The extensive processing of fish often results in substantial amounts of by-products, comprising approximately 70% of the total fish weight, estimated annually at 28 million tons. This waste biomass includes discarded components like fish skin which contains high amount of collagen. The vast wide-ranging use of collagen derivatives like undenatured collagen, gelatine, and collagen hydrolysates, coupled with discussions surrounding religious prohibitions, concerns about zoonotic disease transmission associated with collagen from terrestrial animals, the environmental impact of biomass waste, and the market value of collagen which is expected to grow up to $19.9 billion in 2030, will allow marine collagen emerging as a desirable alternative to mammalian sources. Its widely acknowledged that different extraction methodologies yield a variety of outcomes, and conditions such as solvent selection, pH, time, and temperature, significantly affect the efficiency of extraction, but also the purity, and quality of the collagen(Bai et al., 2017; Bisht et al., 2021).

The existing processes for extracting and purifying marine collagen suffer from low efficiency and limited scalability, posing a significant barrier that must be overcome. Our aim is to understand the effect of materials and methods on the extraction processes and to devise a cost-effective efficient downstream process of marine collagen and its derivatives using Deep Eutectic Solvents (DESs) with aqueous biphasic systems, ultrafiltration, or induced precipitation purification techniques, at maximizing extraction yields while maintaining the highest purity levels, to ensure that all resultant products, whether undenatured collagen, gelatine, or collagen hydrolysates, are not only economically and sustainably viable but also sustainable on a commercial scale.

Keywords: *Marine Collagen, Collagen Type I, Codfish By-Products, Protein, amino-acids, Eutectic solvents, downstream processes, Scale-up*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC).

Three-phase partitioning systems based on biocompatible ionic liquids towards the efficient purification of bacterial RNAs from cell lysates

Ana F. Pereira[†,⋆,1], Augusto Q. Pedro[2], Leonor S. Castro[1], Maria J. Quental[1], Ana P. M. Tavares[1], Luís C. Branco[3], João A. P. Coutinho[1], Fani Sousa[4], Mara G. Freire[1]

1. CICECO Instituto de Materiais de Aveiro, Departamento de Química, Universidade de Aveiro, Portugal
2. 1CICECO Instituto de Materiais de Aveiro, Departamento de Química, Universidade de Aveiro, Portugal
3. LAQV-REQUIMTE, Departamento de Química, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Portugal
4. CICS-UBI Centro de Investigação em Ciências da Saúde, Universidade da Beira Interior, Portugal

⋆ Corresponding author; † Presenting author; Biotechnology.

Abstract. RNA-based biopharmaceuticals have dominated the attention of the scientific community, standing at the forefront of R&D activities toward innovative medicines with a revolutionary impact on a broad range of hard-to-treat diseases. However, several obstacles persist in conventional RNA bioprocessing technologies, namely RNA instability issues, the multitude of contaminants in cell lysates sharing similar chemical and structural features with RNA, and the complexity/cost of purification strategies (Pedro et al., 2018). Amino-acid-based ILs (AA-ILs) may play a significant role in overcoming these obstacles, arising as effective platforms for purifying RNA by exploiting the high versatility of amino acids, either in the creation of more biocompatible ILs, as well as due to their ability to establish preferential interactions with RNA bases (Quental et al., 2019).
This work aims to develop more competitive and cost-effective RNA purification platforms from complex biological matrices resorting to the use of three-phase partitioning (TPP) strategies and ionic liquid-based aqueous biphasic systems (IL-based ABS). A new set of AA-ILs comprising cholinium, L-arginine, L-lysine and L-histidine as cations combined with chloride, DL-aspartate, L-tyrosine, or L-phenylalanine were synthesized and characterized, and the respective ternary phase diagrams with polypropylene glycol were determined. Extraction studies were then performed with complex samples, from which the ABS composed of [Arg]Cl, [Ch][Phe] and [Ch][Asp] stand out as the most promising ones by allowing the selective precipitation of the impurities, representing thus a TPP approach.
Overall, the results show that by tailoring the chemical structure of AA-ILs, RNA was successfully extracted with high yield to the IL-rich phase in the TPP systems, while the impurities precipitated.
Therefore, these strategies represent effective and versatile platforms to fulfill the critical demand of RNA with high integrity, purity, and biological activity with potential use as biotherapeutics.

Keywords: *Biopharmaceuticals, Aqueous Biphasic Systems, Three-phase partitioning, Amino acid ionic liquid, Purification*

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Acknowledgements. This work was developed within the scope of the projects CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC), and the EIC-Pathfinder YSCRIPT project with reference 101047214, supported by the budgets of the Horizon Europe Program. Ana Pereira and Leonor Castro acknowledge FCT for the PhD grants 2022/13247/BD and 2020/05090/BD, respectively. Ana Tavares and Augusto Pedro acknowledge FCT for the research contracts under the Scientific Stimulus Individual Call CEECIND/2020/02599 (DOI 10.54499/2020.01867.CEECIND/CP1589/CT0013) and CEECIND/2020/01867 (DOI 10.54499/2020.02599.CEECIND/CP1589/CT0023), respectively.

Exploiting Avian Immunoglobulin Y (IgY) antibodies to surpass the challenges of Antimicrobial Resistance

Catarina Almeida[†,1], Márcia C. Neves[1], Mara G. Freire [⋆,1]

1. 1CICECO-Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal Institution 2 RYA Purification Technologies, 3830-352 Ílhavo, Portugal.

⋆ Corresponding author; † Presenting author; Biotechnology.

Abstract. The undue and inappropriate consumption of antibiotics met in the past years contributed for the progression of Antimicrobial Resistance (AMR) scenario [1,2]. Within this, Methicillin-resistant Staphylococcus aureus (MRSA) stands out as one of the most dangerous bacteria [1]. Therefore, pursuing alternative therapeutics to the conventional antibiotics, namely biopharmaceuticals, is imperative. Avian Immunoglobulin Y (IgY), an antibody that could be recovered from hens egg yolk, is a promising solution. Owing to its polyclonal nature, IgY recognize numerous epitopes of an antigen, minimizing the resistance event [3,4]. This represents an advantage when using these antibodies for the treatment microbial diseases. Given the exposed, the potential application of IgY as a biopharmaceutical to tackle infectious diseases caused by MRSA was explored in this work. To this end, IgY antibodies targeting the Penicillin-Binding Protein 2a (PBP2a) of MRSA were isolated from the egg yolk of hyperimmune eggs. Anti-PBP2a IgY-based formulations were prepared by combining this active ingredient with conventional protein stabilizers, such as sugars, polyols, or amino acids that were then, maintained under refrigerated and freezing temperature conditions for up to 2 months. The antibody stability in formulation was assessed by monitoring its secondary structure and percentage of aggregates through Circular Dichroism Spectroscopy and Size Exclusion- High Performance Liquid Chromatography (SE-HPLC), respectively. Their recognition ability for the antigen was monitored by dot-blot and ELISA, and their in vitro and in vivo toxicity assessed for human colorectal adenocarcinoma cells and rodent models, respectively. The use of stabilizers in anti-PBP2a IgY-based formulations contributed to decrease the percentage antibody aggregates and to preserve its stability, without compromising the antigen recognition. Furthermore, anti-PBP2a IgY revealed to be non-toxic to either cells or rodents. Hence, this evidence supports the use of IgY antibodies in therapeutic formulations for MRSA infections, allowing to surpass the challenges faced due to AMR.

Keywords: *Antimicrobial Resistance; Methicillin-resistant Staphylococcus aureus; Biopharmaceuticals; Avian Immunoglobulin Y*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020) financed by national funds through the FCT/MCTES (PIDDAC). CA acknowledge FCT for the doctoral grant 2022.11570.BD. MCN acknowledge FCT for the research contract CEECIND/00383/2017/CP1459/CT0031 (DOI 10.54499/CEECIND/00383/2017/CP1459/CT0031).

Heart-on-a-chip: a fully-human 3D printed device for disease modelling and drug screening

Inês A. Deus[†,⋆,1], Catarina A. Custódio[2], João F. Mano[2]

1. Department of Chemistry, CICECO, University of Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro
2.

⋆ Corresponding author; † Presenting author; Biotechnology.

Abstract. According to the World Health Organization, 17.9 million people die every year from cardiovascular diseases, accounting for about 31% of all deaths worldwide.(1) Simultaneously, a large number of drugs are withdrawal from the market due to cardiac side effects that are not detected in early stages.(2) Together, these two factors make heart one of the major targets for the pharmaceutical industry in current times. However, predictive models that recapitulate the human heart physiology in the laboratory are still lacking. Recent advances in 3D cell culture and microfluidic organ-on-chip technologies have demonstrated potential to mimic human tissues in vitro with higher accuracy thus enabling a more reliable assessment of the efficacy and safety of new drugs and therapies. In this regard, natural biomaterials, such as Matrigel, collagen and fibrin, have been largely investigated due to their similarity to the cardiac extracellular matrix(ECM). Also, natural-based bioinks, like GelMA, have been shown promising to produce complex cardiomimetic constructs. Yet, in both cases the use of animal-derived biomaterials remains problematic due of interspecies variabilities.
One possible solution, that has been deeply explored by our group, relates to the use of platelet lysates and perinatal tissues as a source of human proteins to produce photopolymerizable matrices.(3-5) Using this technique we were already able to create 3D cell culture platforms and disease models that are not associated with ethical issues, while being cost-effective and readily-available. During my PhD, I want to further explore the potential of these human-based materials, especially of the amniotic membrane(AM), as a heart-on-a-chip with health and fibrotic features for drug screening applications.

Keywords: *nan*

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Scouting soil saprophytic fungi for the rehabilitation of plastic impacted soils

Laura Carvalho[†,⋆,1], Isabel Lopes[2], Solange Magalhães[3], Paulo Cardoso[2], Cátia Venâncio[2]

1. Department of Biology, University of Aveiro, 3810-193 Aveiro, Portugal
2. CESAM Centre for Environmental and Marine Studies, University of Aveiro, 3810-193 Aveiro, Portugal
3. *University of Coimbra, CERES, Department of Chemical Engineering, 3030-790 Coimbra, Portugal

⋆ Corresponding author; † Presenting author; Biotechnology.

Abstract. Agriculture soils may represent a large reservoir for plastic particles. Current agricultural practices rely on many plastic-based materials for irrigation, mulching, greenhouse planting, just to name a few. Saprophytic fungi are hypothesized to be a promising cleansing strategy due to their role as natural decomposers, thus fitting both as agriculture soil remediators while being eco-friendly. To address this problem, an experiment to assess the biodegradation potential of two saprophytic fungi (Trametes versicolor and Pleurotus sajor caju) on a common plastic material (polyethylene terephthalate - PET) was conducted. Five treatments, each with 4 replicates (T. versicolor only, P. sajor caju only, T. versicolor + PET, P. sajor caju + PET,and PET only) were assembled in 250 mL minireators during 56 days with sampling points every 14 days. The biodegradation process was followed by ammonia production, alkaline phosphatase, and lipase activity in fungi exudates, as well as PET pellets weight and functional groups. Fungi exudates composition changed overtime, and it was different between the two tested species. For instance, ammonia production remained practically unchanged for T. versicolor + PET compared to T. versicolor only, while in P. sajor caju it decreased over time with PET. Regarding the alkaline phosphatase determination, it was observed an increase over time in reactors containing fungi + PET compared to those containing only fungi. Lipase activity increase in T. versicolor+ PET compared to T. versicolor only, whilst the opposite was found for P. sajor caju. Regarding the PET pellets, no significant changes were found in dry weight although FTIR analysis showed an increase in spectrum areas corresponding to the proteins and lipids (functional groups, CH2, CH3) and functional group P=O, and polysaccharides with functional groups C-O-C and C-O-P in P. sajor caju + PET in the 2nd sampling compared to the 1st.

Keywords: *Rot white fungi, Polyethylene terephthalate, Secretome, Trametes versicolor, Pleurotus sajor caju, Sustainability*

Acknowledgements. Thanks are due CESAM financed by national funds through FCT/MCTES (UIDB/50017/2020, UIDP/50017/2020, LA/P/0094/2020) through strategic programs and the LabEx DRIIHMDispositif de Recherche Interdisciplinaire sur les Interactions Hommes-Milieux and OHMIObservatoire Hommes-Millieux International Estarreja for funding the project CLEAR - Resorting to microbial Consortia to restore metal contaminated soils for the area of EstArReja.

Supramolecular human protein-derived granular hydrogels as injectable platforms for wound healing

Bruno M. Ladeira[†,*,1], Maria C. Gomes[1], Catarina A. Custódio[1], João F. Mano[1]

1. Department of Chemistry, CICECO, University of Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro

⋆ Corresponding author; † Presenting author; Biotechnology.

Abstract. Granular materials have become an emergent tool in the field of tissue engineering and regenerative medicine. Formed by jamming microgels into a densely packed state, these materials display intrinsic macroporosity and shear-yielding properties, which are optimal for the development of injectable fillers, support materials for cell delivery or novel bioinks. (Muir et al., 2022; Qazi & Burdick, 2021) However, there are still challenges to overcome regarding the biocompatibility, immunocompatibility, processability and mechanical integrity of these materials.To this effect, we propose here the development of granular materials from human amniotic membrane (hAM), an easily accessible resource that can replicate the properties of native tissues while boasting anti-inflammatory and immunomodulatory properties. (Deus et al., 2020) Bulk hydrogels are first produced through the supramolecular assembly of hAM, and are then fragmented into micro-sized particles. The reversible nature of the supramolecular interactions used to produce the hydrogels allows the granules to reestablish interactions between them over time, generating a self-curing matrix. This grants the material with self-healing properties, allowing it to rapidly recover up to 95% of its original mechanical properties after injection, while also promoting the self-assembly of microgels into a reconstituted bulk structure, forming a transient scaffold that can fill defects and hold cells in place as the surrounding tissue recovers. The composition of the original hydrogels can be adjusted to fine-tune the mechanical properties of the resulting scaffolds. Additionally, the granular material exhibits shear-thinning and thixotropic behaviors, which are optimal to ensure its injectability. When cells are mixed with these materials, it is possible to retain high cell viability rates after injection, indicating that the materials are able to shield cells from shear stress. Finally, the granular materials were able to promote the recruitment of capillaries in an in vivo chick embryo model, evidencing their ability to integrate into surrounding tissues.

Keywords: *Granular materials, injectability, human amniotic membrane, wound healing*

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Acknowledgements. This work was financed by European Research Council grant agreement ERC-2017-ADG-883370 for project REBORN, by the European Unions Horizon Europe research and innovation programme under the grant agreement No. 101079482 (SUPRALIFE) and by the Fundação da Ciência e Tecnologia (FCT) through the individual contract 2020.01647.CEECIND, the doctoral grant 2022.10626.BD and in the scope of project TETRISSUE (PTDC/BTM-MAT/3201/2020). This work was developed at CICECO - Aveiro Institute of Materials, within the scope of project UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MCTES (PIDDAC).

Using thermoreversible aqueous biphasic systems and ionic liquids to improve the manufacturing of mRNA vaccines

Maria I. Sousa[†,*,1], Andreia Correia[1], Mara G. Freire[1], Francisca A. e Silva[1], Augusto Q. Pedro[1]

1.

* Corresponding author; minessousa@ua.pt; † Presenting author; Biotechnology.

Abstract. Messenger RNA (mRNA) vaccines hold promising potential in the prophylaxis and therapeutics of human diseases. However, mRNA vaccines production is still a complex and expensive process, overall requiring improved technologies to produce more stable and widely accessible products while meeting a timely and sufficient manufacturing capacity.
Ionic liquids (ILs) are molten salts comprising organic cations, with a remarkable structural diversity. Properly engineered ILs can improve the stability of RNA and contribute to the achievement of highly selective purification processes when applied as components of aqueous biphasic systems (ABS). From the exposed, this work aims to integrate the production and clarification steps of mRNA vaccines manufacturing processes using IL-based thermoreversible ABS and thus simplifying subsequent purification steps.
Initially, mRNA was produced by in vitro transcription using a T7 polymerase-based cell-free system. ABS formed by dextran from Leuconostoc spp. with an average molecular weight of 450.000-650.000 g/mol (Dex 500), polyethylene glycol (PEG) 3350 g/mol, and ILs as adjuvants were then characterized. These systems display an upper critical solution temperature (UCST) behavior, which renders them promising candidates for the development of the integrated process. Preliminary mRNA extraction experiments using the developed ABS indicate that mRNA is preferentially partitioned toward the Dex-Rich phase, being recovered with high yield and high integrity. However, in the presence of ILs, mRNA partition is altered toward the IL-PEG-rich phase. Overall, promising systems for mRNA purification have been identified, and current work focuses on integrating mRNA synthesis in the most promising IL-based ABS for initial mRNA clarification.
In conclusion, the development of a new integrated production-clarification platform, resorting to thermoreversible ABS comprising ILs, can be used to overcome the challenges of current mRNA vaccines production, namely by lowering costs and environmental impact while improving mRNA stability, yield, and speed of production.

Keywords: *mRNA vaccines; ionic liquids; thermoreversible aqueous biphasic systems; in vitro transcription*

Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). Augusto Q. Pedro and Francisca A. e Silva acknowledge FCT respectively, for the research contracts CEEC-IND/02599/2020 (DOI 10.54499/2020.02599.CEECIND/CP1589/CT0023) and CEEC-IND/03076/2018 under the Scientific StimulusIndividual Call. Maria I. Sousa acknowledges FCT for the PhD grant 2022.11476.BD.

Unveiling MSCs osteodifferentiation patterns across donors through non-invasive NMR exometabolomics

Daniela S. C. Bispo[†,⋆,1], Mariana B. Oliveira[1], João F. Mano[1], Ana M. Gil[1]

1. Department of Chemistry, CICECO - Aveiro Institute of Materials (CICECO/UA), University of Aveiro, Campus Universitario de Santiago, 3810-193 Aveiro, Portugal.

⋆ Corresponding author; d.bispo@ua.pt; † Presenting author; Biotechnology.

Abstract.
The secretion profile of mesenchymal stem cells (MSCs) is a major driver of their therapeutic effects (e.g. in bone regeneration).[1] However, some secretome constituents, namely metabolites, are still largely unexplored.[2] In this context, Nuclear Magnetic Resonance (NMR) exometabolomics may reveal new information on MSCs osteodifferentiation [2,3] and clarify how the secretome reflects intracellular behavior. This non-invasive strategy provides a means to monitor differentiation, in addition to traditional testing (key gene/protein markers).Here, untargeted NMR metabolomics was applied to monitor exometabolome changes of human adipose-derived mesenchymal stem cells (hAMSCs) from 3 different donors throughout 21 days of osteodifferentiation, compared to proliferation alone (controls). For all donors, both osteogenesis and proliferation involved i) consumption of glucose, glutamine, pyruvate, serine, and branched-chain amino acids (BCAAs), and ii) secretion of several energy-related compounds (e.g. Krebs cycle intermediates, creatine, phosphocreatine and lactate), BCAAs breakdown products, ornithine and histidine. During osteodifferentiation, cells underwent evident changes in metabolic activity, increasing the secretion of lactate, ornithine (byproduct of Cr synthesis and precursor of polyamines) and pyroglutamate, while reducing the consumption of several amino acids (including glutamine and BCAAs), pyruvate and glucose. This suggests a glycolytic downregulation with redirection of pyruvate towards reduction to lactate, instead of oxidation for Krebs cycle entry. Exometabolome results were articulated (Spearman correlation) with endometabolome changes in the same cells, providing further insight into the above-mentioned energy metabolic switch, as well as adaptations in cell membrane metabolism, antioxidative protection and creatine biosynthesis. The donor-independent features unveiled in this work may be exploited to monitor cell osteogenic ability and advance potential metabolic candidates for media optimization towards osteocommitment enhancement.

Keywords: *Osteogenic Differentiation; NMR metabolomics; Exometabolomics; Non-Invasive monitoring;*

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Business and economics

Digitalisation and Country Profile: Towards a Framework for the promotion of Nigeria National Image

Dauda Adegoke Adejumo[†,1]

1. University of Aveiro

⋆ Corresponding author; † Presenting author; Business and economics.

Abstract. Digitalisation can significantly impact a country's image, transforming the perception of its economic competitiveness and cultural identity (Benoit Denis, 2022). Digital technologies can help countries to showcase their unique attributes and achievements through websites, social media platforms, and digital marketing campaigns. This digital storytelling allows countries to influence perceptions among key stakeholders, including tourists, investors, policymakers, and the global community. Digitalisation has democratised access to information, empowering individuals and communities to participate in shaping their country's image (Ahmed et al., 2021), but it has also brought new risks as regards misinformation, cyber-attacks, and online reputation management. Despite these challenges, the extant literature emphasises the importance of authenticity, storytelling, and digital diplomacy in shaping global perceptions. Understanding how countries use digital tools to shape their image is crucial for policymakers, marketers, and scholars. Subsequently, a provisional conceptual framework for primary research in Nigeria that will examine the interplay of digitalisation and country image.The research objectives are role of digital technologies in shaping a countrys image, analyze how digital technologies have impacted Nigerias image, including issues relating to cybersecurity and develop and validate a digital technology framework for the promotion of Nigerias image. This research will be conducted in Nigeria, selected for its significant demographic and economic attributes. Nigeria, the most populous country in Africa, is home to over 200 million people, providing a rich and diverse demographic for the study. Economically, Nigeria boasts the largest economy in Africa, driven by sectors such as oil and gas, agriculture, and services. The country's growing technology sector, marked by a thriving startup ecosystem, adds another layer of relevance to the study. Nigeria's political landscape, characterized by diverse phases including military rule, democratic transitions, and ongoing security challenges such as insurgency in the northeast and communal conflicts, provides a comprehensive backdrop for analysing the influence of digitalization on the national image (World Bank, 2020). It is a mixed-method research approach, combining deductive and inductive approaches to address research objectives. All data will be processed using the Statistical Package for Social Sciences (SPSS) version 23. The expected result would be an improved and dynamic portrayal of Nigeria on the global stage, leading to increased investment, tourism, and opportunities for national development.

Keywords: *Digitalisation, Country Image, Provisional Conceptual Framework, Digital Transformation*

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Acknowledgements. No funding

Integration of biodiversity and ecosystem into Ocean Total Economic Value (TEV) Approach: A Systematic Review

Altaf Akbar[†,1], Ana isabel lillebø[⋆,2]

1. Student
2. Principal Investigator with Aggregation

⋆ Corresponding author; † Presenting author; Business and economics.

Abstract. Introduction:
The assessment of ecosystem services (ES) and biodiversity in general has turned out to be a significantly compulsory area of research as the awareness of the importance and profits of the fields have been realized recently (Mace, Norris and Fitter, 2011). However, while considering the difference between the concepts of ecosystem services and biodiversity valuation of the former is commonly evaluated through TEV (Damodaran, 2007), but scaling and scope of biodiversity is different (Paul et al. 2020).
Problem Addressed:
While considering the socioeconomic importance of biodiversity (Lillebo et al. 2017), it is of great importance to quantify the biodiversity in order to empirically examine the importance of biodiversity. Therefore, one of the dominant approaches in literature is TEV but it is more closely linked with the valuation of ecosystem services. Therefore, it is required to integrate both concepts into TEV approach.
Suggested Solution for the Problem:
In order to address the research problem, a detailed analysis is required. In this regard, one of the foremost solutions to address the problem would be conduction of detailed review of the existing literature. This would help in structuring the commonalities among ES and Biodiversity which ultimately help in development of TEV for quantification of economic benefits of biodiversity.
Methodology and Materials Used or to be Used:
Since it has been decided to conduct a detailed literature review to address the research problem and therefore, systematic literature review would be most suitable (Nightingale, 2009). It is one of the widely acceptable and used type of literature review. In this regard, the research problem will be divided into different keywords and searched in the Scopus most commonly and popularly used abstract and citation database (Alexander, 2020). The collected papers will be reviewed and information will be collected to address the research problem.
Results:
Expected results of the study would be a detailed guideline for the usage of TEV for quantification of economic value of biodiversity benefits.

Keywords: *Biodiversity, Ecosystem, Total Economic Value, Marine Economy*

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A GESTÃO DA QUALIDADE NO ENSINO SUPERIOR ANGOLANO

Nicolay Africano[†,1], Maria João Pires da Rosa[⋆,1]

1. Aveiro

⋆ Corresponding author; m.joao@ua.pt; † Presenting author; Business and economics.

Abstract. A gestão da qualidade no subsistema do Ensino Superior em Angola tem sido alvo de crescente interesse motivado pelo impacto na performance das instituições do setor. As instituições de ES em Angola, considerando que são instituições de carácter multidimensional, isto é, envolvem uma diversificação de funções e atividades (ensino e programas académicos, investigação, recursos humanos, estudantes, infraestruturas e meio académico) deveram procurar instrumentos necessários para o auxílio da melhoria dos serviços que prestam a comunidade académica.

Recorreremos a uma metodologia mista, apoiada por elementos da variável qualitativa como: Fontes documentais; revisão bibliográfica dos conteúdos teóricos que suportam a investigação empírica, bem como análise de documentos legais da instituição (legislação sobre o Ensino Superior, estatutos, regulamentos da instituição). A abordagem quantitativa envolverá a aplicação de um questionário aos gestores das IES Angolanas.

Propusemos a realizar o presente estudo, pelo facto do estudo primário realizado, mostrar a necessidade de mecanismos ligado a garantia da qualidade dentro das IES, bem como criar uma ferramenta especifica que ajuda as mesmas no processo do sistema interno da qualidade.

Pretende-se que o trabalho de investigação proporcione ao Ministério do Ensino Superior Angolano e às IES angolanas um enquadramento capaz de orientar os seus esforços na implementação de mecanismos internos e externos de garantia de qualidade, promovendo a cultura da melhoria continua no subsistema de ensino superior.

Keywords: *Ensino Superior, Sistema Interno de Garantia da Qualidade, Norma ISO 9001:2015, Angola.*

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Analyzing financial literacy: Determinants, challenges, and solutions

Bárbara Carvalho[†,1], Mara Madaleno[1]

1. University of Aveiro, Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP), Campus Universitário de Santiago, 3810-193, Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Business and economics.

Abstract. Financial literacy is the set of competencies and skills in the financial area, assuming an understanding of financial products and concepts, and the ability to identify risks and make informed decisions. There is no concrete method for measuring financial literacy, but it can be measured as financial knowledge, behaviors, and attitudes (Vidoviová, 2021).
Individuals with less education, especially women, and young people between the ages of 18 and 29 are more susceptible to financial illiteracy (Bucher-Koenen & Lusardi, 2011). Those over 60 also show lower financial knowledge and economic well-being (International Survey of Adult Financial Literacy, 2020). Between the ages of 30 and 59, financial well-being is highest (International Survey of Adult Financial Literacy, 2020).For Portuguese individuals, it was concluded that a higher level of financial literacy exists when compared to the notion of financial risk. Academic business training is also associated with a better level of financial literacy (Santos & Tavares, 2020).
The creation of financial literacy educational programs has been identified as the main solution to overcome illiteracy (Huston, 2010), and these programs should be included from an early age in educational institutions (International Survey of Adult Financial Literacy, 2020). Although financial education is seen as a solution, it is important to note that individuals behave according to their personal preferences (Goyal & Kumar, 2021) and according to the culture of their country (Faulkner, 2022).
The digitalization of financial services has created opportunities for individuals to manage their finances (Banco de Portugal, 2023), but there is a lack of knowledge to take full advantage of these opportunities (Aziz & Naima, 2021), thus giving rise to digital financial illiteracy. A higher level of digital skills positively influences the level of financial literacy (Kumar et al., 2022).
Of the determinants of financial literacy that have already been studied, the following stand out: Level of education (Jappelli, 2010); Academic background in economics/finance (Pang, 2010); Gender (Grimes et al., 2010) and Age (Monticone, 2010).
On the other hand, some factors such as Motivation (Mandell & Klein, 2007); Political Ideology (Walstad & Rebeck, 2002); Region (Koshal et al., 2008); Marital Status (Monticone, 2010); Professional Status (Monticone, 2010); Ethnicity (Grimes et al., 2010); and Work Experience (Koshal et al., 2008) - present contradictory results and have not yet been defined as determinants or not of financial literacy. Therefore, one of the contributions of this study will be to fill this gap in the literature.

Keywords: *nan*

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Acknowledgements. This work was financially supported by the Research Unit on Governance, Competitiveness and Public Policies (UIDB/04058/2020) + (UIDP/04058/2020), funded by national funds through FCT - Fundação para a Ciência e a Tecnologia.

The economics of happiness and climate change: a quantitative approach

Margarida Casau[†,⋆,1], Marta Ferreira Dias[1], Gabriel Leite Mota[2]

1. DEGEIT, Departamento de Economia, Gestão, Engenharia Industrial e Turismo, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. Instituto Superior de Serviço Social do Porto, Av. Dr. Manuel Teixeira Ruela, 370,4460-362 Senhora da Hora, Portugal

⋆ Corresponding author; amcasau@ua.pt; † Presenting author; Business and economics.

Abstract. As the importance of environmental sustainability and well-being has risen on the global agenda, so has the interest in understanding the intricate relationships between them. The conceptual framework underlying this association rests upon the field of economics of happiness - a discipline that stresses the broadening of traditional economic analyses by accounting for more holistic measures of utility, encompassing non-income related facets that influence individual well-being (Agrawal et al., 2023). This paradigm acknowledges that the relentless pursuit of GDP growth can sometimes overshadow detrimental societal implications, particularly environmental degradation and increasing disparities (Fleurbaey, 2012; Hayden and Wilson, 2016). In fact, integrating happiness metrics into economics can lead to more comprehensive policy-making, balancing economic growth with environmental sustainability and societal well-being (Stern and Stiglitz, 2023). Well-being captures the essence of human existence, binding together strands of happiness, quality of life, human development, and welfare. Researchers and policymakers have increasingly acknowledged the role of well-being in influencing climate change mitigation strategies (Creutzig et al., 2022). While the present paradigm of climate change mitigation pivots around temperature goals and emission constraints, the intersections of human needs, quality of life, and resource utilization within societies have yet to be thoroughly integrated. Well-being should be a pillar in climate change mitigation research, offering invaluable insights into creating equitable, just, and sustainable pathways to a low-carbon future (Ferreira and Moro, 2010; Lamb and Steinberger, 2017).
This research employs a robust quantitative approach, utilizing data from the European Social Survey (ESS) Round 10 (2020). The study applies econometric modeling to analyze the impact of various environmental indicatorssuch as air quality, climate extremes, and nature connectednesson subjective well-being (SWB) across European countries. Key control variables include socio-economic and demographic factors such as age, gender, income, and education. The primary quantitative method used is Ordinary Least Squares (OLS) regression, chosen for its interpretability and robustness in estimating the relationships between the predictors and the dependent variable, life satisfaction. The research findings underscore the significant impact of environmental quality on happiness levels.This paper contributes to the broader dialogue on sustainable development and well-being, advocating for 'beyond GDP' indicators that incorporate environmental and social considerations into measures of societal progress. It presents a compelling case for a paradigm shift in policy-making and research, emphasizing the integration of environmental factors into the understanding of human happiness and the development of effective climate change mitigation strategies.

Keywords: *Economics of happiness, Well-being, Sustainability*

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Acknowledgements. This work was supported by the research unit on Governance, Competitiveness and Public Policy (UIDB/04058/2020) + (UIDP/04058/2020), and by the PhD grant no. 2023.00282.BD, funded by national funds through FCT - Portuguese Foundation for Science and Technology.

Business and innovation

Technologies for increasing the capacity utilization of transport logistics trucks

Markus Messmer[†,1], Prof. Ana Moura[2], Prof. Rui Borges Lopes[⋆,3]

1. University of Aveiro, Portugal
2. INESC-Coimbra and GOVCOPP Research Centres
3. DEGEIT / CIDMA, University of Aveiro

⋆ Corresponding author; rui.borges@ua.pt; † Presenting author; Business and innovation.

Abstract. Transport logistic is undergoing a fundamental change in business. Increasing cost and green deal requirements are forcing the transport industry to better utilize available resources. In addition to these major challenges, millions of kilometres are driven by trucks in Europe with unused capacity. In order to develop practicable solutions for this task, a research project was set up consisting of the following three sub-projects: (1) technology assessment for cargo weight recognition, (2) technology assessment for cargo volume recognition and (3) the Cargo Pilot software. This contribution provides an overview of sub-projects 1 and 2, from the initial technology analysis to the preparation of tests in real traffic.

Keywords: *empty runs, vehicle route planning, driving patterns, logistics transports, telematics*

Acknowledgements. Author Markus MeSSmer would like to thank Prof. Dr. Dudek from DHBW Baden-Wurttemberg State University for his mentoring and the DHBW Center for Digitalization in Mobility Systems. Author Rui Borges Lopes would like to thank the support by The Center for Research and Development in Mathematics and Applications (CIDMA) through the Portuguese Foundation for Science and Technology (FCT - Fundação para a Ciência e a Tecnologia), references UIDB/04106/2020 (https://doi.org/10.54499/UIDB/04106/2020) and UIDP/04106/2020 (https://doi.org/10.54499/UIDP/04106/2020).

The Development of an Information Technology Architecture for Automated, Agile and Versatile Companies with Ecological and Ethical Guidelines

Klaus Kuehnel[†,⋆,1], Manuel Au-Yong-Oliveira [2]

1. PhD Student
2. INESC TEC, GOVCOPP, Department of Economics, Management, Industrial Engineering and Tourism

⋆ Corresponding author; klauskuhnel@ua.pt; † Presenting author; Business and innovation.

Abstract. Based on many years of experience as a management consultant in different industries and corporate structures and cultures, the motivation to use digital transformation in connection with variable corporate goalssuch as fluctuating workloads, agile response to customer inquiries, and ecological and economic sustainabilityresults in a process or a product to be developed that intelligently adapts to market requirements and requires forward-looking leadership. Using an AI-based methodical analysis and synthesis approach, the high consumption of economic and human resources is to be continuously monitored and optimization measures initiated at an early stage. The necessary information technology with its infrastructure and architecture is the starting point to accompany the agility and changeability of corporate goals. Researching the relevant documents begins with writing the panorama or the state of knowledge on the topic. This article is about the IT infrastructure based on the requirements for an architecture and behavior that a versatile, agile company needs to accompany the constantly changing framework conditions of the market. The technology used and the available resources, including the human resources, need to be adapted as early as possible. Data now represent the most valuable asset on Earth and future industrial manu-facturing systems must maximize the opportunity of data usage. Low-level data must be trans-formed to make them useful in supporting intelligent decision-making, for example. Furthermore, future manufacturing systems must be highly productive, adaptable, absent of error, and kind to the environment and to local communities. The all-important design should minimize the waste of material, capital, energy, and media. Herein, we discuss the fulfilling of agile customer require-ments involving adaptable and modulated production processes (related to the agile manufactur-ing and digital transformation perspectives).

Keywords: *agile manufacturing; manufacturing information systems; digital transformation; mod-ulated production processes; VOSviewer*

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Green Innovation Within the Framework of Circular BioEconomy Practices: A Review

Beatriz Sobral Hoffmann-Kuhnt[†,1], Bárbara Coelho Gabriel[1], João Marques

1. Universidade de Aveiro, Rua de S. Tiago, 3810-193 Aveiro

⋆ Corresponding author; barbara.gabriel@ua.pt; jjmarques@ua.pt; † Presenting author; Business and innovation.

Abstract. Achieving sustainability within the agri-food sector requires the integration of green innovation and actionable circular bioeconomy practices (Alfano et al., 2023; D'Amato et al., 2017; Kaszycki et al., 2021). This approach is crucial for reshaping the use of natural resources in the production of goods and services, aiming to reduce environmental impact through eco-friendly methods and resource efficiency. Key elements of this transformation include eco-innovation, the development of resource-efficient green technology solutions, and the promotion of bio-based innovations (Kaszycki et al., 2021). Examples include using bio-solutions to create sustainable products, thereby reducing dependency on fossil resources (Weiland et al., 2024). Circular principles further support this approach by advocating for designs that promote material reuse, repurposing, recycling, and regeneration, thus minimizing waste and the demand for primary resources. To accelerate the transition towards a circular bioeconomy, targeted policy frameworks, regulatory interventions, and support mechanisms, such as the EU Green Deal of Innovation and the Farm-to-Fork strategy, are essential (Wagh et al., 2024). The integration of green innovation and circular bioeconomy practices highlights the importance of interdisciplinary collaboration, stakeholder engagement, and systemic approaches for advancing towards an environmentally conscious economy. This approach is essential for resilience in the face of contemporary social, economic, and climate challenges (Wagh et al., 2024). Building on this foundation, the central research question is: How can the integration of green innovation and circular bioeconomy practices be strategically activated to enhance sustainability within the agri-food sector? Additionally, what are the key drivers, challenges, and opportunities associated with this transition? Data will be collected from journals and literature reviews, incorporating relevant case studies. Note: Only key references are included due to space limitations. Full list available on request.

Keywords: *agri-food; green innovation; circular bioeconomy; green deal; farm-to-fork*

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Acknowledgements. I'd to express my gratitude to Prof.Bárbara Coelho Gabriel and Prof.João Marques for their guidance and insightful feedback. Their expertise has been instrumental in shaping the direction and quality of my work. I deeply appreciate their mentorship which continue to enrich my understanding and development as a researcher.

An assisted group decision-making model for reaching hard consensus in multi-national organizations

Ricardo Lopez[†,1], Rui Borges Lopes[⋆,1], Sergio Tavares[1]

1.

⋆ Corresponding author; † Presenting author; Business and innovation.

Abstract. Resources in organizations are finite, but the complexity of their decisions is not. The number of factors influencing decision-makers (DM) is often unquantifiable. Several factors hinder the ability to make effective and efficient decisionsindividual interests, personal preferences, or heuristics, among other influencing factors, impact DMs (Wang et al., 2022). Decision-making in large multi-stakeholder settings, requiring hard consensus, is usually a lengthy process compounded by the epistemic uncertainty of DMs (Herrera-Viedma et al., 2014). Moreover, the dynamics and variation in the types of information considered in the decision-making process add to the complexity (Bashir et al., 2018; Goepel, 2018). In decision-making scenarios where applying stakeholder knowledge-based consensus through aggregation built on expertise weight is not possible, a decision support model combining Multi-Criteria Group decision-making (MCGDM) as an objective methodology with known assessment criteria, together with Multi-Objective Group Decision Making (MOGDM) as subjective methodology to handle unknown or uncertain stakeholder objectives is used. Furthermore, a consensus-reaching process (CRP) utilizing a dynamic consensus approach (DCA) to achieve consensus by iterative acceptance, rather than agreement of shared knowledge, is applied. Finally, preliminary results of a model utilizing a Total Impact Value (TIV) process to quantify the relative priority of a decision as compared with the alternatives are given.

Keywords: *Group decision-making, Consensus, Uncertainty, Multi-Criteria*

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Promoting innovation through an autonomous digital quality and risk management system for medical device manufacturers

Guilherme Semedo[†,⋆,1]

1. Programa Doutoral em Inovação em Empresas

⋆ Corresponding author; guilhermesemedo@ua.pt; † Presenting author; Business and innovation.

Abstract. The European Union (EU) has the second-largest medical device market, accounting for 26.4% of the global share, just below the USA's 46.6%. Medical technology is a central force driving innovation, being the second sector with the most patents submitted to the European Patents Office. (MedTech Europe, 2023)
In 2017, the regulatory landscape for medical devices in the EU changed dramatically with the implementation of the Medical Device Regulation (MDR) and in vitro Diagnostic Medical Device Regulation (IVDR). While these regulations are critical for advancing healthcare standards and improving patient safety, they significantly increase the regulatory burden and the difficulty of achieving compliance. (Carl & Hochmann, 2023) Given that 92% of the medical device manufacturers in the EU are small and medium-sized enterprises, there is a clear struggle to meet these new regulatory demands, particularly in clinical evaluation, risk management, and post-market surveillance. (MedTech Europe, 2023)
As a result, innovation projects are being discontinued, and enhancements to existing products are often halted. EU manufacturers are increasingly looking towards regions with quicker and more predictable regulatory processes, such as the USA. (Ben-Menahem et al., 2020)
This project aims to improve the industry's approach to innovation by developing an automated medical device risk management system enhanced by Artificial Intelligence, supported by a digital quality management system. This system will streamline regulatory compliance by automating critical processes such as risk management, thereby reducing the burden on manufacturers.
The academic component of this project will be based on extensive literature review and validation studies intended to: (1) Identify challenges faced by EU medical device manufacturers, (2) Assess existing similar solutions, (3) Understand how medical device certification entities approach automated quality and risk management systems, and (4) Assist in the validation of the platform.
The deliverables of this project will contribute to a better understanding of the challenges faced by EU medical device manufacturers and assist in developing a solution that can enhance EU competitiveness, drive innovation, and improve patient outcomes in the medical device sector.

Keywords: *Medical Device; Risk Management; Quality Management; Innovation; Artificial Intelligence*

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Acknowledgements. I gratefully acknowledge the support of Critical Catalyst for the invaluable contribution to this research. I also express gratitude to my supervisors for their expertise, insights and encouragement.

Maximizing the value of university-driven online communities for entrepreneurship

Andrés Rueda[†,1]

1. University of Aveiro

* Corresponding author; † Presenting author; Business and innovation.

Abstract. Social networks shape entrepreneurship by facilitating resource acquisition and project implementation, with weak ties playing a crucial role in connecting individuals to diverse opportunities. Online platforms offer entrepreneurs new spaces for community-building to expand their social capital and drive innovation. Simultaneously, digital entrepreneurship has emerged as a new research field to explore, i.a., technology's impact on entrepreneurial processes. Universities, as key stakeholders in entrepreneurship ecosystems, are increasingly using online communities to support different entrepreneurial activities and increase founders social capital.

Scholars debate the nuances of building social capital offline versus online. While multiple contacts and weak ties offer access to diverse resources, stronger ties are usually necessary to efficiently acquire them. Online communities serve as vital pathways for resource access; however, accumulating online ties doesn't ensure entrepreneurial success, and the impact of online social networks on entrepreneurship remains limited. The novelty of digital entrepreneurship calls for further study, particularly regarding the role of online social ties, as well as the usage of online communities and platforms in venture creation and development. This research deals with the question of how to maximize the value of online communities to foster university-driven entrepreneurship.

The expected outcome of the research is the development of a theoretical framework (artifact) to maximize the role of online communities on digital platforms to support entrepreneurs. The research adopts a mixed-methods approach guided by Design Science Research (DSR). DSR involves iterative cycles of problem explication, requirement definition, artifact design and development, artifact demonstration, and artifact evaluation. DSR follows a five-step procedure including problem explication, requirement definition, artifact design, artifact demonstration, and artifact evaluation.

Keywords: *nan*

Case-based Axiomatic Design Assistant (CADA): Combining Axiomatic Design and Case-Based Reasoning to create a Design Knowledge Graph for pharmaceutical engineering

Roland Wölfle[†,⋆,1], Leonor Teixeira [1], Irina Saur-Amaral [1]

1. University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro

⋆ Corresponding author; rolandwoelfle@gmx.de; † Presenting author; Business and innovation.

Abstract. Modern pharmaceutical production facilities are mainly designed to manufacture one type of drug per production line. Emerging concepts, such as personalised medication, require faster market time and enhanced flexibility in manufacturing processes. These requirements raise new uncertainties and risks, which can be minimised using structured design methods to mitigate these challenges in developing new equipment. Design within a regulated environment poses specific requirements regarding the traceability of information and decision-making processes. The relationships between problems and solutions become critical when they impact product quality. The initial conceptual design phase lays the foundation for developing complex production equipment and for the successful implementation and production outcomes. This study aims to develop a design methodology that facilitates the analysis of requirements, structured reasoning and the evaluation of solutions, thereby supporting the engineering of pharmaceutical production equipment. The research proposes a novel design methodology and workflow to systematically organise the steps of conceptual Design. Axiomatic Design is used for its simplicity and graphical tools for quality evaluation. Integrating data structure and continuous improvement from the Case-Based Reasoning provides an additional layer of necessary complexity. This combination is put into practice in the shape of a visual assistant, which uses a knowledge graph to represent the design elements holistically. The proposed Case-based Axiomatic Design Assistant (CADA) is a novel design methodology with an easy-to-use workflow and advanced graphical capabilities, whose usage is exemplified in the context of pharmaceutical manufacturing.

Keywords: *Pharma Equipment, Axiomatic Design, Case-Based Reasoning, Knowledge Graph, Design*

Catalyzing Business Innovation in the Pharmaceutical Industry: Developing a Change Management Model for Good Manufacturing Practice (GMP) Environments

Andreas Wingendorff[†,⋆,1]

1. Doctorate of Business Innovation

⋆ Corresponding author; andreas.wingendorff@ua.pt; † Presenting author; Business and innovation.

Abstract. The pharmaceutical industry operates within a complex web of stringent regulations adhering to Good Manufacturing Practices (GMP). While traditional change management models exist, they often lack the specificity required to address the pharmaceutical sector's unique challenges and opportunities (Fischer & Breitenbach, 2013). It outlines the need for a tailored change management model specific to the regulated GMP pharmaceutical industry sector to address unique challenges and opportunities. The proposed project aims to explore how a tailored change management model can drive business innovation, improve adaptability and ensure regulatory compliance in the pharmaceutical industry, thus developing a new change management framework.Established models such as Kurt Lewin's 3-Stage Model (Burnes, 2019) and John Kotter's 8-Phase Model (Kotter, 2011) were not explicitly designed to be inapplicable in regulated environments. A preliminary literature search within Scopus, Web of Science, and EMBASE databases revealed a paucity of evidence regarding change management models specifically tailored for the Good Manufacturing Practice (GMP) environment. The majority of retrieved results were not directly applicable to the current research focus, which aims to develop a change management model that addresses the unique challenges of implementing innovative methods and fostering a culture of change within the pharmaceutical industry. This finding aligns with the author's professional experience, suggesting a significant gap in the existing literature and underscoring the need for further research in this area.By leveraging data analysis and behavioral insights, the study seeks to develop a Change Management-Model that fosters innovation and long-term success in this highly regulated landscape The aim of the Project is to equip change managers in the pharmaceutical industry with a model to implement change successfully and innovatively.This study will employ a mixed-methods research design, integrating both qualitative and quantitative data collection strategies to comprehensively explore the change management landscape within the pharmaceutical industry. Quantitative data will be gathered through surveys administered to pharmaceutical employees, while qualitative insights will be elicited via semi-structured interviews with subject matter experts within the organizations. This approach allows for triangulation of findings, enhancing the validity and reliability of the research results (Johnson & Onwuegbuzie, 2004).

Keywords: *Change Management, Business Innovation, Pharmaceutical Industry, Good Manufacturing Practice, GMP, Process Optimization*

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The development of fire brigade training facilities at various state levels in Germany and Austria

Muhammad Samer Rida[†,1], Nuno Lopes[⋆,2], Paulo Silva[3]

1. DBI- Doctorate in Business Innovation
2. Department civil engineering
3. department of social, political and territorial sciences

[⋆] Corresponding author; nuno.lopes@ua.pt; [†] Presenting author; Business and innovation.

Abstract. The development of fire brigade training facilities at various state levels in Germany and Austria.
The management of fire services in Germany and Austria falls under the jurisdiction of district and municipal administrations as per state regulations [2]. This includes overseeing the education of fire brigades, with responsibilities distributed across state, district, and municipal levels. As technology advances and the number of fire brigades growsdespite fewer fire incidentsthere is a need to periodically update fire training facility standards.
To keep training up to date, administrations may need to renovate existing facilities or build new ones according to the latest standards [1]. However, funding and resource constraints often make the construction or renovation of fire stations and training facilities a lower priority for governments managing multiple projects. These financial and bureaucratic challenges can delay project completion, even though such facilities often offer significant cost-saving opportunities and are a valuable investment within the fire station construction sector.
The development of a new planning tool that integrates modern software, artificial intelligence, and Building Information Modeling (BIM) represents a significant step forward in building planning and execution. This tool incorporates functionalities of existing software for modeling fire training facilities and planning information based on standards from various authoritative bodies including the German Institute for Standardisation and the Austrian Guideline for the Construction of Fire Stations. It also considers regional building codes and the architectural integration of facilities into urban or rural settings, ensuring the functionality and support of modern technologies and equipment.
This advanced approach allows governments and private investors to plan more economically, optimizing costs and promoting sustainable development. The tool not only connects and summarizes architectural design software but also incorporates various regulations and analyses different training scenarios for professional, volunteer, or company firefighters. The planning and design of these facilities and the tool itself are part of a broader research initiative spread across three papers. A prototype of this tool will serve as a platform to aid decision-making, offering a customizable approach that will be applied not only in Germany and Austria but also benchmarked against international standards from countries like the USA, Australia, Portugal, and others. This will enhance local fire training facility standards by adapting best practices and innovative solutions.

Keywords: *Fire Training Facilities, Building Information Modeling, BIM, artificial intelligence, AI, Tool, Fire Brigade, Fire Station, Architecture, Planning*

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Acknowledgements. I would like to offer my thanks to the professors and colleagues at the doctoral school at the University of Aveiro, as well as to my supervisors

Relevance of AI compliance for autonomous driving and how explainable AI can leverage the scale up

Lucas Bublitz[†,⋆,1]

1. University of Aveiro

⋆ Corresponding author; lucas.bublitz@p3-group.com; † Presenting author; Business and innovation.

Abstract. Autonomous driving technology is advancing rapidly, accompanied by a wave of regulations in major markets such as the EU, China and the US. Regulatory requirements for AI compliance pose significant challenges for the development of self-driving systems (SDS). Due to the high-risk classification of AI based on the forthcoming EU Implementing Act for the Harmonized Rules on Artificial Intelligence used in SDS development, the complexity of ensuring compliance with evolving regulations is strongly increasing. Explainable AI (XAI) is a critical pillar that supports the process of complying with AI regulations. It is proving to be a critical enabler for companies striving to achieve AI compliance in autonomous driving. Explainable AI provides transparency and interpretability of the technology and decision-making processes of AI. By implementing explainable AI, regulators, companies and other stakeholders gain a better understanding of the logic behinde the self driving technology, which contributes to the a smoother validation requirements, reporting processes to authorities and implementation of requirements by affected companies.
The presentation addresses the effect of AI on autonomous driving, compare the existing AD regulation and upcoming AI regulation and normalization efforts and aligns them with the result of a stakeholder study in a framework for Autonomous Driving/Mobility. It mandates a guide for stakeholders in the autonomous driving ecosystem to proactively address regulatory complexity, implement efficient processes to meet regulatory requirements, and accelerate the safe deployment of self-driving vehicles at scale through the use of explainable AI. Therefore it points out the impact of XAI on different regulative use cases just as the homologation approach or the field supervision.

Keywords: *Field Monitoring, Autonomous Vehicles, Machine Learning (ML) / Deep Learning (DL),Self-Driving System, Safety, XAI, Explainable AI, Regulation*

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The challenges of digitalisation the role of leadership, culture and technology empirical evidence

Thorsten Schölver[†,⋆,1], Marco Pimpao[2], Leonor Teixeira [3]

1. Ph.D. Student
2.
3. University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro

⋆ Corresponding author; t.schoelver@ua.pt; † Presenting author; Business and innovation.

Abstract. Digitalisation is one of the key drivers of today's business. A SLR conducted in the context of this thesis revealed that issues with business models functions and processes, are already being dealt with in multinational companies, with SMEs lagging behind. While different maturity models of overall Industry 4.0/digitalisation targets are presented in the literature, little is known about the transformation/implementation of these models, and the few studies that report on it neglect the main driver of sustainable results the alignment of leadership, culture and the inclusion of technology. (Pech & Vrchota, 2020)

To address this gap, this thesis proposes a clearly defined transformation roadmap tailored for SMEs to enhance their supply chains by improving process efficiency and resource utilization (Chonsawat & Sopdang, 2017). The roadmap aims to empower SMEs to overcome their inherent disadvantages compared to larger corporations.

The initial analysis from the SLR suggests that the literature insufficiently addresses the linkage between digitalisation, leadership, and corporate culture. There are scant examples of holistic transformation approaches that consider these elements as a coordinated triad. Existing maturity models typically focus on individual aspects without considering their synergistic application.

Practically, the research develops a transformation model that identifies critical weaknesses in SMEs, including know-how and resource availability. It simplifies and aligns the model closely with SME business practices, ensuring accessibility and applicability.

Progress to date includes conducting and partially analyzing five out of eight expert interviews. These interviews aim to empirically verify the proposed model and explore the significant impact of the leadership, technology, and culture triad on digital transformation success.

In conclusion, this research will contribute a systematic process to address the digitalisation challenges faced by SMEs, enabling them to independently develop and execute a coherent digitalisation strategy.

Keywords: *SMEs, Digitalisation, Transformation Roadmap, Industry 4.0.*

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Acknowledgements. Acknowledgements

This work was supported by the Institute of Electronics and Informatics Engineering of Aveiro (IEETA) [grant agreement number UIDB/00127/2020], funded by national funds through FCT - Fundação para a Ciência e a Tecnologia.

The author gratefully acknowledge Leonor Teixeira
Associate Professor
Department of Economics, Management and Industrial Engineering and Tourism (DEGEIT) / Institute of Electronics and Informatics Engineering of Aveiro (IEETA)
University of Aveiro, Portugal
lteixeira@ua.pt
Marco Pimpão
Adjunct Professor
Escola Superior de Tecnologia e Gestão de Águeda (ESTGA)
University of Aveiro, Portugal
pimpao@ua.pt

Addressing key challenges on integrating AI to research on physician communications

Beny Rubinstein[†,*,1], Sérgio Matos[2]

1. DBI - Escola Doutoral da Universidade de Aveiro Reitoria - Universidade de Aveiro Edifício Central e da Reitoria | Campus Universitário de Santiago | 3810-193 Aveiro | Portugal
2. Department of Electronics, Telecommunications and Informatics (DETI) and Institute of Electronics and Informatics Engineering of Aveiro (IEETA), Portugal

[*] Corresponding author; benyr@ua.pt; [†] Presenting author; Business and innovation.

Abstract.
Large language models (LLMs) have contributed significantly and meaningfully to the advancement of natural language processing. Artificial intelligence (AI) for medical research is rapidly advancing thanks to models like GPT-4, Med-PaLM2, and Llama (Large Language Model Meta AI). These models have the potential to significantly improve healthcare through AI. Biomedical information retrieval, question answering, medical text summarization, information extraction, and medical education are among the areas where they are applicable in medicine. (Tian et al., 2024) Recent studies have evaluated the quality of LLM responses to questions on biomedical and clinical knowledge. (Chen et al., 2024) We intend to investigate their potential for communication with other experts and physicians, even though the current focus has mainly been on scenarios with LLM-assisted communication with patients. With that, we expect to better understand both the potential value and the risks associated with the utilization of LLMs, potentially chatbots or AI agents, in the context of patient cases.
Our approach requires an analysis of conversations between physicians to assess how AI can create value. Given the challenges of accessing real-world data, we propose a methodology for data augmentation that generates synthetic physician conversations from metadata describing real inter-physician case discussions. Using these synthetic data, we will explore innovative ways to integrate AI as decision-supporting conversational agents during physician discussions.
Our preliminary results will be a starting point for advancing research on this topic, while minimizing issues related to data privacy and/or bias. As these are common issues in medical research, we expect to devise a more suitable approach to the analysis of physician conversations using AI, which could also be relevant to a broader community of AI medical researchers.

Keywords: *Artificial Intelligence, LLM, NLP, Privacy, Physician communications, Synthetic data*

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Performance management system architecture for effective social impact measurement schemes

Daniela Moldoveanu [†,1]

1. University of Aveiro

[*] Corresponding author; [†] Presenting author; Business and innovation.

Abstract. Measuring Corporate Sustainability (CS) has been identified as an important enabler for integrating sustainability into corporate practices (Pazienza et al., 2023). Different methodologies and frameworks for measuring CS have been developed in the literature with limited success. Similarly, despite the importance of social impact to social entrepreneurship, standards for measuring an organizations social impact (SI) are underdeveloped on both theoretical and empirical grounds (Pazienza et al., 2023). Sustainability Balanced Scorecard (SBSC) architecture has been under review on both theoretical and empirical grounds to effectively incorporate sustainability related themes. (Hansen et al., 2016; Hahn et al., 2018)This thesis proposal aims to address the identified gaps following a sequential process where the first step is to assess the nature of current limitations in the measurement of CS, SI through a Systematic Literature Review process, the second step is to design the measurement proposal and test it in a Case Study approach and as a final third step, to present and test the management performance system to support it.

Expected contribution (i.e Systematic Literature Review, Paper 1) in the first step takes the form of guidelines that need to be incorporated when aiming to effectively operationalize a measurement scheme for CS, SI. In the second step (i.e Foundational Ground for Effective, Standardized and Integrated Social Impact Measurement Approach, Paper 2), the expected contribution is defining and testing the characteristics needed for the essential qualities in SI measurement. The final step (i.e Performance Management System for Social Impact Measurement, Paper 3) aims to contribute with the operational infrastructure required for effective target setting, tracking and monitoring.

The novelty behind the process is two folded: it addresses the currently unsettled gap in academia when it comes to measuring CS,SIM and in the same time, it is a fully integrated approach (i.e from measurement scheme to management performance system to support it). At its core, its intended to serve a practical need with an approach that is standardized, operational and integrated in the business process.

Keywords: *social impact measurement, corporate sustainability measurement, sustainability balanced scorecard, integrated and standardized approach*

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Acknowledgements. The author gratefully acknowledge Irina Saur-Amaral Professor

CIMAD & ISCA - Universidade de Aveiro, NECE-UBI - Universidade da Beira Interior, isaur@ua.pt
and Carla Ferreira,
ProfessorTEMA - University of Aveiro, Portugal, carlasusana@ua.pt

Car Manufacturers Competitiveness in Future Mobility: A Systematic literature Review

Ramin Sh. Amiri[†,1], Irina Saur-Amaral [2], Margarida C. Coelho [2]

1. DBI
2.

⋆ Corresponding author; † Presenting author; Business and innovation.

Abstract. The changing landscape of the automotive industry, which is characterised by connected, automated, electric, and shared mobility, and the subsequent challenges have already been addressed by some researchers. However, to the best of our knowledge, there has not been a comprehensive account of how established vehicle manufacturers are doing business and how new rivals are challenging this business. Two research questions have been formulated: How do Established Car Manufacturers (ECMs) conduct business? How do new rivals threaten ECMs? We use a systematic literature review approach, performed on ISI Web of Science Current Contents, with a final sample of 73 studies. The findings show that the business practices of ECMs and new rivals can be categorised into organisational aspects of the product development. Future research directions include assessing impacts outside of vehicle and services R&D and cross-industry comparative analysis.

Keywords: *Car manufacturer; Automotive; firm; company; Future mobility; New rivals; Systematic literature review; competition*

The Green Finance Dilemma: No Impact without Risk A Multiple-Case-Study on Renewable Energy Investments

Laura Grumann[†,⋆,1], Mara Madaleno[2], Elisabete Vieira[3]

1. https://orcid.org/0000-0003-2501-9755 PhD Student in Business Innovation Campus Universitário de Santiago, 3810-193, Aveiro, Portugal
2. https://orcid.org/0000-0002-4905-2771 Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP), DEGEIT Department of Economics, Management, Industrial Engineering and Tourism, Universidade de Aveiro, Portugal,
3. Unidade de Investigação em Governação, Competitividade e Políticas Públicas (GOVCOPP), Instituto Superior de Contabilidade e Administração da Universidade de Aveiro (ISCA-UA)

⋆ Corresponding author; † Presenting author; Business and innovation.

Abstract. The transition to a carbon-neutral European Union (EU) economy requires innovation in technology and huge financing efforts from the public and private sectors, increasing the relevance of and interest in green finance. At the latest, European sustainable finance regulation on sustainability preferences (Delegated Regulation (EU) 2021/1235) made green finance a mainstream topic for retail investors. Among others, sustainability preferences refer to economic activities supporting climate change mitigation and adaptation as defined in the EU taxonomy (Delegated Regulation (EU) 2023/2486). The European Central Bank (ECB) published a working paper on financial markets and green innovation that reflects climate goals dependency on technological innovation (Aghion et al., 2022).

Given the venture characteristics of green innovation on the one side and retail investors' characteristics on the other side, we assume a dilemma. Green innovation is largely discussed as bearing risks, and renewable energy projects are related to high risk by one strand of the literature. Our article aims to shed light on retail investors‘ risk exposure in green finance. We address this question by reviewing green finance literature first. We find few articles mentioning retail investors at all (Bourcet & Bovari, 2020; Polzin & Sanders, 2020; Ringel & Mjekic, 2023). Only Ringel and Mjekic (2023) dedicate their research to the role of banks as intermediaries addressing the retail investors and commenting on the gap between a retail investors risk profile and the high-risk perception of renewable energy projects. Second, we take a multi-case study approach to deep dive into green finance risk related to renewable energy projects.

In case analysis, we follow a new approach and decompose green finance risk (GFR) into risk components related to the type of financial instrument (FIR), the investee company (ICR), and the operational risk (OR) of renewable energy projects. The cases analyzed demonstrate that a toxic mixture of risky financial instruments, poor governance within the investee company, and operational risk related to renewable energy projects caused major losses for retail investors. Thanks to a better understanding of green finance risk, we provide red flags that may alert future retail investors and suggest measurements for green finance risk mitigation. Our results contribute to green finance literature and mark a starting point for future research since our results are limited to the scope of selected cases. Especially quantitative research could test the significance of our findings.

Keywords: *Green Finance, Green Innovation, Green Finance Risk, Retail Investor, Multiple Case Study*

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Acknowledgements. This work was supported by the Research Unit on Governance, Competitiveness and Public Policies (UIDB/04058/2020) + (UIDP/04058/2020), funded by national funds through FCT - Fundação para a Ciência e a Tecnologia.

Chemical engineering

Recycling of multilayer plastic packaging using green solvents and supercritical fluids

Luanna Maia[†,1], Anareth Cavuquila[2], Andreia Dias[2], Adélio Mendes [3], Carlos Manuel Silva[2], Ana Barros-Timmons[⋆,4]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, Campus de Santiago 3810-193 Aveiro, Portugal
2. CICECO - Aveiro Institute of Materials
3. LEPABE Laboratory for Process Engineering, Environment, Biotechnology and Energy, Faculty of Engineering
4. CICECO Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract. The widespread use of plastics is unquestionable, as they are essential in various areas of modern daily life due to their versatility, adaptability, and affordable cost. Such dependence highlights the critical importance of developing sustainable methods for plastic waste management, promoting the principles of a circular economy (Bucknall, 2020).
Plastic packaging materials play pivotal roles across various industries, owing to their exceptional barrier properties and durability. However, the complex structure of multilayer plastics, which typically combine various polymers and sometimes inorganic materials, presents substantial challenges for traditional recycling processes (Kaiser et al., 2018).
Conventional recycling methods often rely on solvents that may have harmful environmental impacts and struggle to separate and recover high-quality materials from these composites effectively (Cabrera et al., 2022; Kaiser et al., 2018). This inefficiency leads to severe ecological concerns, particularly in waste management and sustainability practices. A global push towards sustainability intensifies the urgency to address these issues and reduce reliance on non-renewable resources.
Considering this, this work investigates advanced techniques for recycling multilayer plastic waste, focusing on the potential of green and supercritical solvents. The objective is to evaluate the viability of these alternative solvents in yielding materials suitable for food packaging applications while meeting stringent regulatory standards. Ultimately, this study seeks to develop an environmentally sustainable process characterized by minimal toxic emissions and potentially enhancing the recovery of virgin polymers.

Keywords: *nan*

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Supercritical CO2 extraction as an option for the recovery of transition metals from end-of-life smartphones

Cátia Afonso [†,1], Carlos M. Silva[1], Cláudia B. Lopes [⋆,1]

1. CICECO-Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; claudia.b.lopes@ua.pt ; † Presenting author; Chemical engineering.

Abstract. The escalating use of electrical and electronic equipment (EEE) worldwide has led to a rapid increase in the production of electronic waste (e-waste), which is expected to reach 120 million tons by 2050 (Xia & Ghahreman, 2024). This surge underscores the critical need for sustainable strategies to manage e-waste and recover valuable metals. Recycling end-of-life electronic devices is a key solution to avoid critical metal depletion and promote a circular economy (Shahabuddin et al., 2023). Electronic waste represents a reservoir of valuable materials, including metals, glass, and plastics. Therefore, efficient recovery methods are crucial. This study aims to develop an efficient and sustainable method for recovering metals from end-of-life smartphones using supercritical CO2 modified with organic acids and complexing agents to enhance metal solubility and extraction efficiency (Bertuol et al., 2020; Wu et al., 2022). In addition, ultrasound-assisted and conventional leaching techniques are being explored, with an emphasis on replacing hazardous inorganic acids with environmentally friendly (bio)organic alternatives (Reisdörfer et al., 2020). By providing alternative, sustainable routes for recycling valuable metals, the findings of this research will have significant international relevance in addressing the pressing challenges of e-waste management and resource conservation.

Keywords: *nan*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). C. Afonso also acknowledges financial support from FCT through the Ph.D. grant (2023.02929.BI), and CBL for her researcher contract (DOI 10.54499/2021.03739.CEECIND/CP1659/CT002).

Biological valorization of spent frying oil through PHAs production by mixed microbial cultures

André Oliveira[†,⋆,1], Sílvia Petronilho[2], Mário Coelho[1], Luísa S. Serafim[2]

1. CICECO - Aveiro Institute of Materials, Chemistry Department, University of Aveiro, Aveiro, Portugal
2. LAQV-REQUIMTE, Department of Materials and Ceramic Engineering, University of Aveiro, Aveiro, Portugal
3.

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract. Annually, several tons of food frying waste derived from household and restaurant kitchens and industrial processes are neglected potentiating environmental concerns. One of such waste is spent frying oil (SFO) which is produced at high volumes, although part of it is redirected to biodiesel. However, due to its chemical nature and toxic compounds, SFO treatment in wastewater treatment plants (WWTP) is difficult. In this work, the possibility of producing short-chain organic acids (SCOAs) from SFO through acidogenic fermentation (AF) was evaluated (Oliveira et al., 2023). Herein, SFO, transport tank wastewater (ER), and an SFO alkaline hydrolysate, with 76% yield and 100% of free fatty acids (FFA), were used as substrate. SFO revealed a triacylglycerides content of 97.9%, with oleic (49.1%), linoleic (26.6%), and linolenic (14.5%) acids as main constituents, and 2% of FFA. ER revealed a total nitrogen concentration of 1.990 g/L, where 0.229 g/L corresponded to nitrate concentration, and 7.58% and 9.34% of volatile and total solids, respectively. Two inocula were used to determine the most suitable for AF: an aerobic (AES) and an anaerobic (ANS) sludges from a municipal WWTP, at food to microorganism (F/M) of 1 g COD/g VSS. Promising results were revealed through the production of a high diversity of SCOAs, with the assays with ER resulting in a faster SCOAs production. This work revealed the potential of lipid-based substrates to produce SCOAs through AF, that can be further used as feedstock for PHAs bioproduction, while reducing waste and pollution, following the circular economy concept.

Keywords: *Short-Chain Organic Acids, Food Frying Waste, Mixed Microbial Cultures, Polyhydroxyalkanoates*

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Acknowledgements. Thanks are due to the University of Aveiro and FCT/MCTES for the financial support of CICECO-Aveiro Institute of Materials (UIDB/50011/2020, UIDP/50011/2020, LA/P/0006/2020) and LAQV-REQUIMTE (UIDB/50006/2020, UIDP/50006/2020, LA/P/0008/2020) research units, through PT national funds, and when applicable, co-financed by FEDER, within the PT2020 Partnership Agreement and Compete 2020. FCT is also thanked for the PhD grant 2023.01406.BDANA (AO). SP thanks its research contract to the project FAIST Fábrica Ágil, Inteligente, Sustentável e Tecnológica (Project no. 66 with application C644917018-00000031). The Portuguese companies Resiway, SA and SIMRia are also acknowledged for supplying food frying waste and WWTP sludges, respectively.

RemAb: Reshaping mAbs biomanufacturing with ProA alternatives

João Vasco Valente[†,⋆,1], Emanuel V. Capela[2], Ana C. A. Sousa[3], João P. Coutinho[1], Mara G. Freire[1]

1. CICECO Aveiro Institute of Materials, Chemistry Department, University of Aveiro, 3810-193 Aveiro, Portugal
2. CICECO- Aveiro Institute of Materials
3. CHRC Comprehensive Health Research Centre and Department of Biology, University of Évora, Évora, Portugal

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract. Society has been facing an increased prevalence of non-treatable or hard-to-treat diseases, which are expected to continue increasing due to an aging society and a rise in emerging infectious diseases. This trend stresses the need for cost-effective therapeutic and diagnostic solutions. Monoclonal antibodies (mAbs) are powerful tools in medicine, being key players in therapy and diagnosis. However, contrarily to chemical drugs, biopharmaceuticals, e.g. mAbs, are produced by living cells and, consequently, more challenging to produce, purify and preserve, translating into higher costs. Indeed, biopharmaceuticals are generally 12x more expensive than chemical drugs (Gooch et al., 2017). The traditional mAbs manufacturing encompasses the upstream processing, corresponding to cell cultivation, in which cells propagate and the target biomolecules are produced, and the downstream processing, which typically include 6 unit operations: (i) clarification; (ii) capture (protein A (ProA) chromatography); (iii) viral inactivation; (iv) polishing steps (two chromatography steps); (v) virus removal; and (vi) enrichment/conditioning for preservation (Capela et al., 2017). However, the current strategy faces three main bottlenecks: the higher cell density cultures that lead to undesired mAb aggregates and places an extra burden on the downstream processing, the need for multiple steps in the downstream processing with the utilization of highly cost affinity chromatography steps with biological ligands, and the high facility footprint due to batch operation. To overcome these drawbacks, the exploration of alternative techniques that prioritize simpler, cost-effective, and continuous processes is being pursued by using ionic liquids throughout the entire mAbs production, including cell cultivation, clarification, capture, polishing and conditioning for preservation. The tailoring of the optimal ligands will be assisted by the application of computational simulations, such as molecular docking.

Keywords: *Antibodies; Downstream Processing; ProA substitutes; Computational simulation.*

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Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Uncovering the scale-up drawbacks on the recovery of proteins from algae and their valorization as peptides

Bárbara M.C. Vaz[†,1], Sónia P.M. Ventura[⋆,1]

1. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract. Protein hydrolysates are a purified form of proteins consisting of oligopeptides, peptides, and amino acids that are obtained by partial or complete hydrolysis (Nasri, 2017). Depending on the final application, proteins can be commercialized as heterogeneous mixtures of peptides with different molecular weights, suitable for specialized foods, infant and sports nutrition, dietary supplements, and cosmetics, or as bioactive peptides, a purer fraction of proteins with a specific molecular weight (Soto-Sierra et al., 2018). These exhibit numerous biological functions (antioxidant, antihypertensive, immune-modulatory, anti-cancer, hepatic protective, and anticoagulant activities) with potential opportunities to substitute synthetic compounds and develop pharmaceuticals and medical applications for the prevention and treatment of diseases (Admassu et al., 2018). However, an increase in animal and plant consumables production alone will not be viable to meet protein demand.
The use of algal biomass emerges as an alternative protein source with higher protein content (~50 %) compared to common protein sources like soy (37 % DW protein), milk (26 % DW protein), meat (43 % DW protein), and yeast (39 % DW protein). In addition, it contains valuable nutritional properties, low allergenicity, and production and growth advantages over terrestrial biomass (Soto-Sierra et al., 2018)(Geada et al., 2021). Besides the potential of algal biomass as a sustainable and renewable feedstock for the production of high-value compounds, downstream processing still represents an economic obstacle. Recently, deep eutectic solvents (DESs) were applied in the solid-liquid extraction of proteins as performance boosters (Yue et al., 2021). DES are composed of a hydrogen bond acceptor and a hydrogen bond donor that are prepared by mixing natural starting materials with high melting points, in different molar ratios, to form a liquid.
Therefore, the novelty of this work is developing an efficient and economically viable downstream process from lab to pilot scale to extract and purify proteins and their hydrolysates from two different algae.

Keywords: *Deep eutectic solvents; Peptides; Solid-liquid extraction; Process simulation; Scale-up; Algae*

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Customized ionic liquid patches for efficient and non-invasive transdermal delivery of messenger RNA vaccines

João L. Fernandes[†,1], Augusto Q. Pedro[1], Mara G. Freire[1]

1. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract. mRNA vaccines are regarded as the missing link to address conventional vaccines limitations due to their improved safety, highly efficient immune responses, lower time-to-market demands, and potential application to non-infectious diseases (Pardi et al., 2018). They were among the first to receive regulatory approval during the COVID-19 pandemic and were crucial to combat this public health crisis (Szabó et al., 2022). However, they are still challenged by the lack of thermostability due to the stringent cold chain requirements during storage and transportation, as well as the low patient adherence due to pain caused by parenteral administration (Baryakova et al., 2023; Uddin & Roni, 2021). Leveraged on the ability of ionic liquids (IL) to stabilize RNA and improve drug permeation across the skin, this project aims to fabricate biocompatible ionogel patches envisioning the non-invasive transdermal delivery of mRNA with enhanced mRNA stability. To achieve this goal, a set of Tasks was designed, initially comprising the production of the target mRNA sequence by in vitro transcription followed by the synthesis and cytotoxic evaluation of bio-based ILs. The most promising IL candidates will then be applied in the fabrication of suitable ionogel patches by combining the selected ILs with a biocompatible polymer, and the loading of mRNA will be optimized. In the end, the biocompatibility of mRNA-loaded ionogels patches will be evaluated onto human cell lines, and their performance to permeate the model mRNA vaccine candidate evaluated ex vivo. Fabricated under the light of sustainability concepts and by requiring less stringent cold chains while being adaptable to various diseases, the successful development of this work will respond to international policies on public health and will contribute to economic growth.

Keywords: *Messenger RNA vaccine; ionic liquid patch: transdermal drug delivery; non-invasive systemic administration;*

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Unlocking the potential of polymeric ionic liquids as chromatographic supports for recombinant protein downstream processing

Leonor S. Castro[†,1], Augusto Q. Pedro[1], Márcia C. Neves[1], Isabel M. Marrucho[1], Mara G. Freire[1]

1.

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract. In recent decades, the development of novel therapeutics such as protein-based biopharmaceuticals allowed major progress in the treatment of chronic illnesses with unprecedented efficacy and safety profiles. This has led to longer lifespans and better overall health of the population. A successful example is the case of interferon alpha-2b (IFN-2b), which is often used to manage chronic hepatitis C and holds a significant impact on the global therapeutic proteins market. However, the widespread use of biopharmaceuticals is still challenged by the complex and costly manufacturing processes (Castro et al., 2021), especially for the downstream stages still encompassing multi-step and expensive chromatographic processes. In this field, efforts have been made to develop effective chromatographic supports and ligands, such as in the case of polymeric ionic liquids (PILs). These PILs result from the polymerization of polymers and/or IL, and due to the high degree of structural diversity, and chemical structures of ILs, these new materials present a wide variety of chemical structures and physicochemical properties (Jacinto et al., 2018). Therefore, this work aims to synthesize and characterize novel PILs, and their application in column liquid chromatography for the purification of the biopharmaceutical IFN-2b directly from the culture broth. Initially, PILs were prepared by ionic exchange between poly(diallyldimethylammonium) chloride solution and several ILs and characterized using techniques such as Fourier-transform infrared spectroscopy (FTIR) and thermogravimetric analysis (TGA) (Tomé et al., 2013). Afterwards, the new materials were packed into a Tricorn column and applied in the purification of IFN-2b obtained using Komagataella phafii X-33 harboring the pPICZ vector coupled with a secretion signal for the secreted expression of IFN-2b in a broth containing 0.1% of Tween 80. Overall, the results obtained so far demonstrate that the PILS act as typical hydrophobic resins, being able to selectively elute the recombinant protein using a decreasing stepwise ammonium sulfate gradient.

Keywords: *biopharmaceuticals; interferon; purification; preparative chromatography; polymeric ionic liquid*

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(DOI 10.54499/2020.02599.CEECIND/CP1589/CT0023) and CEECIND/00383/2017/CP1459/CT0031 (DOI 10.54499/CEECIND/00383/2017/CP1459/CT0031).

Enzymatic pathway for enhanced polydopamine-based coatings

Flávia F. Magalhães[†,1], Maria Laura Alfieri[2], Mara G. Freire[3], Ana Paula Tavares[1], Lucia Panzella[2]

1. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, Aveiro, Portugal
2. Department of Chemical Sciences, University of Naples Federico II, Naples, Italy
3. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract.
Laccases (EC 1.10.3.2) are multicopper enzymes that use molecular oxygen to catalyse the oxidation of several substrates, such as phenolic compounds and aromatic amines (Jeon et al., 2012). Laccases are used in a wide range of industrial and biotechnological processes, including the synthesis of polymers (Debnath & Saha, 2020). Among them, polydopamine (PDA) is an added-value biopolymer produced from dopamine polymerization, used in the modification and functionalization of surfaces with biomedical applications (Ding et al., 2016). In contrast to the conventional method of dopamine polymerization, which is chemical-based, time-consuming and produces PDA films with poor stability, the production of PDA using laccase improves the efficiency and rate of the process, fulfilling some green chemistry principles (Magalhães et al., 2022). However, on an industrial scale, it is relevant to develop novel methods to allow biocatalyst recovery and reuse. In this field, aqueous biphasic systems (ABS), which are liquid-liquid systems mainly composed of water, appear as a promising alternative since they provide a mild and biocompatible environment for biocatalysts (Magalhães et al., 2021). This work aims to optimise glass PDA coating using laccase as a biocatalyst and explore the use of ABS to improve the process.
Glass and quartz were coated using dip-coating technology using a solution with dopamine and laccase. Several parameters for the enzymatic production of PDA and film deposition into the glass, including stirring velocity, dopamine and laccase concentration, were tested. The polymerization process was monitored with ultraviolet-visible (UV-Vis) spectroscopy. In addition, enzymatic polymerization using ABS (composed of polymer and salt) as a reaction media was explored by testing different dopamine and laccase concentrations. Biocatalyst recovery and reuse were explored in the ABS. Compared to traditional methods, enzymatic polymerization of dopamine proves more efficient, requiring lower dopamine concentrations for film formation. Using laccase in PDA polymerization reaction is a promising tool to elevate the polymerization processes and enhance material coating.

Keywords: *Laccase, Polydopamine, Material coating, Aqueous Biphasic System*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). Ana Tavares acknowledge FCT for the research contract CEECIND/01867/2020 (10.54499/2020.01867.CEECIND/CP1589/CT0013). Flávia Magalhães acknowledges the SPQ/FCT PhD grant SFRH/BD/150669/2020.

Análise do potencial papeleiro da madeira de Eucalyptus saligna angolana

Ramos Afonso Bangui[†,1], Dmitry Evtyugin[⋆,1]

1. Departamento de Química, Universidade de Aveiro, 3810-193, Portugal

⋆ Corresponding author; dmitrye@ua.pt; † Presenting author; Chemical engineering.

Abstract. A madeira de eucalipto é considerada particularmente interessantes dentro da indústria da pasta e papel, utilizada como matéria-prima em vários países, garante uma boa qualidade ao produto final, essencialmente devido a sua composição química. Em Portugal, a espécie de eucalipto mais plantada é o Eucalyptus globulus, representando 95% da área florestada de eucalipto, contribuindo significativamente como matéria-prima nacional na indústria da pasta e papel (Pereira, 2012). Diferente de Portugal, em Angola a espécie mais plantada é o Eucalyptus saligna, o país ainda não possui uma indústria nesta área, portanto, a madeira é usada essencialmente para construção de imoveis e queima (Matas, 2011). Dentre as duas espécies de eucalipto, a madeira de Eucalyptus globulus plantada em Portugal é a que foi mais amplamente estudada, e apresenta muito potencial para produção de pasta e papel. Porém, já existem alguns estudos, embora muito superficiais, de caraterização química da madeira de Eucalyptus saligna angolana que indicam algum potencial (Penín, 2020). Este projeto de investigação centrou-se mais recentemente na caraterização química detalhada desta espécie de eucalipto, foi dada especial atenção ao teor e a estrutura química dos componentes da madeira, nomeadamente o teor de lenhina, extratáveis, celulose e hemicelulose. O teor de lenhina determinou-se através do método de Klason (28,9% m/m), os extratáveis pela extração etanol:tolueno (1:2, v/v) (4,5% m/m), celulose foi seguindo a abordagem de Kürschner-Höffner (47,9% m/m) e as pentosanas pelo método do brometo/bromato (19,5% m/m). Com tudo, esta etapa do projeto ainda está em investigação, pretende-se utilizar a extração NaOH 0,1molar (M) antes de se determinar o teor de lenhina, pois alguns extratáveis (por exemplo, composto polifenólicos) que não saíram com etanol:tolueno (primeira extração), possivelmente contribuíram para o alto valor do teor de lenhina. Relativamente ao cozimento da madeira, de acordo com os ensaios preliminares, observou-se que não é viável cozer a madeira de Eucalyptus saligna para índice K baixo (<16), consome-se muito reagente, obtém-se uma viscosidade relativamente baixa e perde-se algumas propriedades papeleiras. Portanto, o principal foco deste trabalho consiste em encontrar as condições ótimas de produção de pasta e papel da madeira de Eucalyptus saligna angolana e comparar com a pasta e papel de Eucalyptus globulus produzido em Portugal.

Keywords: *Eucalyptus saligna, cozimento kraft, propriedades papeleiras*

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New developments in emulsion polymerization towards improved PVC products

Liliana Lameiras[†,⋆,1], Joana Marques[2], Ana Barros-Timmons[3], Fernão Magalhães[4], Arnaldo Tomás[5]

1. CICECO-Aveiro Institute of Materials, Chemistry Department, 3810-193, Aveiro University, 3810-187Aveiro, Portugal
2. Companhia Industrial de Resinas Sintéticas, CIRES, LDA, Rua da Cires Nř8, 3960-160 Avanca, Portugal
3. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, Aveiro, Portugal
4. LEPABE, Chemical Engineering Department, Porto University, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal
5. ALiCE Associate Laboratory in Chemical Engineering, Faculty of Engineering, University of Porto, Rua Dr. Roberto Frias, 4200-465 Porto, Portugal

⋆ Corresponding author; liliana.lameiras@ua.pt; † Presenting author; Chemical engineering.

Abstract. Poly(vinyl chloride) (PVC), is one of the oldest synthetic polymers, its history dating back to 1835. It can be industrially produced via three methods: emulsion, bulk, and suspension. (Endo, 2002) Emulsion PVC (E-PVC) represents 12 % of the total PVC production and is used to manufacture products such as synthetic leather, flooring, sealants, and automotive coatings. The synthesis involves, in addition to the vinyl chloride monomer (VCM), water-soluble initiators and anionic emulsifiers. The nature and concentration of the emulsifiers play an important role in the particle size distribution (PSD) and in the latex colloidal stability. (Fischer, Schmitt, Porth, Allsopp, & Vianello, 2014) PSD is determinant for some characteristics of the final products, and thus the final applications portfolio. Bimodal distributions with particles of larger average diameters results in plastisols (mixture of PVC resin and plasticizer) with lower viscosity. (Ko, Kong, & Namgoong, 2018) Residual VCM is a volatile organic compound (VOC) that must be removed from the latex during the PVC production process. Taking into account the environmental concerns, it becomes crucial to enhance latex colloidal stability in order to promote more effective removal of residual VCM, because the latex is submitted to vapor injection to remove the residual VCM and others VOCs. Furthermore, the properties of the emulsifiers used, such as chain length or ionic or non-ionic nature, influence the fogging index and the amount of VOCs released by a polymer sample. (Endo, 2002)
The aim of this work is to develop new PVC products, based on a a new system of emulsifiers, in order to: (i) manipulate the particle size distributions, providing better control of plastisol rheology, and (ii) improve the colloidal stability of latexes, thus promoting the reduction of fogging index and VOCs.

Keywords: *Emulsion polymerization, vinyl chloride, particle size distribution, latex stability, VOCs.*

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Acknowledgements. The financial support of FCT, PRT/BD/154504/2022, is gratefully acknowledged. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC) and supported by national funds through FCT/MCTES (PIDDAC): LEPABE, UIDB/00511/2020 (DOI: 10.54499/UIDB/00511/2020) and UIDP/00511/2020 (DOI: 10.54499/UIDP/00511/2020) and ALiCE, LA/P/0045/2020 (DOI: 10.54499/LA/P/0045/2020)

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Integrated process for the recovery and purification of recombinant messenger RNA vaccines resorting to ionic liquids

Ana S. C. Marques[†,⋆,1], Augusto Q. Pedro[1], Ana P. M. Tavares[1], Mara G. Freire[1]

1.

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract. Messenger RNA (mRNA)-based vaccines, crucial in combating COVID-19 pandemic, offer a promising alternative beyond traditional vaccines. Current production via in vitro transcription (IVT) is costly and supply-chain dependent, posing challenges for large-scale and high-quality manufacturing (Rosa et al., 2021). Therefore, it is essential to create a reliable and efficient mRNA production process ensuring product integrity and purity. Yeasts, as safe (GRAS) eukaryotic organisms, are promising alternatives as recombinant microfactories for mRNAs, being currently under investigation for this purpose (Yscript, 2023). This work aims the development of a cost-effective and integrated extraction-purification process of mRNA bioproduced from yeasts resorting to biobased ionic liquids (ILs). ILs have been widely used as a tool to concentrate, extract and purify biopharmaceuticals (Dinis et al., 2023). Built upon the improved ability of ILs to dissolve several types of biomass, these compounds have already been applied to promote the lysis of yeasts and microalgal envisaging the recovery of bioactive intracellular compounds (Mussagy et al., 2019). If properly engineered, IL-based aqueous biphasic systems (ABS) can be designed as effective RNA extraction-preservation platforms and the biocompatible nature of adequately designed ILs tuned to improve the RNA stability (Quental et al., 2019). This work foresees the production of mRNA through recombinant technology, yeast cell disruption using ILs and initial clarification (simultaneous concentration and pre-purification) using IL-ABS. Preliminary results indicate that some ILs were able to promote yeast cell disruption and to successfully extract the mRNA of interest. Overall, it is expected that the integrated extraction-purification platform under development will lead the way towards more sustainable manufacturing processes of mRNA vaccines by allowing a decrease in the number of purification steps and keeping/improving the biological performance.

Keywords: *mRNA vaccine, Bioprocess, Ionic liquids, Extraction, Integrated process*

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Exploring technological solutions using alternative solvents for stabilizing natural pigments from algae

Alexandra Conde[†,1], Sónia P. M. Ventura[⋆,1]

1. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

[⋆] Corresponding author; [†] Presenting author; Chemical engineering.

Abstract. Now, there is a serious environmental crisis, and it is essential to change habits to preserve the environment and avoid disastrous consequences.
One of the measures implemented is the industrial replacement of synthetic by natural products. A good example here are the colorants. These are mainly used to make products more appealing, whether in food/feed, cosmetics, or pharmaceuticals but they are generally synthetic, based on petroleum and metals. Replacing them with pigments from renewable sources becomes essential. These pigments can be found in plants, fruits, and vegetables but also microorganisms. Algae, however, are an excellent source which, in addition to being renewable, contain various types of pigments, such as phycobiliproteins, carotenoids and chlorophylls. Pigments of this type can be very advantageous due to their properties, such as biological activities, and their incorporation in various formulations (from food, cosmetics to nutraceuticals) can be very beneficial. Nevertheless, there widespread use is still significantly limited by their low stability to different stressing factors, namely light, temperature, pH and oxidation. This means that they can only replace synthetic dyes if the problems of stability are surpassed allowing to guarantee the same or better properties of those currently in use. It is therefore essential to develop stabilization techniques for natural colorants and pigments.(Wijesekara and Xu 2024)
For now, the most promising techniques are copigmentation and encapsulation. Copigmentation focuses on intrinsic factors, seeking to stabilize the molecular structure of the pigments. Meanwhile, encapsulation prioritizes protection from extrinsic factors, such as light and temperature, by integrating bioactive compounds into solid systems or liquid vesicles.
Since pigment stabilization is a crucial factor, this work aims to develop stabilization techniques using alternative solvents as task-specific copigments. Indeed, study of eutectic solvents and biosolvents as possible aids in copigmentation, while the application of bio-polymers may be of high relevance to encapsulate pigments. The stability of the pigments will be studied in terms of changes in temperature, light and time. In the end, the aim is to have natural pigments eligible to replace synthetic dyes in various areas such as cosmetics and cosmeceutics, contributing to the achievement of more sustainable practices in these industries. (Trouillas et al. 2016; Weiss, Okun, and Shpigelman 2023)

Keywords: *Natural Pigments, Algae, Chemical Stability, Alternative Solvents, Encapsulation, Copigmentation*

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LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). This work is co-financed by the project "Pacto da Bieconomia Azul"(C644915664-00000026) supported by PRR Plano de Recuperação e Resiliencies and the Next Generation EU European Funds and the FCT project with the Ref: 2022.04670.PTDC, and also by supporting the PhD of A. Conde. The authors would like to thank FCT for the doctoral grant of B.M.C Vaz (2022.13816.BD)

Conversion of tannery wastes by AM technologies

Sílvio Abrantes†,1, Sara Magalhães da Silva⋆,2, J. M Oliveira3

1. Escola Superior Aveiro Norte, Universidade de Aveiro, Estrada do Cercal, 449, Santiago de Riba-Ul, 3720-509 Oliveira de Azeméis, Portugal
2. EMaRT Group - Emerging: Materials, Research, Technology, University of Aveiro, 3720-511 Oliveira de Azeméis, Portugal
3. Department of Materials and Ceramic Engineering
4. CICECO - Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
5. 1) EMaRT GroupEmerging: Materials, Research, Technology, School of Design, Management and Production Technologies Northern Aveiro, University of Aveiro, Oliveira de Azeméis, Portugal. 2) CICECO AveiroInstitute of Materials, University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract. Tannery wastes are produced throughout the leather production process and, if improperly handled, can have serious negative effects on the environment and human health [1,2]. The goal in mind is to repurpose these wastes in the additive manufacturing (AM) industry to increase their value, with an emphasis on the solid residues. Two AM technologies are proposed for this PhD project (extrusion and powder-based) but for the meanwhile the primary focus is extrusion-based. Extrusion-based fused filament fabrication (FFF) is one example of an AM technique. A variety of composite materials was assessed with various polymeric matrices and leather waste contents to understand the applicability of this AM technology.

To this point, two distinct thermoplastic matrices were used to develop leather polymeric composites (LPC). Polylactic acid (PLA) and a blend of Polybutylene adipate terephthalate with thermoplastic starch (PBAT/TPS) were selected to enable various applications within the FFF technology and to contrast various sources and end-of-life. Regarding filler material, leather scraps obtained from local tanneries were reduced into fine powder (under 100 ţm) and mixed into the matrix at various volume ratios varying from 10% to 40%. For the PBAT/TPS blend, a coupling agent based on maleic anhydride was also studied to improve the performance of the prepared LPC. For the preparation of the LPC, a Brabender-type mixer was utilized.

The performance of the generated LPC was assessed overall using morphological, mechanical, and thermal studies. The printability of the chosen LPC formulations was then assessed by extruding them into 1.75mm-diameter filaments. The studies with PLA matrix were key to exhibit leathers nucleating ability and crucial stage in any extrusion-based additive manufacturing method is crystallization behavior. With the PBAT/TPS blend the purpose is to take advantage of the sustainable side of matrix alongside its flexibility, both characteristics matching the natural material that is leather.

Keywords: *Additive manufacturing, tanning industry, bio-based composites, waste valorization*

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Encapsulated ionic liquids in membrane contactor module for indoor air quality

Isabella M. G. de Souza[†,⋆,1], Pedro J. Carvalho[2]

1. CICECO-Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193, Aveiro, Portugal.
2. CICECO-Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193, Aveiro, Portugal

⋆ Corresponding author; isabellamgsouza@ua.pt; † Presenting author; Chemical engineering.

Abstract. Roughly 2.4 billion people are exposed to dangerous household air pollution levels (WHO 2024). Indoor air contamination is caused by particulate matter (PM), biological particles, inorganic gases (such as COx, O3, and H2S), volatile organic compounds (VOCs), like aldehyde, formaldehyde, benzene, toluene, and emerging pollutants (US-EPA 2018). Restrooms are one of the house areas with the highest emissions of contaminating gases. Although forced ventilation could mitigate the pollutant concentration, it can be unpractical when difficult to implement (construction restrictions), the outdoor air is also a source of contamination and/or incompatible with the house heating system. Thus, the implementation of air-cleaning devices stands as a possible solution (US-EPA 2023). Various technologies, such as filtration, adsorption, ionization, ultraviolet disinfection, and UV-photocatalytic oxidation, plasma could be used to tackle the problem. Nonetheless, they are limited to target pollutants, can generate more harmful pollutants, could have energy- and size-demanding setups, or their efficacy may still be unproven. Separation technologies have tackled huge interest in literature as a mechanism to clean indoor air. Nonetheless, these emerging green solvents have not reached a development level suitable for real deployment. Among these solvents, ionic liquids (ILs) have garnered attention for their absorption capacity and selectivity, and negligible volatility. Nonetheless, the use of ILs presents significant challenges, particularly regarding the required large separation units imposed by their transport properties, which are incompatible with the size restrictions of a house/office environment. To overcome this limitation, their encapsulation in carbon sub-microcapsules (ENILs) has been proposed by the group, allowing instantaneous absorption kinetics while retaining the sorption capacity. In this work, the incorporation of the ENILs in polymeric matrices is proposed as a technology to take advantage of the sorption capacity and selectivity of the solvents and the small size requirement, modularity, compactness, lower footprint, and easy scale up the membranes. Using a gas-liquid membrane contactor removes the need for a regeneration unit/step, thus envisioning the technology as less energetic, demanding, and feasible to operate in continuous mode without needing maintenance. These features in the membrane contactor module promise a significant breakthrough in improving indoor air quality in restrooms.

Keywords: *Volatile organic compounds (VOCs), Encapsulated ionic liquids (ENILs), Gas permeability, Polymeric membranes.*

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Development of innovative and sustainable hemicelluloses-based materials

José M. Silva[†,⋆,1], Mara G. Freire[1], Armando J. D. Silvestre[1], Carmen S. R. Freire[1]

1. University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; jose.miguel.silva@ua.pt; † Presenting author; Chemical engineering.

Abstract. Over the last decades, the extensive use of petroleum-based single use products, allied with the continuous growth of the world population and the depletion of fossil resources have been leading to serious environmental problems. As a result, there is a growing need and demand for sustainable alternatives to petroleum-based materials (United Nations, 2015). Hemicelluloses, are abundant macromolecular components of lignocellulosic biomass (Neto et al., 2004), that can be converted into chemicals, and used for the fabrication of sustainable materials with a wide variety of applications, spanning from active packaging materials, drug delivery and biomedical applications, among others (Naidu et al., 2018).
In this context, the main objective of this work is to develop novel functional biobased materials composed of xylans, and other biopolymers as chitosan and cellulose nanofibers, that can be used in the transition towards more sustainable and circular economy.
In this sense, we have followed two distinct approaches: namely, i) the development of wood inspired films; and ii) highly flexible chitosan/xylan films plasticized with deep eutectic solvents (DES). The wood inspired films (i) were prepared by solvent casting of a mixture of xylans, cellulose nanofibers and lignosulfonates mimicking the macromolecular composition of wood. The ensuing materials presented excellent optical, mechanical and thermal properties, as well as antioxidant capacity and UV protection features (Silva et al., 2024), showing high potential for active packaging applications. The chitosan-xylan based films (ii) were also prepared by solvent casting, and displayed good optical properties, mechanical performance, thermal stability, moisture uptake capacity and antibacterial activity (in vitro and ex vivo) against a Methicillin-resistant Staphylococcus aureus (MRSA) strain, as well as non-cytotoxicity towards human keratinocytes (HaCaT cells), with cell viability 80% for 2 days, and wound healing capacity (in vitro), demonstrating their potential application in the biomedical field.

Keywords: *Xylans, Biobased materials, Biorefinery, Bioeconomy, Films*

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Acknowledgements. This work was developed within the scope of the projects CICECO-Aveiro Institute of Materials (UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020)), financed by national funds through the FCT/MECTES (PIDDAC). FCT is also acknowledged for research contracts under Scientific Employment Stimulus to C.S.R.F. (DOI 10.54499/CEE-CIND/00464/2017/CP1459/CT0033). The authors would also like to acknowledge Celbi - Celulose da Beira Industrial, SA and The Navigator Company for funding the PhD scholarship.

Novel approaches to hydrometallurgical recovery of Platinum Group Metals from automotive catalytic converters

Flavia N. Braga[†,1], Helena Passos[⋆,2], João A. P. Coutinho[1]

1. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, Aveiro, Portugal
2. LSRE-LCM - Laboratory of Separation and Reaction Engineering - Laboratory of Catalysis and Materials, Faculty of Engineering, University of Porto, Porto, Portugal and ALiCE - Associate Laboratory in Chemical Engineering, Faculty of Engineering, University of Porto, Porto, Portugal

⋆ Corresponding author; hpassos@fe.up.pt; † Presenting author; Chemical engineering.

Abstract. The European Union's Critical Raw Materials list identify Platinum Group Metals (PGM) - platinum, palladium, rhodium, osmium, iridium, and ruthenium - as materials facing a significant risk of supply scarcity (European Commission, 2023). Automotive catalytic converters, essential for mitigating pollutants produced during combustion processes, are the most relevant application of PGM and correspond of more than 60 % of the market share for Pt, Pd and Rh (Cowley, 2023). In the past few decades, driven by the increase in global automobile production and the enforcement of environmental regulations, there has been a substantial and rapid accumulation of spent automotive catalytic converters (SACC). Despite the criticality and value of PGM, with average prices of 2023 of 31,30 $/g for Pt, 43,30 $/g for Pd and 212,50 $/g for Rh (Matthey, 2024), recycling rates from SACC remain lower than 50 % (Bahaloo-Horeh & Mousavi, 2020). The industrial extraction of Pt from SACC is currently achieved by pyrometallurgical processes, but hydrometallurgy have been studied as a more environmentally friendly alternative. Therefore, the aim of my PhD thesis is to develop a sustainable, cost-effective, and efficient hydrometallurgical process that aligns with the principles of circular economy for the recovery and separation of PGM. Initially, rather than employing traditional highly acidic solutions, we introduced an alternative method for the leaching process using aqueous solutions of aluminium chloride and aluminium nitrate, which effectively dissolved 91 % of Pt. Salts concentration, solid:liquid ratio, temperature and time of reaction were optimized. The analysis revealed that temperature emerged as the primary influential factor. Future studies will focus on purification and refining of metals using alternative strategies, namely liquid-liquid extraction, adsorption, among others. Ultimately, the work aims to reduce environmental waste production and transform SACCs into a valuable source of raw materials.

Keywords: *Circular economy, Hydrometallurgy, Ionic liquids, Recycling, Waste valorization*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MEC (PIDDAC). This work was further supported by national funds through FCT/MCTES (PIDDAC): LSRE-LCM, UIDB/50020/2020 (DOI: 10.54499/UIDB/50020/2020) and UIDP/50020/2020 (DOI: 10.54499/UIDP/50020/2020); and ALiCE, LA/P/0045/2020 (DOI: 10.54499/LA/P/0045/2020). This work was also financially supported by national funds through FCT Fundação para a Ciência e a Tecnologia, I.P., within the scope of the project PlatILPlus (2022.04478.PTDC, DOI: 10.54499/2022.04478.PTDC). F. Braga also acknowledge FCT for the Ph.D. grant 2023.01749.BD.

Enhancing the energy density by controlling the solubility of redox species to develop more efficient redox flow batteries

Gabriel L. Camilo[†,*,1], Catarina M. S. S. Neves[1], João A.P. Coutinho[1]

1. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

[*] Corresponding author; gcamilo@ua.pt; [†] Presenting author; Chemical engineering.

Abstract. Renewable energy sources, like solar and wind technologies, face intermittency issues requiring therefore Energy Storage Systems (ESS) for storing excess energy during peak generation and deploying it during low power periods. Notable advancements have been made in battery technology, particularly in lithium-ion batteries. However, metal scarcity and cost limit their large-scale applications. In contrast, Redox-Flow Batteries (RFBs) are highly regarded for cost-effective storage, especially suited for extended discharges, and prolonged storage periods. RFBs employ liquid-state species dissolved in electrolyte solutions, offering extended operational lifetime and cost benefits (Wang et al., 2022). Vanadium RFBs are the main technology used in this type of batteries systems but face some drawbacks, like high cost and corrosion susceptibility (Wang et al., 2022). As an alternative, organic redox compounds present a cost-effective option with structural diversity, high tunability afforded by molecular engineering and good accessibility. Regarding electrolyte solutions, non-aqueous flow batteries encounter limitations such as high cost and flammability, while aqueous RFBs offer some advantages since they are non-flammable, have a high dielectric constant, and high ionic conductivity. Enhancing redox-active species solubility in RFBs electrolytes is crucial for increasing energy density and minimizing solid precipitate formation. However, high electrolyte concentrations may increase viscosity and take to undesired side reactions, affecting cycling stability and capacity retention. Optimal redox-active species concentration is vital for balancing energy density, viscosity, and parasitic reactions (Pan et al., 2023). To overcome this issue, mainly structural modifications have been studied, including introducing hydrophilic groups and counter-ion replacements, yet the stability concerns persist. Therefore, this work proposes, through predictive modelling using COSMO-RS and experimental measurements, enhancing redox-active species solubility by investigating the introduction of structural asymmetry to redox-active molecules, or by using additives in solution. By addressing these challenges, scalable and sustainable energy storage solutions can be achieved, facilitating renewable energy integration into the grid.

Keywords: *Redox flow batteries, solubility, asymmetry, additives, COSMO-RS*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). This work has received funding from the European Innovation Council (EIC) under grant agreement 101046742. The EIC receives support from the European Unions Horizon Europe research and innovation programme.

Development of thermoplastic materials by modification of biopolymers of marine origin

Vasco Valente[†,⋆,1], Carla Vilela[1], Carmen S. R. Freire[1]

1. CICECO Instituto de Materiais de Aveiro, Departamento de Química, Universidade de Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; vasco.valente@ua.pt; † Presenting author; Chemical engineering.

Abstract. Over the past two decades, a growing demand for bioresources to mitigate the depletion of fossil fuels and address the significant environmental concerns that arise from their massive and widespread utilization have been witnessed (Müller et al., 2019). The marine environment is an important source of functional biopolymers, particularly polysaccharides, which have gathered growing attention for a wide range of applications, including biomedicine, food packaging or water remediation. The most common marine polysaccharides are alginates, chitin (and its derivative chitosan) and carrageenans, which can be extracted from algae and seafood wastes (Wong et al., 2021).
Chemical modification is a common approach to enhance or modify the properties of polysaccharides. By substituting, introducing, or removing specific functional groups from the polysaccharide chains, significant changes can be made to their physicochemical properties, such as improved hydrophobicity, or thermal processability (Cumpstey, 2013). For example, thermoplasticity can be induced by covalent bonding of long-chain aliphatic molecules onto the backbone of a polysaccharide, thus breaking their intramolecular hydrogen bonds (Shibakami et al., 2014).
In this context, this PhD thesis project aims to develop novel thermoplastic materials by chemical modification of polysaccharides from marine origin. To achieve this, polysaccharides from marine sources (e.g., alginate, chitosan, and carrageenan) will be chemically modified with aliphatic long-chain moieties through reaction with highly reactive molecules (e.g., fatty-acid chlorides, and aliphatic isocyanates). Then, the polysaccharide derivatives will be characterized regarding their chemical structure, thermal properties, and thermal processability, addressing their potential as suitable substitutes of synthetic thermoplastics or as additives in thermoplastic formulations.

Keywords: *Marine polysaccharides, Chemical modification, Thermoplastics, Long-chain moieties*

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Acknowledgements. This work was developed within the scope of the project Pacto da Bioeconomia Azul (C644915664-00000026) supported by PRR Plano de Recuperação e Resiliência and the Next Generation EU European Funds, and project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). FCT is also acknowledged for the research contracts under Scientific Employment Stimulus to C.V. (DOI 10.54499/2021.01571.CEECIND/CP1659/CT0024) and C.S.R.F. (DOI 10.54499/CEECIND/00464/2017/CP1459/CT0033).

Sustainable production of iron alloys coupled with green hydrogen generation

Adélio Fumo[†,⋆,1], Daniela V. Lopes[2], Andrei.V. Kovalevsky[2]

1. Department of Chemistry, CICECO Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Materials and Ceramic Engineering, CICECOAveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract. The steelmaking industry is a highly significant sector in terms of energy consumption and it makes a major contribution to the global emissions of CO2. Currently, this industry explores alternative decarbonisation solutions involving the use of advanced technologies and more sustainable approaches. Several large projects have been approved and implemented during the last years, seeking alternative CO2-free approaches (e.g. SIDERWIN, 2017-2023). The electrochemical reduction of iron oxides in alkaline conditions arises as a possible alternative technology for steel production against the traditional carbothermal method. Nevertheless, the electroreduction mechanisms in alkaline media are still poorly understood, while only simple systems of hematite and magnetite have been investigated.

The present PhD Thesis project aims to enhance electrochemical reduction as a flexible and CO2-free technology, allowing for the first time, the production of iron alloys. Based on the first thermodynamic predictions from Pourbaix diagrams, this approach seems feasible for the production of Ni-, Cu- and Co- containing alloys. To date, there have been no alkaline electrowinning attempts to produce metallic alloys using either bulk or suspension methods. This project intends to address this technological gap, presenting an initial proof-of-concept for the production of such alloys from natural iron-containing minerals or wastes and residues, therefore promoting the circular economy. Another novel concept is to identify strategies for integrating iron alloy production with green hydrogen generation powered by renewable energies like solar and wind, adjusting it to their natural intermittency. In all instances of iron electroreduction technology, the hydrogen evolution reaction (HER) from the alkaline water splitting is typically seen as an undesirable side-effect, decreasing the Faradaic efficiency. However, one expects to adjust and optimize iron alloys and hydrogen co-production.

Materials analogous to natural minerals like trevorite (NiFe2O4), cuprospinel (CuFe2O4), and Fe-Co oxides are promising for alloy electrodeposition in strongly alkaline media and are expected to allow flexible tuning of the HER rate. The electroreduction mechanisms and Faradaic efficiencies will be analysed taking into account relevant process variables (temperature, electrolyte concentration, bulk cathode composition, solid load in suspension, stirring rate), combined with post-mortem analysis using X-ray diffractometry XRD, scanning electron microscopy SEM, and energy dispersive X-ray spectroscopy- EDS.

The innovation of the proposed project lies in developing a CO2-free electrochemical technology to produce both iron alloys and green H2, offering direct benefits in the metallurgical and environment sectors, accordingly having a positive direct impact on society.

Keywords: *Electrowinning, Electrodeposition, Alkaline electrolysis, Steelmaking, Hydrogen evolution*

Acknowledgements. The authors gratefully acknowledge the financial support from the Portuguese Foundation for Science and Technology (FCT) through the grant (PRT/BD/154825/2023).

Ionic-liquid-based aqueous biphasic systems for minicircle DNA recovery from cell lysates

Ana I. Valente[†,⋆,1], João Vasco Valente[1], Athenas De Francesco[1], Augusto Q. Pedro[2], Ana P. M. Tavares[1], Fani Sousa[3], Mara G. Freire[4]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, Aveiro, Portugal
3. CICS-UBI Health Sciences Research Center, University of Beira Interior, Av. Infante D. Henrique, 6200-506 Covilhã, Portugal
4. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemical engineering.

Abstract. Biopharmaceuticals, known for their remarkable specificity and efficacy, are increasingly pivotal in combating cancer. Among these, nucleic acids have emerged as promising agents in cancer therapy due to their capacity to target specific genetic abnormalities. Plasmid DNA (pDNA) and minicircle DNA (mcDNA) have notably garnered attention as non-viral vectors for gene therapy in recent years. However, the complex manufacturing processes and purification techniques for these nucleic-acid-based biopharmaceuticals present challenges in terms of cost and efficiency.
This study focuses on using ionic-liquid-based aqueous biphasic systems (IL-based ABS) as a primary method for capturing p53-mcDNA biopharmaceuticals. The production of p53-mcDNA involved optimizing recombinant Escherichia coli cells to enhance cell growth and produce parental plasmid (PP), followed by the recombination induction using L-arabinose to produce p53-mcDNA. Ongoing research is dedicated to refining the separation of PP and p53-mcDNA using tailored IL-based ABS. Overall, employing IL-based ABS as a primary capture method shows promise for advancing the manufacturing of nucleic-acid-based biopharmaceuticals, especially in the field of cancer therapy.

Keywords: *Minicircle DNA, ionic liquids-based aqueous biphasic systems, clarification, lysate*

Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). CICS-UBI project, UIDB/00709/2020 (DOI:10.54499/UIDB/00709/2020) and UIDP/00709/2020 (DOI:10.54499/UIDP/00709/2020), financed by national funds through the FCT/MCTES also helped to develop this work. Additional funding was provided by the project PureDNA (2022.03394.PTDC, DOI:10.54499/2022.03394.PTDC), financially supported by national funds (OE), through FCT/MCTES. Ana I. Valente and João V. Valente acknowledge FCT, respectively, for the PhD grants 2021.08352.BD (DOI:10.54499/2021.08352.BD) and 2023.04779.BDANA. Augusto Q. Pedro and Ana P. M. Tavares acknowledge FCT for the research contracts under the Scientific Stimulus Individual Call, respectively, CEECIND/2020/02599 (DOI:10.54499/2020.02599.CEECIND/CP1589/CT0023) and CEECIND/2020/01867 (DOI:10.54499/2020.01867.CEECIND/CP1589/CT0013).

Waste-to-wealth approach towards the full valorisation of spent lithium battery

André Nogueira[†,1], Nicolas Schaeffer[*,1], João A.P. Coutinho[1]

1. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

[*] Corresponding author; nicolas.schaeffer@ua.pt; [†] Presenting author; Chemical engineering.

Abstract. Waste electric and electronic equipment is the fastest growing waste streams in recent years. (Forti et al., 2020) While the plastic waste associated with these poses high concern, the associated electronic components offer a unique opportunity for material recovery. Chief amongst them are waste batteries, whose production soared with the electrification of modern society, and pose a challenging waste management problem for the coming years. (IEA, 2023)The proper treatment of waste Lithium-ion batteries (LIBs) offers both environmental and economic benefits. Suitable waste management solutions are needed to mitigate the environmental and occupational hazards associated with handling this waste. More generally, LIBs contain high concentrations of valuable metals such as lithium, nickel, manganese, and cobalt, making them an interesting source of these rare and critical materials. (IEA, 2021; Zheng et al., 2023) The valorisation of LIBs along the entire waste hierarchy is crucial to foster a more circular economy that reduces reliance on virgin resources and minimizes environmental impact. This project aims to exploit the unique structure and high-valency composition of LIBs cathodes for catalytic purposes, providing a second life for these materials prior to the recycling and separation of the metallic content.This Thesis Preparation Project is organized in three chapters. Firstly, an overview of the different sources of transition metal rich battery waste and their political and economic relevance within a European Union context is presented before briefly exploring catalyst preparation methodologies and applications from LIBs. The second chapter details the PhD workplan, starting in March of 2023. Finally, the third chapter provides a report of the work completed thus far and potential impacts on the initially proposed timeline.

Keywords: *hydrometallurgy, critical metals, circular economy, lithium-ion batteries*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). André Nogueira acknowledges FCT Fundação para a Ciência e a Tecnologia, I.P for the Ph.D. grant 2023.01418.BD.

Innovative solutions for the (bio)degradation of polyolefins wastes and design of novel polymers

Mariana I. S. Aguiar[†,⋆,1], Ana M. Ferreira[1], Ana P. M. Tavares[1], João A. P. Coutinho[1], Frederik R. Wurm[2], Andreia F. Sousa[1]

1. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Molecules Materials, MESA+ Institute, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands

⋆ Corresponding author; m.aguiar@ua.pt; † Presenting author; Chemical engineering.

Abstract. Polymers are widely used in modern society due to their exceptional properties. However, the recycling of fossil-based polymers fails, hence they accumulate in the environment (Europe, 2022). Mechanical recycling, the most common approach for plastic waste treatment, leads to final products that do not have the same characteristics as virgin polymers, which requires their incorporation in a different, and usually lower quality, market (Schyns & Shaver, 2021). The presence of additives makes the processing of polymers even more difficult (Ügdüler et al., 2020). Therefore, it is crucial to find more efficient alternatives to the currently used methods to manage plastic waste. Additionally, fossil fuels are not renewable resources, so it is essential to find an alternative to fossil-based polymers. Bio-based polymers may be the answer to this problem. However, it is also important to have efficient waste treatment processes for these bio-based polymers before they become a reality in daily lives, otherwise the problem with plastic waste accumulation will remain, just with another type of polymers accumulated.

Therefore, this project addresses the sustainability challenge of non-biodegradable polyolefin waste, such polypropylene (PP), through an interdisciplinary approach. Firstly, enzymatic depolymerisation of PP without additives in alternative solvents to enhance biocatalyst activity will be explored, since there are already multiple studies applying microorganisms in de biodegradation of PP, but only one that uses enzymes (Tan et al., 2024), leaving a gap in this field. Secondly, the synthesis of polymers with properties similar to polyolefins but with inherent biodegradability will be pursued. Although there are already a few studies on it, this matter is still quite unexplored, especially when talking about bio-based polymers with an intrinsically triggered biodegradation ability (Eck et al., 2023). The purpose is to synthetise polymers from monomers with cleavage points, e.g., phosphoester, that will enable an efficient and accelerated enzymatic degradation.

Keywords: *Biodegradation; Biodegradable Polymers; Sustainable Polymer Chemistry; Plastic Waste; Polyolefins; Polypropylene; Enzymes; Polycondensation*

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Acknowledgements. This work was developed partly within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). MISA acknowledges FCT for PhD grant PRT/BD/154714/2023. AMF, APT, AFS acknowledge FCT for CEEC contracts CEECIND/00361/2022, CEECIND/02322/2020, CEECIND/01867/2020, respectively. This publication is supported by COST Action FUR4Sustain, CA18220.

Green extraction of artemisinin using aqueous solutions of hydrotropes: from plant to formulation

Isabella W. Cordova[†,1], Olga Ferreira[2], Simão P. Pinho[3], João A. P. Coutinho[⋆,1]

1. Centro de Investigacao de Montanha (CIMO), Instituto Politécnico de Braganca, 5300-253, Braganca, Portugal
2. Laboratório para a Sustentabilidade e Tecnologia em Regioes de Montanha, Instituto Politécnico de Braganca, 5300-253, Braganca, Portugal
3. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193, Aveiro, Portugal.
4. Laboratório para a Sustentabilidade e Tecnologia em Regioes de Montanha, Instituto Politécnico de Braganca, 5300-253, Braganca, Portugal.
5. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193, Aveiro, Portugal

⋆ Corresponding author; jcoutinho@ua.pt; † Presenting author; Chemical engineering.

Abstract. In 2020, the World Health Organization estimated 241 million cases of malaria, and 627000 deaths, which gives the global dimension and relevance of this disease, endemic in 85 countries (World Health Organization, 2021). Artemisinin, a sesquiterpenoid lactone peroxide found in leaves of sweet wormwood (Artemisia annua L.), is an essential component of artemisinin-based combination therapies, recognized as one of the most successful treatments against uncomplicated malaria (World Health Organization, 2021). Although many efforts are being made to develop synthetic routes, extraction from plant matrices remains the major source of artemisinin (Numonov et al., 2019). Conventional industrial extraction uses volatile and petroleum-based solvents, followed by several purification steps to obtain high-purity artemisinin (Martino et al., 2019). Thus, the search for cleaner and safer solvents and more efficient techniques has been a major scientific effort. Greener extraction methods have been previously studied to obtain artemisinin (Numonov et al., 2019). Unfortunately, artemisinin has exceptionally low solubility in water (Sales et al., 2021), hindering the application of this green solvent. The use of hydrotropes and co-solvents to increase the solubility of poorly water-soluble compounds is well-known in the pharmaceutical area (Patil et al., 2021). The objective of this work is the development of more efficient, safer, and cleaner processes for extracting artemisinin, a key compound in the treatment of malaria whose main source is the leaves of A. annua. Novel aqueous solutions of hydrotropes and biobased solvents will be used as alternative solvents to increase the solubility of artemisinin, artemisinin precursors and derivatives, as well as relevant model compounds, namely vanillin, ethyl vanillin and carbamazepine, and combined with advanced techniques (microwave-assisted, ultrasound-assisted, and pressurized liquid extractions). To reduce experimental effort, the fully predictive Conductor-like Screening Model for Real Solvents, a quantum-based statistical thermodynamic model, will be applied for preliminary solvent or hydrotrope selection.

Keywords: *Extraction process; hydrotropes; green solvents; solvent screening; antimalarial drug*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020, and LA/P/0006/2020, and CIMO-Mountain Research Center, UIDB/00690/2020 and LA/P/0007/2020, financed by national funds through the Portuguese Foundation for Science and Technology/MCTES. Isabella W. Cordova thanks FCT for her Ph.D. grant (2022.12407.BD).

Novel strategies for the nasal delivery of messenger ribonucleic acid

Bojan Kopilovic[†,1], João A.P. Coutinho[1], Chantal Pichon[2], Mara G. Freire[⋆,1]

1. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. Centre de Biophysique Moléculaire (CBM), UPR 4301 CNRS, University of Orléans, 45071 Orléans, France

⋆ Corresponding author; maragfreire@ua.pt; † Presenting author; Chemical engineering.

Abstract. Biopharmaceuticals hold remarkable potential for diseases that traditional medicines struggle to treat, namely cancer and genetic disorders. Today, thanks to advances in nanotechnology, vaccine development is getting a major boost. This allows scientists to create high-quality genetic material such as messenger ribonucleic acid (mRNA) and efficient delivery systems using delivery vectors. One promising approach is using "third-generation vaccines"comprising in vitro produced mRNA, which have the potential to address urgent and unmet medical needs. However, current methods for mRNA delivery often face challenges like instability, inefficient cellular uptake and potential safety concerns [1]. This research proposes a novel approach utilizing a aqueous biphasic systems (ABS) comprising gellable biopolymers for the nasal delivery of mRNA-loaded nanocarriers. The studied systems help the nanoparticles pass through the protective mucosal lining achieving an mRNA transfection efficiency of 70% in upper airway epithelial cells while maintaining high cell viability. These systems present a promising solution for nasal mRNA delivery. The proposed biopolymer-enhanced ABS minimize the cytotoxicity and are a potentially safe and effective strategy for future mRNA vector delivery.

Keywords: *mRNA; nasal delivery; aqueous biphasic system*

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Keratin films prepared from chicken feather waste: a sustainable approach for biomedical applications

Cariny Polesca[†,⋆,1], Helena Passos[2], Bruno M. Neves[3], João A. P. Coutinho[4], Jason P. Hallett[1], Mara G. Freire[5]

1. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, Aveiro, Portugal
2. LSRE-LCM - Laboratory of Separation and Reaction Engineering - Laboratory of Catalysis and Materials, Faculty of Engineering, University of Porto, Porto, Portugal
3. ALiCE - Associate Laboratory in Chemical Engineering, Faculty of Engineering, University of Porto, Porto, Portugal
4. iBiMED - Department of Medical Sciences and Institute of Biomedicine, University of Aveiro, Aveiro, Portugal
5. Department of Chemical Engineering, Imperial College London, London, United Kingdom

⋆ Corresponding author; carinypolesca@ua.pt; † Presenting author; Chemical engineering.

Abstract. Chicken is one of the most consumed meats worldwide, generating substantial feather waste during its industrial processing and highlighting the necessity of developing a sustainable way of feather waste valorisation. Regarding feathers composition, 90 wt % corresponds to keratin, a fibrous protein with low solubility in conventional solvents. In that regard, our research group introduced a novel approach for feather dissolution using acetate-based ionic liquids (ILs) [1,2]. The optimisation of keratin recovery parameters (e.g. time, coagulant solvent, and amount) resulted in a maximum keratin recovery of 93 wt %. Furthermore, the IL recovery and reuse were evaluated, achieving around 94 wt % for at least four cycles. A techno-economic assessment of the developed process revealed that the minimum selling price for keratin is 22 $ůkg-1, making this process suitable for biomedical applications [1]. For this purpose, keratin films were processed and characterised by physicochemical and biological analysis. The cytotoxicity of keratin films in various cell lines (macrophages, monocytes, and keratinocytes) revealed no adverse effects, and the in vitro wound healing study showed that the keratin film improves the proliferation of keratinocytes and fibroblasts, accelerating wound healing [2]. Overall, this study underscores the promise of ILs for feather valorisation, while opening the door for the development of high-performance keratin films with potential applications in the biomedical field.

Keywords: *poultry-industry waste, ionic liquids, keratin-based films, wound healing*

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New sustainable approaches to eco-recycling of polyesters wastes into novel (bio)degradable polyesters

Beatriz Agostinho[†,⋆,1], Armando J. D. Silvestre[1], Andreia F. Sousa[1]

1. CICECOAveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal.

⋆ Corresponding author; beatriz.agostinho@ua.pt; † Presenting author; Chemical engineering.

Abstract. Poly(ethylene 2,5-furandicarboxylate) (PEF) and poly(trimethylene 2,5-furandicarboxylate) (PTF) are bio-based furanic polyesters, widely known to be a viable alternative for conventionally used poly(ethylene terephthalate) (PET), mainly due to its relevant thermal and mechanical properties as well as standout barrier features (Loos et al., 2020) (Fei et al., 2020).
However, these bio-based alternatives keep raising the same environmental persistence challenges during their End-of-Life (EoL), and since current recycling processes are still poorly efficient, the development of alternative recycling approaches is of the utmost importance.
In this work, we use previously reported methodology (Agostinho et al., 2022) of continuous, mild, and close-loop recycling, applied to furanic polyesters, by making use of the superior capacity of Deep Eutectic Solvents (DES) to catalyse both alcoholysis and polyesterification reactions. Both PEF and PTF were recycled using a urea-based DES, reaching a maximum yield of 91% and 92% for PEF and PTF, respectively.
Furthermore, this process was also evaluated for the recycling of copolymers. The proposed recycling approach confirms the potential of DES to catalyse de-/re-polymerization in a continuous way, as an efficient and greener option to chemically recycle persistent polyester wastes, promoting a more circular approach for its EoL.

Keywords: *Poly(ethylene 2,5-furandicarboxylate) (PEF), Poly(triethylene 2,5-furandicarboxylate) (PTF), Deep Eutectic Solvent (DES), Chemical Recycling, Polymers End of Life.*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). The FCT is acknowledged for the research contract under Scientific Employment Stimulus to AFS (CEECIND/02322/2020, DOI 10.54499/2020.02322.CEECIND/CP1589/CT0008) and for a doctorate grant to BA (2020.04495.BD). This work was supported by COST Action FUR4Sustain (CA18220) supported by COST (European Cooperation in Science and Technology).

Charting sustainable horizons: advancing polyester circular solutions through chemical recycling with bio-based eutectic solvents

Vinícius de Paula[†,⋆,1], Armando J. D. Silvestre[1], Andreia F. Sousa[1]

1. CICECOAveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal.

⋆ Corresponding author; vgmp@ua.pt; † Presenting author; Chemical engineering.

Abstract. Polymers are singular materials in shaping modern society since they have exceptional properties such as low cost, durability, and low density (Kleme et al., 2021). These properties which turned polymers into privileged materials also contributes to some significant challenges, as most of them are neither easily recyclable, nor degradable in the environment, leading to their accumulation in the ecosystem if inadequately disposed. Thus, novel technologies for polymers recycling are paramount to improve circularity and to reduce the environmental burden associated with polymers use and the sustainable development of this sector.
Recent studies showcased the potential of eutectic solvents (ES) as a greener approach for polyester depolymerization (Attalah et al., 2021), where our group also showcased the recycling of poly(ethylene terephthalate) (PET) and poly(ethylene 2,5-furandicarboxylate) (PEF) (Agostinho et al., 2022; de Paula et al., 2023). Building on these findings, the present study introduces a process involving the alkaline catalyzed hydrolytic depolymerization of PET and PEF into terephthalic acid (TPA) and 2,5-furandicarboxylic acid (FDCA), respectively, using bio-based ES, where the combined effect between ES components and the base was found to be essential for effective polyester depolymerization. Structural characterization confirmed the purity of the recovered acids. The recyclability of the ES was evaluated, demonstrating the effectiveness of the reaction media for at least 7 depolymerization cycles without a relevant loss in catalytic activity. Yields exceeding 90 % and 80 % for TPA and FDCA, respectively, were achieved at relatively mild reaction temperature, room pressure and not exceeding 5 h of reaction. Green metrics were determined, with E-factors akin to those found in the fine chemicals industry (Sheldon, 2016). Finally, the feasibility of using the recycled monomers for repolymerization into PET and PEF was also proven successful, demonstrating the potential of this process for the chemical recycling of polyester waste.

Keywords: *polymer recycling, poly(ethylene terephthalate), poly(ethylene 2,5 furandicarboxylate), eutectic solvents, green chemistry, sustainability*

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Chemistry

Removal of rare-rarth elements from aqueous solutions by microporous titanosilicate ETS-4

João Pinto[†,⋆,1], Daniela Tavares[2], João Rocha[3], Eduarda Pereira[4]

1. LAQV-REQUIMTE Associated Laboratory for Green Chemistry, University of Aveiro, Aveiro, Portugal
2.
3. Department of Chemistry, CICECO
4. Chemistry Department, LAQV REQUIMTE, and Central Laboratory of Analysis, University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemistry.

Abstract. The unsustainable nature of the mining of Rare-Earth Elements (REE) raises environmental, economic, and societal concerns, prompting the development of suitable technologies for their removal from contaminated waters. Sorption is, in general, a clean and efficient method to decontaminate water. While microporous titanosilicates are promising materials for REE removal from water, the effect of solution parameters on this process is poorly understood. The present work assesses the influence of pH (4-8), concentration (1-5 ţM) and sorbent amount (20-180 mg/L) on the removal from water of a REE3+ mixture (Y, La, Ce, Pr, Nd, Eu, Gd, Tb, Dy) by the microporous titanosilicate ETS-4 (Na9Ti5Si12O38(OH)ů12H2O). The experimental conditions studied were based on a Box-Behnken design, and the results were expressed as three-dimensional response surfaces. The removal mechanism relies on the ion exchange of Na+ by REE3+, with pH being the main process variable (i.e., competition with H+). Increasing pH results in higher removal, which reaches 100 % for ETS-4 amounts of 180 mg/L and REE concentrations of 1 ţM. Most REE3+ removal occurs in the first 15 minutes, with little difference between metals (except for Y, which shows lower removal). For ETS-4 amounts of 20 mg/L, REE are highly concentrated in the sorbent, reaching 145 mg/g (15% of the sorbents mass, post sorption). The results show that even low ETS-4 amounts have a considerable potential to remove high concentrations of REE3+ from aqueous solutions with pH close to natural systems.

Keywords: *Rare earth elements; Titanosilicates; Sorption; Recovery*

Acknowledgements. João Pinto acknowledges his Ph.D. grant (2020.05323. BD) given by the National Funds through the Portuguese Science Foundation (Fundação para a Ciência e a Tecnologia, FCT).

Multidisciplinary approach to study the interaction of antimicrobial peptides with membrane models

Andrea Chacón Calderón[†,1], Luis Mafra[2], Mariana Sardo[2], Pavel Zelenovskii[1], Ildefonso Marin-Montesinos[2], Ana Barros-Timmons[3]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
3. CICECO Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemistry.

Abstract. Antibiotic resistance has become one of the main health-related problematics worldwide in the last few decades. With the escalating challenges associated to the development of new antibiotics, attention has turned towards alternative treatments, notably antimicrobial peptides (AMPs). These naturally secreted peptides show promising potential for human therapeutics, targeting bacteria, fungi, and viruses through diverse pathways [1]. However, their implementation at a larger scale has been limited by a lack of understanding of their mechanisms of action [2].
The main focus of this work is to develop a well interconnected multidisciplinary approach that can give further insight into the mechanism of action of melittin, a well-known AMP. Various biomimetic membranes were employed to investigate melittin's interaction with bacterial cell membranes. Through dynamic light scattering (DLS), Langmuir-Blodgett technique, solid-state nuclear magnetic resonance (ss-NMR), and atomic force microscopy (AFM), model membranes such as Langmuir monolayers, lipid bilayers, and thin solid lipid films were studied in the presence and absence of melittin. From this multidisciplinary approach it was confirmed that melittin has a strong influence in the structural organization of lipid bilayers. The peptide disturbs the spatial arrangement of liposomes via strong electrostatic interaction with anionic phospholipids, and at higher concentration manages to penetrate the layers and disturb the acyl-chain region, as seen by ss-NMR and Langmuir-Blodgett. Additionally, AFM showed that melittin distorts the natural phase distribution of lipid films, and at high concentrations it causes phase homogenisation and aggregation for both solid thin films and liposomes in suspension.

Keywords: *Antimicrobial peptides, melittin, ss-NMR, Langmuir-Blodgett, model membranes, AFM*

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C-glycosylation of flavonoids through photocatalysis

Patrícia I. C. Godinho[†,*,1], Raquel G. Soengas[2], Artur M. S. Silva[1]

1. LAQV-REQUIMTE, Departamento de Química, Universidade de Aveiro, 3810-193 Aveiro, Portugal
2. Departamento de Química Orgánica e Inorgánica, Universidad de Oviedo, Julián Clavería 7, 33006, Oviedo, Spain.

* Corresponding author; patricia.godinho@ua.pt; † Presenting author; Chemistry.

Abstract. Nowadays, one of the most important health problems is the spread of antimicrobial resistance (AMR). Bacterial resistance is increasing at an alarming rate, and the key to fight AMR is the search for antibacterial agents with novel mechanisms of action.[1] Flavonoids (FL) are a group of natural products which exhibit a great diversity of biological activities, including antibacterial action against many pathogenic microorganisms.[2] Naturally occurring FL can be usually found in their glycosylated form; in this regard, glycosylation has a tremendous impact on the biological profile. Despite O-glycosylated FL are more common in nature, C-glycosylated FL are less prone to hydrolysis.[3] Considering the antibacterial activity of FL and the improved biological profile of the corresponding glycosylated forms, the C-glycosylation of FL could be a promising strategy for obtaining new drugs against resistant bacteria. However, this is a chemically demanding reaction.
Photocatalysis, which converts visible light into chemical energy under benign conditions allowing catalytic and mild generation of reactive radicals, is one of the hottest topics in organic synthesis. The photocatalytic generation of radicals present fundamental advantages of over the use of stoichiometric organometallic reagents, which provides greener opportunities for drug delivery. [4] The recent trend is the development of dual processes that incorporate a photoredox catalyst and another catalytic cycle, achieving activation of multiple substrates in a single reaction and improving the sustainability of C-C bond-forming processes.[5]
In this work, we studied novel strategies based on photocatalysis for the derivatization of FL and their application to the synthesis of C-glycosyl FL-type compounds, with the aim of developing novel compounds with antibacterial activity and promising clinical efficacy.

Keywords: *C-Glycosyl-flavonoids, Photocatalysis, Antibacterial activity*

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SYNTHESIS AND CATALYTIC ACTIVITY OF IRON TRICARBONYL CYCLOPENTADIENONES IN HYDROGEN BORROWING AMINATION OF CYCLITOLS

M. J. Verganista[†,⋆,1], Nuno R. Candeias[2]

1. LAQV-REQUIMTE
2. LAQV REQUIMTE, Departamento de Química, Universidade de Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; mverganista@ua.pt; † Presenting author; Chemistry.

Abstract. Chemists aim to replace noble metal catalysts like rhodium, ruthenium, iridium, platinum, and palladium with more cost-effective and Earth-abundant alternatives like iron, copper, cobalt, or nickel. Iron is particularly appealing because it's the second most abundant metal in the Earth's crust, is biocompatible, and has a broad range of oxidation states.[1] Iron-based heterogeneous catalysts are widely used in industrial processes for syngas and ammonia production. However, homogenous iron catalysts have only gained significant attention in the past 15 years, marking a "new iron age".[2][3] A promising group of homogenous iron catalysts is the iron tricarbonyl cyclopentadienones (ITCs), which resemble the ruthenium-based Shvo pre-catalyst in structure and catalytic activity.[4]

ITCs are readily synthesized through the reaction of alkynes with iron (0) carbonyls, and they can catalyze various reactions, including hydrogenation, oxidation, and hydrogen borrowing. In this study, we report the synthesis of novel ITCs and investigate their catalytic performance in hydrogen borrowing reactions. Our findings highlight the potential of ITCs as efficient and versatile catalysts for sustainable chemical transformations.[5]

Keywords: *iron catalysis, hydrogen borrowing, cyclitols*

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Acknowledgements. This work received support from PT national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) through the projects UIDB/50006/2020, UIDP/50006/2020, CEE-CINST/2018 and PTDC/QUI-QOR/1131/2020.

Ru-HKUST analogue: a promising material drug delivery against leishmania

Nádia E. Santos[†,⋆,1], Alexadra Stubelius[2], Filipe A. Almeida Paz[3], Susana S. Braga[4]

1. CICECO Instituto de Materiais de Aveiro, Departamento de Química, Universidade de Aveiro
2. Division of Chemical Biology, Department of Life Sciences
3. CICECO Instituto de Materiais de Aveiro, Departamento de Química, Universidade de Aveiro, Portugal
4. LAQV REQUIMTE

⋆ Corresponding author; nadiaasantos@ua.pt; † Presenting author; Chemistry.

Abstract. Leishmaniasis, a parasitic disease that affects millions of people around the globe, is characterised by the phagocytosis of leishmania promastigotes into neutrophils and macrophages (de Menezes, Saraiva, & da Rocha-Azevedo, 2016), disrupting their regular functions and preventing their activation (Olivier, Gregory, & Forget, 2005). Pentavalent antimonium compounds and amphotericin B are the most widely prescribed medications but have severe toxic effects, causing anaphylaxis and death in extreme cases. For this reason, new treatments that are both active and safe are urgently needed.
In the last decades, metal-organic frameworks (MOFs) have emerged has potential materials for carrying drugs and small molecules by non-covalent encapsulation into their pores, which could be used as a potential approach to reduce toxicity. MOF-199 (also known as HKUST-1) is a promising material, mainly due to its high porosity and stable structure. However, its slow degradation and consequent copper release cause it to have some associated toxicity (Abramenko et al., 2021). Studies have demonstrated that MOFs toxicity is highly dependent on the nature of the metal ions, where biocompatible ones such as Fe and Ru are safer (Tamames-Tabar et al., 2014).
In this work, we have successfully synthesised Ru-MOFs by both solvothermal and microwave approaches, with structures analogous to MOF 199 with diverse particles size (from 100 nm to 1-2 ţm). The materials were characterised by x-ray diffraction, scanning-electron microscopy, and elemental analysis, which confirmed isostructurality. With these materials, we expect to take advantage of the properties of both the MOF and its ruthenium centres, which we expect to be safer, and to be slowly released to form mononuclear complexes (that may act as anti-parasitic agents). Preliminary cytotoxic effects against several cells from the immune system will be performed in the next couple of weeks.

Keywords: *MOFs, leishmaniasis, nanoscale, ruthenium, multifunctional compounds*

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Acknowledgements. The authors acknowledge University of Aveiro and FCT/MCTES (Fundação para a Ciência e a Tecnologia, Ministério da Ciência, da Tecnologia e do Ensino Superior) for financial support to LAQV-REQUIMTE (Ref. UIDB/50006/2020; doi 10.54499/UIDP/50006/2020), and to CICECOAveiro Institute of Materials (Refs. UIDB/50011/2020, doi 10.54499/UIDB/50011/2020; UIDP/50011/2020, doi 10.54499/UIDP/50011/2020; LA/P/0006/2020, doi

10.54499/LA/P/0006/2020) through national founds (PIDDAC) and, where applicable, co-financed by the European Regional Development Fund (FEDER), within the PT2020 Partnership Agreement.Nádia E. Santos acknowledge the financial support from the Portuguese Foundation for Science and Technology (FCT) through the PhDs grant 2022.09798.BD and the European Cooperation in Science and Technology (COST) for the financial support through the E-COST-GRANT-CA21110-a4b8b017 grant.The authors also acknowledge the Portuguese Nuclear Magnetic Resonance Network (PTNMR) for providing to the scientific community access to modern and up-to-date NMR spectrometers.

Unlocking 3-aminopyridine synthesis harnessing a stepwise Kröhnke chemistry

Telmo N. Francisco[†,⋆,1], Artur M. S. Silva [1], Hélio M. T. Albuquerque[1]

1. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; telmofrancisco@ua.pt; † Presenting author; Chemistry.

Abstract. The Kröhnke pyridine synthesis involves a multicomponent reaction between ,-unsaturated carbonyl 1 and -pyridinium methyl ketone salt 2, with an ammonia source present.[1,2] No modifications or evolutions have been made to the 60-year-old reaction for generating pyridines. Consequently, the reaction invariably leads to pyridine synthesis, with substituents only in ortho- and para-positions (Figure 1 A). By examining the Kröhnke reaction's mechanism, we can confirm that its final step involves the aromatization of pyridine through the extrusion of the pyridinium moiety. Consequently, it is reasonable to assume that if we could promote the aromatization of pyridine before removing the pyridinium, it could act as a leaving group for an aromatic amination with ammonia, which originates from the same nitrogen source responsible for the synthesis of pyridine (Figure 1 C).

To uphold our theory, we thoroughly exploited the reactivity of ether-tethered ,-unsaturated carbonyls 5 in their reaction with Kröhnke salts 2, which allowed for the aromatisation into pyridines by cleavage of the ether moiety (Figure 1 C1). As a result, the pyridine framework was completed retaining the pyridinium group, enabling the aromatic pyridine amination with ammonia (Figure 1 C2). In contrast to the known Kröhnke synthesis, that allows the synthesis of 2,4,6-trisubstituted pyridines 4, our method elegantly enables the simple and straightforward synthesis of 3-aminopyridines 8 (highly challenging position for amination) with substitutions at positions 2 and 5, following a multi-component two-step reaction (Figure 1 C). Therefore, this method allows the functionalization of electronically neutral carbons, instead of the common substitution in C-2, 4 and 6 that tend to be electron deficient (Figure 1 B). The synthesis of 3-aminopyridines 8 will be discussed along with the reaction's optimized conditions, scope, limitations, and mechanistic considerations. The synthesis of complex heterocyclic structures using these innovative compounds will also be investigated and evaluated.

Keywords: *Pyridine, Kröhnke Synthesis, Multicomponent Reaction*

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Acknowledgements. This work received financial support from PT national funds (OE) through FCT/MCTES (Fundação para a Ciência e a Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) within the projects: LAQV-REQUIMTE (UIDB/50006/2020 and UIDP/50006/2020) and MuTaTher-AD:Multi-target theranostics for Alzheimers disease (10.54499/2022.06064.PTDC). Telmo N. Francisco thanks FCT/MCTES (Fundação para a Ciência e a Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) for her PhD grant (2022.12243.BD). Hélio Albuquerque acknowledges MuTaTherAD for his research contract.

Active polymeric filtration membranes with siderophore for iron(III) removal from aqueous systems

Ricardo A. L. S. Santos[†,*,1], Diana C. G. A. Pinto[1], Célia M. P. G. Amorim[2]

1. University of Aveiro, Campus Universitário de Santiago 3810-193 Aveiro
2. Faculty of Pharmacy, University of Porto, R. Jorge de Viterbo Ferreira 228, 4050-313 Porto

* Corresponding author; † Presenting author; Chemistry.

Abstract. The excess of iron(III) in industrial effluents and in the blood is an issue. Not only the iron catalyzes the oxidation of organic compounds from living beings, but also forms highly insoluble precipitates of iron(III) oxyhydroxides [1]. Then, that solid's deposits interfere with the fluidic systems' normal flow.
One way to solve this problem is to dop filtration membranes with active agents such as siderophores to enable the chemisorption of the iron(III) present in the samples during the filtration process. It was chosen compounds of the hydroxamic acid family, with long alkyl chains for that purpose. They are known to have very high complex formation constants [2]. The addition of an alkyl chain to the hydroxamic acid was the strategy found to improve the lipophilicity of the siderophore, avoiding it leaching from the polymeric membrane structure during the nonsolvent-induced phase inversion process.
Those membranes, with the siderophore included, were prepared by spin-coating. They were then characterized in respect to their siderophore contents, porosities, and maxima water flows. Their specific iron(III) absorptions were analyzed in static and dynamic conditions.
The acidic constants of those siderophores were determined using the NMR technique.

Keywords: *membrane, siderophore, metal absorption, acidic constant*

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Acknowledgements. Acknowledgments
Thanks are due to the University of Aveiro and Portuguese National Funds, through FCT (Fundação para a Ciência e Tecnologia), and as applicable co-financed by FEDER within the PT2020 Partnership agreement by funding the LAQV-REQUIMTE (UIDB/50006/2020). RALS Santos thanks FCT for his PhD grant (UI/BD/151268/2021).
Funding
This work received financial support from PT national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) through the projects UIDB/50006/2020 and UIDP/50006/2020.

Examining the anti-inflammatory potential of alkylaminophenols: Uniting computational and experimental approaches for lead optimization

João A. Pacheco[†,⋆,1], Nuno R. Candeias[1], David M. Pereira[2]

1. LAQV REQUIMTE, Departamento de Química, Universidade de Aveiro, 3810-193 Aveiro, Portugal
2. LAQV REQUIMTE, Laboratório de Farmacognosia, Departamento de Química, Faculdade de Farmácia, Universidade do Porto, R. Jorge Viterbo Ferreira, nř 228, 4050-313 Porto, Portugal

⋆ Corresponding author; joaopacheco@ua.pt; † Presenting author; Chemistry.

Abstract. Alkylaminophenols are a family of synthetic phenolic Mannich bases that take advantage of the bioactivity of phenols and amines. The two main synthetic routes for these compounds are through the Petasis borono-Mannich reaction and through reductive amination.1 The versatility of these two pathways leads to the ease of access to a wide chemical space, ideal for lead optimization studies. While this family of compounds has been explored in the discovery of promising candidates with good anticancer and antimicrobial activities,2 the anti-inflammatory activity of this scaffold is practically unknown. This work focuses on the exploration of the anti-inflammatory potential of these compounds through a multi-disciplinary approach based on chemometric analysis, experimental screening, and machine learning-aided design3 of new promising candidates.The cell viability for human macrophages (THP-1 cells), 5-LOX inhibition, and COX-2 inhibition were determined for around 100 alkylaminophenols, these results allowed us to identify the least toxic, most active derivatives in our initial library. Using computational chemistry tools such as the RDKit library, we were able to identify strong structure-toxicity relations for our library, like the detrimental effect of a bicyclic amine moiety. A virtual chemical space expansion was performed using building blocks from chemical vendors, from which the top-performing candidates were selected for synthesis by a combination of supervised criteria, machine learning models trained on known inhibitors, and molecular docking on the selected target. The newly selected candidates will be synthesized and screened against the selected anti-inflammatory targets.The integration of computational techniques allowed us to prioritize highly active compounds while avoiding toxic ones, streamlining the practical synthetic process. In conclusion, this work highlights the bioactive potential of this scaffold, as well as underscoring the efficacy of computational methods for drug design and discovery.

Keywords: *alkylaminophenols, anti-inflammatory, computational chemistry, machine learning*

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Acknowledgements. This work received financial support from PT national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) through the projects UIDB/50006/2020, UIDP/50006/2020, CEE-CINST/2018 and PTDC/QUI-QOR/1131/2020. JP thanks FCT for his PhD grant UI/BD/153616/2022.

Enamide synthesis through a Chan-Evans-Lam reaction as a platform for the synthesis of N-heterocycles

Joana R. M. Ferreira[†,⋆,1], M. Manuel B. Marques[2], Samuel Guieu[3]

1. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, 3010-193 Aveiro, Portugal
2. LAQV-REQUIMTE, Department of Chemistry, School of Science and Technology, Universidade Nova de Lisboa, 2829-516 Caparica, Portugal
3. LAQV-Requimte, Department of Chemistry, University of Aveiro, 3010-193 Aveiro, Portugal
4. b) CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3010-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemistry.

Abstract. Indole and azaindole are N-heterocycles with a wide range of interesting biological properties such as antibacterial, antifungal, anti-inflammatory, and anticancer activities.1 Due to the rising interest in this type of compounds, and on their potential applications, efforts have been made to improve the synthetic methods and facilitate the access to diversely substituted N-heterocycles, as efficient alternatives to the classical synthetic methods.2

Enamines are important scaffolds in organic synthesis due to their exceptional nucleophilicity, however their susceptibility to hydrolysis3 remains a challenge in their application. Enamides present a similar reactivity, and therefore are great alternative with a higher stability.4 The current methods to obtain enamides have moderate yields, poor atom economy, use of expensive metal catalysts, or lack of E/Z selectivity as challenges.4 The use of Chan-Evans-Lam reaction with alkenylboranes and (hetero)aryl amides provides a direct pathway to synthesize (hetero)aryl enamides, but the use of alkenylboronic acids in the Chan-Evans-Lam reactions remains poorly investigated.5

We have been focused on the synthesis of N-heterocycles, namely azaindoles and indoles,6 and given the appeal of (hetero)aryl enamides as versatile synthetic intermediates, herein the reactivity of acetanilides and pyridyl acetamides was investigated for the formation of a CN bond through a Chan-Evans-Lam reaction using arylalkenyl boron-based reagents, yielding a wide scope of N-aryl enamides with an E configuration. These products have been applied to the synthesis of N-heterocycles using a sequential Heck reaction.

Keywords: *Chan-Evans-Lam reaction, Alkenyl organoborane, N-Heterocycles*

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Acknowledgements. Thanks are due to University of Aveiro, FCT/MEC, FCT/MCTES, Centro 2020 and Portugal2020, COMPETE program, and European Union (FEDER program), LAQV-REQUIMTE (LA/P/0008/2020 DOI 10.54499/LA/P/0008/2020, UIDP/50006/2020 DOI 10.54499/UIDP/50006/2020 and UIDB/50006/2020 DOI

10.54499/UIDB/50006/2020), CICECO-Aveiro Institute of Materials (UID/CTM/50011/2019, UIDB/50011/2020 & UIDP/50011/2020), Portuguese NMR Network. JRMF thanks FCT, ESF (European Social Fund), POCH (Programa Operacional Capital Humano) for her PhD grant (UI/BD/151272/2021), and FCT (PTDC/QUI-QOR/0712/2020).

From renewable energy waste to secondary raw materials source: sorption studies with graphene-based materials

Nicole Ferreira[†,⋆,1], Thainara Viana[2], Bruno Henriques[3], Gil Gonçalves[4], Cláudia Nunes[5], Eduarda Pereira[6]

1. Departament of Chemistry, LAQV-REQUIMTE, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
3. LAQV-REQUIMTE
4. Departamento de Química
5. Centre for Mechanical Technology and Automation (TEMA), Mechanical Engineering Department, University of Aveiro, 3810-193 Aveiro, Portugal
6. CICECO, Department of Materials and Ceramic Engineering, University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; nicoleviana@ua.pt; † Presenting author; Chemistry.

Abstract.
Offshore wind energy (OWE) is a key technology in the energy transition. However, the first generation of wind turbines (WT) is reaching its End-of-Life and becoming a waste management problem (325,000 t in 2050) (Lichtenegger et al., 2020). At the same time, supply bottlenecks for critical metals for WT assembly were identified. There is currently no sustainable solution to recycle them. Meanwhile, cumulative demand for key metals will grow from 1.1-25 kt (rare earth elements, REE) to 2-3.7 Mt (Cu, B) (Li et al., 2022). Copper and Dy are identified as the most critical materials since they face the possibility of supply shortage while being fundamental to the functionality of WT (Shammugam et al., 2019).
The present work aims to evaluate the ability of various graphene-based materials to remove critical raw materials (CRM) from complex mixtures simulating WT waste leachate.
The evaluated mixture simulated the composition of the nacelle component (Cu, B, Ni, Co, Nd, Dy, Pr, Y, Tb) in different concentration (100 ţg/L, 100 ţM and real concentration diluted 10-fold). The following materials were evaluated: GO-PEI-alginate, G3DTF and chitosan-GO (doses of 0.5, 1 and 10 g/L). The results showed that G3DTF was selective for Cu after 24 h (removal of 91, 82 and 68 % with increasing concentration) with negligible removal of the remaining elements (215 %). Chitosan-GO was more selective for B removal (90 %) and removed 1421 % of other elements. GO-PEI-alginate showed no selectivity, removing between 55-88 % of REE, 49-95 % of Cu, and 69 % of B.
Overall, the results support the use of graphene-based materials as alternative sorbents to efficiently recover CRM from complex mixtures.

Keywords: *Wind turbine waste, Technology-critical elements, Removal, Secondary resource, Graphene-based materials*

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Acknowledgements. Nicole Ferreira and Thainara Viana thanks the Fundação para a Ciência e a Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior for their PhD grant ref. 2022.13017.BD and 2022.13015.BD, respectively.

A prospective nature-based process to recover technology-critical elements from acid mine drainage

Thainara Viana[†,⋆,1], Nicole Ferreira[2], Eduarda Pereira[3], Bruno Henriques[1]

1. LAQV-REQUIMTE
2. Departament of Chemistry, LAQV-REQUIMTE, University of Aveiro, 3810-193 Aveiro, Portugal
3. Chemistry Department, LAQV REQUIMTE, and Central Laboratory of Analysis, University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal
4. Departamento de Química

⋆ Corresponding author; thainara@ua.pt; † Presenting author; Chemistry.

Abstract. Acid mine drainage (AMD) is environmentally unfriendly, given its acid character and persistence (thousands of years) and the considerable amount of toxic elements (TEs) that are leached and enter the aquatic environment, negatively impairing the marine and terrestrial ecosystems (Candeias et al., 2019). Apart from TEs, AMD has a prominent concentration of technology-critical elements (TCEs) such as Co, Ni and rare-earth elements (REEs) (European Commission, 2020). AMD recovery/valorization would promote advances in one of the main challenges of the mining industry, the recycling/reuse of mining wastes (León et al., 2021). Among potential low-cost sorbent materials, macroalgae are considered to be cost-effective and environmentally friendly and have the potential to recover TCEs from contaminated waters (Ferreira et al., 2020).
The present work aims to evaluate the capability of different macroalgae species for the removal of TCEs from real AMD while improving water quality.
AMD samples were collected from a Portuguese mine and characterized by Inductively Coupled Plasma Mass Spectrometry, selecting the elements of economic interest. The results revealed concentrations in the order of 3001000 ţg/L of REEs, Co and Ni. A comparative study of bioaccumulation and biosorption with Ulva, Gracilaria and Fucus in the original conditions of AMD (pH: 3.2, salinity 1.3 PSU) showed that bioaccumulation was more promising (removals between 32-44 %, 63-75 %, 17-29 % respectively). Living macroalgae could remove >62 % of Fe. Followingly, a precipitation step of non-interest elements was performed. Macroalgal dosage (0.08-0.3 ratio V/m) was evaluated in the pH-adjusted AMD for both Ulva and Gracilaria. The effect of dosage was easily verifiable on the removal (%). By increasing the dosage, REEs removal increased. Overall, Gracilaria stood out and accumulated up to 274 ţg/g of REEs, which correspond to bioconcentration factors between 414-1517.
Overall, these results support the use of living macroalgae as the basis of an efficient, greener, and low-cost technology to remediate AMD-containing TEs, REEs, and other TCEs.

Keywords: *Pyrite mine, Acidic waters, Rare earth elements, Removal, Secondary resource, Marine macroalgae*

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Acknowledgements. Thainara Viana and Nicole Ferreira thanks the Fundação para a Ciência e a Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior for their PhD grant ref. 2022.13015.BD and 2022.13017.BD, respectively.

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Silica-based porous materials for the adsorption of hormones from water

Tiago Morais[†,1], Diogo Pereira[2], Geraldine Sequera[3], Ana C. Moreira[4], Marina Ilkaeva[4], Luis Mafra[5], Mariana Sardo[5], Vânia Calisto[1], Mirtha A. O. Lourenço[⋆,6]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Chemistry, University of Iceland, Science Institute, Dunhaga 3, 107 Reykjavik, Iceland
3. 2CESAM, Department of Chemistry, University of Aveiro, Portugal
4. 1CICECO, Department of Chemistry, University of Aveiro, Portugal
5. CICECO - Aveiro Institute of Materials
6. CESAM Department of Chemistry

⋆ Corresponding author; mirtha@ua.pt; † Presenting author; Chemistry.

Abstract. The 17-ethinylestradiol (EE2) is a synthetic bioactive hormone used in contraceptive pills, that has been found in wastewater treatment plants (WWTPs) around the world [1]. Periodic mesoporous organosilicas (PMO) are promising candidates to perform the EE2 removal from water, due to their interesting characteristics like the ability to tune the organic bridge with smart functionalities, that can give them the desirable properties for this kind of application [2]. Therefore, this work aimed to compare the efficiency of different types of silica-based porous materials, namely MCM-41, vinyl grafted MCM-41 (vinyl@MCM-41), and phenylene-PMO (Ph-PMO), to remove EE2 from water. Batch adsorption tests were performed using an initial concentration of EE2 of 200 ţg.L-1 and the remaining concentration in the treated aqueous was followed by HPLC with fluorescence detection. Preliminary adsorption studies with different materials dosage, pH and water matrix allowed to select Ph-PMO as the material with the higher removal percentages at the studied conditions, being subsequently evaluated in kinetic and isotherm studies. The kinetic studies showed that the adsorption equilibrium was reached up almost instantaneously (after a few minutes) for the different evaluated matrices (ultrapure water, phosphate buffer (pH 8) and wastewater effluent). Regarding equilibrium experiments, Langmuir maximum adsorption capacity (qm) varied between 504 ś 63 ţg.g-1 in phosphate buffer (pH 8) and 456 ś 41 ţg.g-1 in wastewater. The results show the promising potential of PMOs to perform a fast and efficient removal of EE2 from water and this proof of concept serves as a starting point for studies with even more optimized PMOs.

Keywords: *Hormone capture; Periodic Mesoporous Organosilicas (PMOs); Water remediation; 17-ethinylestradiol (EE2)*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MEC (PIDDAC). We also acknowledge funding from project PTDC/QUI-QFI/28747/2017 (GAS2MAT-DNPSENS - POCI-01-0145-FEDER-028), financed through FCT/MEC and cofinanced by FEDER under the PT2020 Partnership Agreement. The NMR spectrometers are part of the National NMR Network (PTNMR) and are partially supported by Infrastructure Project 022161 (cofinanced by FEDER through COMPETE 2020, POCI and PORL and FCT through PIDDAC). This work has received funding from the European Research Council (ERC) under the European Unions Horizon 2020 research and innovation program (Grant Agreement 865974). FCT is also acknowledged by D.P. for a Ph.D. Studentship (2020.05389. BD), M.I., M.A.O.L. and M.S. for Researcher positions (CEECIND/00546/2018, CEECIND/01158/2021 and CEECIND/00056/2020 respectively). M.A.O.L further acknowledges the funding from the European Unions Horizon 2020 research and innovation programme (ERA-PF grant agreement No 101090287).

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Development of dual-targeting probes for fluorescence imaging of amyloid and tau species

Lúcia Melo[†,⋆,1], Artur M. S. Silva[1], Hélio M. T. Albuquerque[1]

1. University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Chemistry.

Abstract. Currently, Alzheimers Disease (AD) remains without a cure.1 Regrettably, the accurate diagnosis only becomes feasible post-mortem. Hence, imaging techniques targeting A and/or tau species offer valuable insights for monitoring and diagnosing AD.2 While existing NIRF-I probes (700-900 nm) are unsuitable for use in human AD patients since A plaques and tau proteins are buried inside the skull-shielded brain, recent studies suggest that NIRF-II imaging (1000 1700 nm) holds a more promising approach.2-4 NIRF-II imaging may circumvent some of the issues of NIRF-I probes, like photon scattering, autofluorescence, and tissue absorption, improving time-spatial resolution compared to traditional NIRF-I methods.2-4 Despite this, the development of NIRF-II probes targeting A and/or tau species is remains limited, with only two NIRF-II proves reported thus far, specifically designed for detecting A oligomers or plaques.
Chromones have gained attention in the field of amyloid beta imaging owing to their structural properties and potential as scaffolds for probe development.5 Overall, they offer a combination of biocompatibility, structural flexibility, fluorescent properties, and chemical stability, crucial to probe optimization for diagnostic and research purposes in AD.5 In fact, previous studies have demonstrated that chromone building blocks hold promise as scaffolds for creating AIE-active probes capable of precisely targeting A plaques with high sensitivity and fidelity.6 However, these probes emit wavelengths within the NIRF-I region, limiting their utility in in vivo and in AD patients.
As such, this project aims to address these limitations, through the implementation of a stepwise design and synthetic strategy for developing NIRF-II probes. It will utilize chromone and quinolone building blocks, incorporating various recognition units in a donor-acceptor-donor (D-A-D) architecture on both sides (east and west), with the anticipation of eliciting distinct fluorescent responses upon binding to A and tau species.

Keywords: *Alzheimers disease, NIR-II probes, A species, Tau species, Dual-responsive compounds*

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Acknowledgements. This work received financial support from PT national funds (OE) through FCT/MCTES (Fundação para a Ciência e a Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) within the projects: LAQV-REQUIMTE (UIDB/50006/2020 and UIDP/50006/2020) and MuTaTher-AD:Multi-target theranostics for Alzheimers disease (10.54499/2022.06064.PTDC). Lúcia Melo thanks FCT/MCTES (Fundação para a Ciência e a Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) for her PhD grant (2023.02496.BD). Hélio Albuquerque acknowledges MuTaTherAD for his research contract.

Bio-based furan polymers via ring opening polymerization

Chaimaa Sadraoui[†,⋆,1], Feriel Abid [2], Giacomo Trapasso [1], Armando J. D. Silvestre[3], Andreia F. Sousa[3], Fabio Aricò[1]

1. Department of Environmental Sciences, Informatics and Statistics, Ca Foscari University of Venice, Via Torino 155, 30172 Venezia Mestre, Italy
2. CICECO - Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
3. CICECOAveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal.

⋆ Corresponding author; chaimaa.sadraoui@ua.pt; † Presenting author; Chemistry.

Abstract. The extensive use of linear polyesters (PEs) in packaging, smart materials, clothing, and electronics is a testament to their remarkable qualities and versatility. PEs like poly(ethylene terephthalate) (PET), and poly(butylene terephthalate) (PBT) are among the most used in everyday life. However, the production and consumption of fossil-derived PEs come with certain critical issues such as the depletion of crude oil resources and environmental concerns related to their frequent low levels of biodegradability. [1] In addition, traditional polymerization strategies often require harsh reaction conditions and metal catalysts, with the consequent production of undesired by-products that need to be removed from the reaction mixture. [2]
From these premises, our recent work has been focused on developing alternative synthetic strategies towards bio-based PEs via Ring Opening Polymerization (ROP) of macrocycles incorporating bio-based monomers, such as 2,5-furandicarboxylic acid dimethyl ester (FDME). The macrocycles were synthesized by reacting FDME with different diols such as tetraethylene glycol and hexaethylene glycol both via pseudo-high dilution condensation (PHDC) [3] and cyclo-depolymerization (CDP).[4]
Subsequent ROP experiments were conducted both on the pure isolated macrocycles and on the macrocyles mixtures to achieve high molecular weight polyesters. Reaction conditions of the ROP such as catalyst, solvent, concentration and temperature were investigated, and efforts were made to recover and reuse solvents and catalysts when feasible.
The structural characterization of the polymers obtained was carried out employing FTIR, 1H NMR, 13C NMR, TGA, GPC and DSC techniques.

Keywords: *Ring Opening Polymerization; 2,5-furandicarboxylic acid dimethyl ester; Green Synthesis; Macrocycles.*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC).
The FCT is acknowledged for the research contract under Scientific Employment Stimulus to AFS (CEECIND/02322/2020, DOI 10.54499/2020.02322.CEECIND/CP1589/CT0008).
FCT and CICECO are also acknowledged for a doctorate grant under LA/P/0006/2020 to FA (BI/UI89/117032/2023) and a researchcontract to PSSL. COST Action FUR4SustainEuropean network of FURan based chemicals and materials FOR a Sustainable development, CA18220, supported by COST (European Cooperation in Science and Technology) is also acknowledged.

Solar-driven photocatalytic removal of antibiotics from wastewater using carbonaceous magnetic nanocomposites

Valentina Silva[†,⋆,1], Nuno J.O. Silva[2], Marta Otero[3], Diana L. D. Lima[4], Vânia Calisto[1]

1. CESAM Department of Chemistry
2. Department of Physics, Department of Chemistry CICECO
3. Departamento de Química y Física Aplicadas
4. HTRC - Health Technology Research Center, Coimbra Health School

⋆ Corresponding author; valentinagsilva@ua.pt; † Presenting author; Chemistry.

Abstract. One of the major public health risks of the 21st century is the spread of bacterial resistance, to which the presence of antibiotics in the aquatic environment contributes. The development of efficient treatments for the removal of antibiotics from aqueous effluents is essential to reduce their entrance in natural waters. Among the most used antibiotics, and therefore commonly present in wastewater, are amoxicillin (AMX), sulfamethoxazole (SMX) and trimethoprim (TMP), which have been added to the watch list of priority substances in the context of the Water Framework Directive. A sustainable way to effectively remove these antibiotics from wastewater is using sunlight for their photodegradation. However, such a treatment lacks the efficiency required for widespread implementation and its application has been mainly laboratory-based. To overcome this limitation, this work aims to develop efficient photocatalysts under sunlight by incorporating carbon dots into titanium dioxide and coupled with magnetic properties, which allow for their easy recovery and reuse. The photocatalysts were synthetized using different methodologies (co-precipitation, functionalization & coupling, hydrothermal treatment, sonication & calcination, and oxidative hydrolysis of iron (II) salts). Resulting materials were compared considering the removal of AMX, SMX and TMP from water. Accordingly, co-precipitation was selected for optimization by a central composite design to evaluate the influence of 3 main synthesis variables on 5 different responses. The proposed strategy is allied with green chemistry principles and materials circularity, with special focus on the photocatalysts magnetic after-use recuperation and subsequent reutilization.

Keywords: *Emerging Organic Microcontaminants, Photodegradation, Photocatalysts, Carbon dots, Antimicrobial resistance, Water treatment*

Acknowledgements. The authors acknowledge financial support to CESAM by FCT/MCTES (UIDP/50017/2020+UIDB/50017/2020+ LA/P/0094/2020), through national funds. Valentina Silva thanks FCT support for the individual PhD grant (2022.10472.BD). Diana Lima acknowledges funding to SOLarClean from Coimbra Health School (ESTeSC IPC) in the scope of the project call I2D: Igniting InterDisciplinarity of 2023.

Valorization of thistles from beira baixa through the study of the biochemical profile and potential bioactivities

Ana C. S. Veríssimo[†,⋆,1], Paula B. Andrade [2], Diana C. G. A. Alves[3]

1. LAQV-REQUIMTE, Department of Chemistry, Campus Universitário de Santiago, University of Aveiro, 3810-193 Aveiro, Portugal
2.
3. 2 REQUIMTE/LAQV, Laboratório de Farmacognosia, Departamento de Química, Faculdade de Farmácia, Universidade do Porto, Rua de Jorge Viterbo Ferreira, no. 228, 4050-313 Porto, Portugal

⋆ Corresponding author; carolinaana@ua.pt; † Presenting author; Chemistry.

Abstract. Thistle is the name given to various weedy, herbaceous, and thorny plants, mostly belonging to the Apiaceae, Dipsacaceae, and Asteraceae families. Usually, they appear spontaneously on agricultural land, pastures, fallow lands, and wastelands, as happens in the Beira Baixa region. These plants have no value for agriculture or animal feed, thus becoming unused waste for local farmers, as they have to be removed, resulting in additional costs. Furthermore, some plants found in the Beira Baixa area have never been studied from a biochemical point of view, namely, their biochemical profile and possible associated bioactivities. Therefore, studying these plants to find alternative ways of valuing them and contributing to the region's development is essential.
Different species of thistle have been used for hundreds of years in traditional medicine to treat various diseases, as they have anti-inflammatory, antibacterial, antipyretic, cytotoxic, and antidiabetic properties, most often prepared by infusion, decoction, or boiling [1]. There are studies where different species of thistles have been explored for their bioactive properties with promising results [2,3].
Therefore, the main objective of this work is to value unexplored thistles in the Beira Baixa region through the study of the biochemical profile and identification of bioactive compounds.

Keywords: *Thistles; valorization; Galactites tomentosus*

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Acknowledgements. Funding: This work received financial support from PT national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) through the projects UIDB/50006/2020 and UIDP/50006/2020.
Acknowledgements: Thanks are due to the University of Aveiro and Portuguese National Funds, through FCT (Fundação para a Ciência e Tecnologia), and as applicable co-financed by FEDER within the PT2020 Partnership agreement by funding the LAQV-REQUIMTE (UIDB/50006/2020+UIDP/50006/2020). Ana C. S.Veríssimo also thanks FCT/MCTES (Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) for her PhD grant ref. 2022.11989.BD

Structural features and health effects of water-soluble organic matter from atmospheric fine air particulates

Antoine S. Almeida[†,⋆,1], Bruno M. Neves [2], Regina M. B. O. Duarte [1]

1. CESAM Centre for Environmental and Marine Studies, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Medical Sciences and Institute of Biomedicine - iBiMED, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; antoinealmeida@ua.pt; † Presenting author; Chemistry.

Abstract. Fine atmospheric particulate matter (PM2.5) exposure has been recognized as a key public health issue [1]. Exposure to atmospheric aerosols has been linked with increased risks of lung cancer, cardiovascular, and respiratory diseases. Additionally, PM exposure affects the immune system, leading to an increased susceptibility to infections and pathogens, or exacerbating other pre-existent lung diseases [2]. The main mechanisms through which PM2.5 can affect the human health, include the induction of reactive oxygen species (ROS), the triggering or exacerbation of an inflammatory response, and PM-related direct cytotoxicity [3]. These toxicological effects have been associated with PM2.5 concentration, and its composition in metals and solvent-extractable organics [4,5]. Although not receiving much attention, the ubiquitous water-soluble organic matter (WSOM) present in PM2.5 has also been linked with these adverse effects [6]. Hence, it is important to better understand the impacts of this PM2.5 fraction.
In this work, the structural features of daytime and nighttime PM2.5 WSOM samples from an urban and a rural location will be discussed by means of NMR spectroscopy. Furthermore, a brief overview of the health effects on a human monocytic cell line (THP-1) will be addressed. Regarding the percentage distribution of 1H functional groups on these samples collected during warm and cold seasons, some differences can be observed between the studied environments. For example, during the daytime of cold seasons, the rural sample exhibits a lower percentage of oxygenated aliphatic groups and increased percentage of saturated aliphatic moieties when compared with the urban samples. On the other hand, the rural WSOM samples from the night period exhibit an opposite trend for the relative distribution of saturated aliphatic and saturated oxygenated moieties compared with their daytime counterparts. This inner daily variation might be linked with the increased biomass burning, a prevalent practice for household heating in this rural area.

Keywords: *fine aerosols; water-soluble organic matter; structural characterization, inflammatory effects*

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Chromeno[3,4-b]xanthones: a first-in-class multitarget scaffold for Alzheimers Disease

Daniela Malafaia[†,⋆,1], Natércia F. Brás[2], Pedro A. Fernandes[2], Maria J. Ramos[2], Lúcia Melo[3], Jéssica Sarabando[4], Ana R. Soares[5], Daniela Ribeiro[6], Joana Saavedra[7], Isabel Cardoso[8], Loreto Martinez-Gonzalez[9], Ana Martinez[9], Hélio M. T. Albuquerque[1], Artur M. S. Silva[1]

1. LAQV-REQUIMTE, Departamento de Química, Universidade de Aveiro, 3810-193 Aveiro, Portugal
2. LAQV-REQUIMTE, Department of Chemistry and Biochemistry, University of Porto, 4169-007 Porto, Portugal
3. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
4. Institute of Biomedicine (iBiMED), Department of Medical Sciences
5. Institute of Biomedicine (iBiMED), Department of Medical Sciences, University of Aveiro, 3810-193 Aveiro, Portugal
6. iBiMED
7. Molecular Neurobiology Group, Institute for Health Research and Innovation (i3S), Institute of Molecular and Cellular Biology (IBMC), Porto, Portugal. Department of Molecular Biology, Abel Salazar Institute of Biomedical Sciences (ICBAS), University of Porto, Porto, Portugal.
8. Molecular Neurobiology Group, Institute for Health Research and Innovation (i3S), Institute of Molecular and Cellular Biology (IBMC), Porto, Portugal. Department of Molecular Biology, Abel Salazar Institute of Biomedical Sciences (ICBAS), University of Porto, Porto, Portugal
9. Centro de Investigaciones Biologica, CSIC, Ramiro de Maeztu 9, 28040 Madrid, Spain

⋆ Corresponding author; danielamalafaia@ua.pt; † Presenting author; Chemistry.

Abstract. Alzheimers disease (AD) is increasingly growing as the worlds population ages.1 This neurodegenerative disorder is mainly characterized for the progressive loss of memory, cognitive, motor and functional capacity.2 Alongside the demographic challenge of the growing number of AD patients is the low success rate in the development of new disease-modifying therapies.1 In fact, since 2003, only a few drugs were approved for the treatment of this disease, particularly the monoclonal antibodies Aducanumab and Lecanemab, controversially approved by the Food and Drug Administration (FDA).3,4 Even though both antibodies emerged as a landmark in the AD drug development, due to the high cost associated to this type of therapy, many experts believe that not everyone will get access to it, particularly low-income and middle-income countries (LMICs), with under-resourced public health systems.1 For this reason, there has been a worldwide effort to develop a more affordable and effective therapy for AD, such as for example small molecules, which are cheaper, widely accessible and more convenient to administer. To address this issue, we disclosed an originally in-house designed scaffold, chromeno[3,4-b]xanthones, proposed to hit multiple AD-related targets.5 Herein, we discuss this first-in-class scaffold both in vitro and in cellulo, including their design and synthetic strategies, anticholinesterase (AChE and BChE) and antiaggregating (A and tau) properties, molecular docking and electron-microscopy studies, bloodbrain barrier (BBB) permeability, cytotoxicity and application in cell models of AD, using an human neuroblastoma cell line (SH-SY5Y).

Keywords: *Alzheimer's disease, chromeno[3,4-b]xanthones, multitarget strategy, cholinesterases, A and tau protein aggregation*

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Acknowledgements. This work received financial support from PT national funds (OE) through FCT/MCTES (Fundação para a Ciência e a Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) within the projects: LAQV-REQUIMTE (UIDB/50006/2020, PTDC/MED PAT/0959/2021 and UIDP/50006/2020), and MuTaTher-AD: Multi-target theranostics for

Alzheimers disease (10.54499/2022.06064.PTDC). Daniela Malafaia thanks FCT/MCTES (Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) and ESF (European Social Fund) through NORTE 2020 (Programa Operacional Região Norte) for her PhD grant (2021.05641.BD). Natércia F. Brás thanks FCT for her CEEC grant (CEECIND/02017/2018). Joana Saavedra thanks FCT/MCTES for her PhD grant (2023.03111.BD). Hélio Albuquerque thanks MuTaTher-AD for his research contract.

Development of new stimulants for the production of pine resin and its valorization

Inês da Silva Lito Farias[†,⋆,1], Nalin Seixas[1], Carla Vilela [1], Sónia A. O. Santos[1], Armando J. D. Silvestre [1]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal.

⋆ Corresponding author; ines.farias@ua.pt; † Presenting author; Chemistry.

Abstract. Resin, or oleoresin, is a translucent, viscous liquid, usually extracted from conifers of the genus Pinus (Pine),(Yadav et al., 2016) which is composed of a volatile fraction, turpentine, rich in monoterpenes and a non-volatile fraction, rosin, rich in diterpenic acids.(Duane F. Zinkel, 1989; Mohamed Naceur Belgacem, 2008; Neis et al., 2019; Yadav et al., 2016) These compounds have numerous industrial applications spanning from insecticides, disinfectants and cleaning products, to paints and adhesives, fragrances or even pharmaceuticals.(Neis et al., 2019; Raquel Gonçalves, 1990) The resin extraction process has several steps, among which the application of a stimulating agent, traditionally based on sulfuric acid, which promotes an increase in resin production. This agent has several associated risks, both for the environment and for those who manipulate it, making it imperative to develop more sustainable alternatives.
Thus, one of the objectives of the present study is the development of new stimulants based on natural compounds with increased safety and productivity. In addition, we also aim at developing new applications of resin acids, namely for the surface treatment of cellulose-based materials.

Keywords: *Natural resin, Resin acids, Stimulants, Biorefinery*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). The RN21 Integrated Project - Innovation in the Natural Resin Sector for the Reinforcement of the National Bioeconomy, is co-financed by the Environmental Fund through Component 12 - Promotion of Sustainable Bioeconomy (Investment TC-C12-i01 - Sustainable Bioeconomy No. 02 / C12-i01 / 202), European funds allocated to Portugal by the Recovery and Resilience Plan (PRR), under the European Union's (EU) Recovery and Resilience Mechanism (MRR), framed within the Next Generation EU, for the period from 2021 to 2026.

Exploring the use of protein-based G-quadruplex-derived supramolecular hydrogels as dynamic and stable bioinks for biomedical applications

Vera Sousa[†,⋆,1], Rita Sobreiro-Almeida[1], João Borges[1], João F. Mano[1]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; vcfs@ua.pt; † Presenting author; Chemistry.

Abstract. G-quadruplexes, unique four-stranded structures found in guanine-rich DNA and RNA sequences, have garnered significant attention due to their self-assembled nature and crucial participation in various biological processes, such as DNA replication, transcription, translation, and telomere maintenance [1-3]. However, the G-quadruplex self-assembled structures developed to date have shown to be rather unstable over time and irreversibly disassemble [4], which is a major bottleneck for biomedical applications.

In this study, a novel gelatin-based G-quadruplex-derived supramolecular bioink was successfully produced by self-assembling guanosine, 2-formylphenyllboronic acid, and gelatin in the presence of potassium ions (K+). The stability of the G-quadruplex supramolecular biomaterials was successfully accomplished by the synergistic effect of transglutaminase (TG)-mediated enzymatic crosslinking and macromolecular crowders (MMC), the latter reducing the activity of water molecules surrounding the G-quadruplex structures and enhancing their stability via dehydration. The dynamic inks were characterized for their chemical and rheological properties, printability, and in vitro biological performance. Our findings revealed that the presence of MMC induced a conformational change from a parallel to an antiparallel secondary structure, which is thermodynamically more stable. Furthermore, the MMC improved the ink viscosity, yield stress, and shear-thinning behavior, thereby enhancing the filament and shape fidelity. This bioink holds great promise for (bio)printing highly complex and multifunctional 3D structures that could better recreate damaged tissues and/or organs and be used in multiple tissue engineering and regenerative medicine strategies.

Keywords: *Dynamic hydrogels, G-quadruplex structures, 3D bioprinting*

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Acknowledgements. This work was funded by the European Unions Horizon Europe research and innovation programme under the grant agreement No. 101079482 (SUPRALIFE). This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MEC (PIDDAC). The financial support by FCT through the individual PhD grant (2020.06771.BD, DOI 10.54499/2020.06771.BD V.S.), and individual Junior Researcher (2022.04605.CEECIND/CP1720/CT0021, DOI 10.54499/2022.04605.CEECIND/CP1720/CT0021 R.S.-A.) and Assistant Researcher contracts (2020.00758.CEECIND/CP1589/CT0007, DOI 10.54499/2020.00758.CEECIND/CP1589/CT0007 J.B.) under the Scientific Employment Stimulus is gratefully acknowledged.

Eutectic solvents as catalysts for polyesters mixed waste chemical recycling.

Simão V. Pandeirada[†,1], Paulo J. A. Ribeiro-Claro[1], Beatriz Agostinho[1], Shanmugam Thiyagarajan[2], Andreia F. Sousa[⋆,3]

1. CICECO and Department of Chemistry, University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal.
2. Wageningen Food Biobased Research, P.O. Box 17, 6700, AA Wageningen, the Netherlands.
3. CICECO and Department of Chemistry, University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal. Centre for Mechanical Engineering, Materials and Processes, Department of Chemical Engineering, University of Coimbra, Coimbra, Portugal.

⋆ Corresponding author; † Presenting author; Chemistry.

Abstract. The widespread use of plastics has played a major role in driving the economic progress worldwide, with an annual production exceeding 400 million tons in 2022 [1]. Nevertheless, only a small portion (c.a. 15%) undergoes recycling due to a myriad of constraints including the highly contaminated and mixed nature of polymer waste, leading typically to their incineration or accumulation in landfills [2]. In that regard, poly(ethylene terephthalate) (PET) have been used in the combination with other functional polymers such as PP, PE and PVC, however the sorting of these polymers and PET selective recycling is sometimes challenging [3]. Given the imminent market introduction of poly(ethylene 2,5-furandicarboxylate) (PEF) it is important to evaluate the impact on the recycling stream of PET due to their potential mixture. Recently, some approaches using eutectic solvents (ES) have been advantageously explored for poly(ethylene terephthalate) (PET) chemical recycling, although mix-polymers waste was not assessed [4,5].
Despite the enormous importance and impact on PET recycling, this is the first study reporting the structural, thermal and thermo-mechanical properties of the recycled copolymers rPET-co-PEF. In this work, the ability of a greener chemical recycling system using ES (Urea:Zinc acetate) as catalyst was tested in the chemical recycling of PET with PEF residual molar percentages, considering 2%, 5% and 10%. The thermal and thermo-mechanical properties of the rPET-co-PEFs revealed very similar thermal behaviour compared to virgin PET. Moreover, the depolymerization mechanism was studied trough DFT calculations, revelling that the hydrogen bond between the urea amine groups and the ester have a major role in reducing the reaction activation energy proving the catalytic effect of used urea-based ES.
The characterization of recycled rPET-co-PEF reveal very similar thermal behavior in comparison with the virgin PET. Moreover, the depolymerization mechanism study proved the crucial role of urea in decreasing the depolymerization activation energy.

Keywords: *Furandicarboxylic acid; Poly(ethylene 3,4-furanoate); Ab inito calculations; Thermal analysis; Crystallization.*

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ADVANCEMENTS IN THE SYNTHESIS OF POLY(ALKYLENE FURAN-2,5-DICARBOXYLATE)s THROUGH RING OPENING POLYMERIZATION

Feriel Abid [†,⋆,1], Paula S. S. Lacerda [1], Armando J. D. Silvestre[1], Andreia F. Sousa[1]

1. CICECOAveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal.

⋆ Corresponding author; feriel.abid@ua.pt; † Presenting author; Chemistry.

Abstract. The escalating concerns, surrounding the extensive use of fossil based polymers and materials, coupled with their environmental threats, greenhouse gas (GHG) emissions, and lack of circularity, have spurred significant research and technological endeavours in polymers derived from renewable sources as viable alternatives to their fossil-based counterparts. However, in addition to the biobased origin of the monomers, from a sustainability perspective, the development of greener strategies for polymers synthesis is also absolutely fundamental. In this regard, the Ring Opening Polymerization (ROP) of macrocyclic esters, to produce the corresponding polyesters, emerges as a more environmentally friendly synthetic pathway. This approach ensures that all reactants utilized are seamlessly integrated into the final polyesters, thus embodying atom-economy principles. Moreover, ROP typically requires milder reaction conditions compared to conventional melt polycondensation methods, further bolstering its green credentials [1].
In this work, firstly we studied the synthesis of two macrocycles based on 2,5-furandicarboxylic acid, namely the ethylene 2,5-furandicarboxylate (CEF) and hexamethylene 2,5-furandicarboxylate (CHF) macrocyles via cyclodepolymerization of the corresponding low molecular weight linear polyesters species under high dilution conditions. Secondly, this study investigated the ROP of these macrocyclic oligoesters using various metal catalysts under different time and temperature conditions to produce high molecular weight polyesters. The obtained macrocyclic and their related polymers were in-depth characterized by FTIR, 1H and 13C NMR, GPC, XRD, DSC, and TGA.

Keywords: *Polyester synthesis; Ring Opening Polymerization; 2,5-furandicarboxylic acid; Greener synthesis*

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Civil engineering

Structural assessment of historical construction at multiple scales: the development of digital tools to preserve cultural heritage

Douaa Elbashir†,⋆,1, Hugo Rodrigues2, Paulo Fernandes3

1. RISCO, Department of Civil Engineering, University of Aveiro
2. RISCO, Department of Civil Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
3. CERIS

⋆ Corresponding author; † Presenting author; Civil engineering.

Abstract. Analysing historical structures requires sophisticated numerical models to account for geometry, material properties, and accurate damage depiction (1). This task is imperative for conservation planning as it provides the ability to verify the structures stability, understand observed damages, estimate performance degradation, and consequently design effective repairing interventions (2).

The work of this thesis is focused primarily on the Monastery of Batalha as a case study, establishing a framework using macro and micro-modelling techniques to represent the monument, identify present damages and understand the structures local and global behaviour. Subsequently, the generated numerical models are then coupled with a Structural Health Monitoring (SHM) system installed in the monastery, thereby enabling the creation of a live digital twin.

The digital twin, a rapidly developing technique, applied across various domains such as manufacturing, energy, and agriculture, is aimed to facilitate scenario-based analysis and offer insights in an intuitive manner (3,4). Within conservation and civil engineering in general, it can be employed to provide control over complex systems and manage data flow by integrating an array of technologies to unify virtual and physical assets throughout the buildings lifecycle. Generating a real-time updated digital replica of the structure will enhance comprehension of damage evolution and facilitate decision-making supported by technology integration (5). In this light, the digitalization in structural rehabilitation and conservation presents an opportunity to enhance productivity levels.

Keywords: *Structural Assessment, Monitoring, Numerical Modelling, Non-destructive Tests, Digital Twin*

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Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Post-earthquake fire numerical analyses on reinforced concrete structures

Hugo Vitorino[†,⋆,1], Paulo Vila Real[1], Carlos Couto[1], Hugo Rodrigues[1]

1. Universidade de Aveiro

⋆ Corresponding author; † Presenting author; Civil engineering.

Abstract. Post-earthquake fires present a significant hazard in urban environments, with the potential to exceed the destructive impact of the seismic event itself. Understanding the behaviour of reinforced concrete structures in such scenarios is crucial for effective risk mitigation and disaster response strategies. To this end, analyses utilizing SAFIR, a software for modelling structural response to fire, have been conducted. Initial studies suggest that post-earthquake damage can compromise the fire resistance of reinforced concrete frames, making them more susceptible to collapse compared to their intact counterparts. A comprehensive study was conducted to assess various factors influencing post-earthquake fire resistance, including the nature and location of damage and fire. It was observed that distinct locations of the fire had a notable effect on the structural response. Three distinct fire curves were employed for analysis: the standard ISO 834 fire curve, as well as parametric fire curves with and without firefighting measures. The use of parametric fire curves without firefighting measures corresponds to an earthquake scenario in which both active and passive firefighting measures are deemed unreliable. The use of these parametric fire curves may represent a preferable approach compared to the use of the standard fire curve ISO 834. It was observed that the frames subjected to the parametric fire curve without firefighting measures exhibited lower times until collapse when compared to the frames exposed to the standard fire curve ISO 834. Moreover, a significant number of frames subjected to parametric curves with active firefighting measures did not collapse, demonstrating prolonged structural integrity even in the face of severe seismic damage. These findings underscore the critical importance of the firefighting measures in mitigating post-earthquake fire hazards. In the chaotic aftermath of a seismic event, delayed rescue operations coupled with diminished structural fire resistance pose heightened risks, potentially resulting in significant loss of life and infrastructures.

Keywords: *Numerical Analyses, Post-Earthquake Fire, Earthquake damage, Standard Fire curve ISO 834, Parametric fire curves, Reinforced concrete, Fire resistance*

Acknowledgements. Financial support provided by the FCT and the FSE under the III Community Support Framework. This thesis was funded by the FCT, through the award of a PhD grant with the reference SFRH/BD/148582/2019.

Development of a novel composite panel incorporating wastes from end-of-life wind turbine blades: mechanical and acoustic performance evaluation

German Vela[†,⋆,1], Antonio Figueredo[1], Vitor Costa[2]

1. RISCO, Department of Civil Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
2. TEMA, Department of Mechanical Engineering, University of Aveiro. 3810-193 Aveiro, Portugal

⋆ Corresponding author; german@ua.pt; † Presenting author; Civil engineering.

Abstract. As global wind energy production grows, wind turbines are currently facing one of their biggest challenges: increased waste generation. The energy grid successfully added 77.6 GW of wind power capacity in the Europe, in 2022, totalizing 906 GW, exhibiting a remarkable annual growth of 9% [1]. Estimates suggest that the turbines will produce 320.000 metric tons of waste over the next 30 years [2]. At the same time, the implementation of current recycling techniques to preserve the original properties of the materials is a complex issue or economically unfeasible due to the complexity of the materials involved, such as glass fibers, carbon fibers and different types of resins. Therefore, it urges to prioritize the research for effective and sustainable solutions to deal with waste disposal from the end-of-life wind turbine blades, considering the involved costs and environmental impact.

The aim of this study is to develop composite panels using wastes from the end-of-life wind turbine blades, for application in the construction sector. A mechanical recycling process to treat the waste wind turbine blades sections is employed, which involves cutting and crushing the blades sections, the resulting crushed fiber and resin mixing being then combined with bio-based binders to create the new composite from which the panels are obtained.

An experimental campaign was developed to evaluate the mechanical properties of the panels, namely their compression and bending strengths. Additionally, acoustic tests were performed to measure and optimize the absorption and the transmission loss, aiming to develop panels with the good expected acoustic characteristics.

The results indicate that the composite material is appropriate for producing panels with good mechanical properties and excellent acoustic characteristics, making it suitable for application in the construction sector. These panels present themselves as a practical alternative to traditional noise insulation solutions, promoting sustainability, circular economy. They are a viable and promising solution for the reuse of wastes from the end-of-life wind turbine blades.

Keywords: *End-of-life wind turbine blades, circular economy, panels for the construction sector, mechanical characteristics, acoustic insulation.*

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Acknowledgements. This research work was supported by the Fundação para a Ciência e a Tecnologia (FCT) [DOI 10.54499/UI/BD/154572/2022] and by the Center for Research on Risks and Sustainability in Construction (RISCO), University of Aveiro, Portugal [UI/BD/154572/2022].

Post-Earthquake Fire Risk Assessment at Urban Scale

Vahid Khiali[†,⋆,1], Hugo Rodrigues[1]

1.

⋆ Corresponding author; † Presenting author; Civil engineering.

Abstract. Post-earthquake fires can have high consequences in terms of human loss and damage to property, where the losses caused by the fire can be even higher than the losses caused by the earthquake. The devastating examples throughout history have motivated the scientific community to study and develop models for estimating the probability of ignition, possible consequences, and damage. PEF studies can be grouped into three categories: (i) fire ignition, (ii) fire spread, and (iii) fire suppression. Many ignition models have been developed to estimate the number, location, and/or times of ignition after an earthquake. Ignitions following an earthquake are related to the built environment and to the way buildings respond to strong earthquakes. Most models used for PEF are based on damage data from recent earthquakes, relating the measure of ignition frequency to the seismic intensity.

This research intends to analyze the risk of existing building stock to post-earthquake fire. Post-earthquake fires are events with high consequences that may cause extensive damage, but their nature has not yet been fully investigated, from the building point of view and at the urban scale. The two main activities in this research project to study the post-earthquake fire phenomenon are: i) the development of numerical analyses to perform an analysis for the building scale, and ii) post-earthquake fire risk assessment at the urban scale. The typical properties and characteristics of buildings will be gathered to be able to develop numerical models considering the different design approaches over time (from the earthquake design point of view, and regarding the building fire resistance). The final aim is to conduct an urban risk assessment study and propose guidelines for risk mitigation.

Keywords: *Multi-risks, Earthquake Risk, Fire Risk, Buildings, Urban Scale*

Developing a structural health monitoring (SHM) system to be applied in a bridge using digital twin

Mohammad Amin Oyarhossein[†,1], Fernanda Rodrigues[2], Hugo Rodrigues[3]

1. University of Aveiro
2. University of Aveiro, 3810-193 Aveiro, Portugal
3. RISCO

⋆ Corresponding author; † Presenting author; Civil engineering.

Abstract. The primary goal is to implement a practical SHM system that effectively monitors existing structures. The EFD program (Extended Finite Element Damage Detection) system, intricately linked to the constructional Building Information Model (BIM), is a testament to this practicality. It incorporates the BHM technique, guided by the principles of digital twin technology. (1)

At the heart of our project is a commitment to thoroughly examine the performance of actual bridge structures. We achieve this by installing sensors for the structure's digital twin in the system, enabling real-time measurement of the bridge's behavior. This immediate feedback is a key feature of our SHM system. (2)

The project evaluates the structure's resilience against natural forces and capacity to adapt to environmental challenges. Model molecules are identified using AI and neural networks, which amplifies their predictive capacity.

The transition from lab to on-site systems occurs smoothly. This process uses extensive testing methods and a validation procedure to confirm the effectiveness of the SHM system in real-life situations. Iterative processes are perfect, and sensors are positioned to achieve optimal system performance. (3)

Keywords: *: Digital Twin Building, building health monitoring, Infrastructure Life cycle, performance, and maintenance prediction*

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Study of ravines in collapsible soils of Luanda, Angola

Francisco Mateus António[†,⋆,1], Fernando Bonito [2], Agostinho Benta [3]

1. PhD student, University of Aveiro, RISCO - Research Centre for Risks and Sustainability in Construction, Portugal
2. PhD, Engineering Laboratory of Angola
3. Professor, PhD, University of Aveiro, RISCO - Research Centre for Risks and Sustainability in Construction, Portugal

⋆ Corresponding author; francisco.m.antonio@ua.pt; † Presenting author; Civil engineering.

Abstract. The Angolan capital, Luanda, has predominantly sandy scarps (barrocas) that rise a few dozen metres above sea level [1]. Rainwater runoff over these "barrocas", or ravines, is mostly torrential, causing severe erosion of the "laterite sands", known locally as "red sands"or "muceque"soils [1, 2, 3]. As a result of this erosion, these ravines progress into the urbanised areas of the city, endangering buildings, roads and agricultural regions [1, 3]. Despite the danger posed by the erosion of these soils, few studies on the water erosion of soils have been carried out locally to date. To contribute towards filling this gap, this work aims to (i) analyse the behaviour of Luanda's "red sands"in the face of surface and subsurface erosion by water, (ii) analyse whether there is any correlation between the erodibility and collapsibility of this soil, and (iii) assess the erosion risk of this soil using an empirical erosion model [4]. The study's research strategy is essentially based on a literature review, field research, laboratory research, an integrated analysis (erosion risk assessment) and the preparation of the thesis. The literature review is being carried out by accessing databases such as Scopus and Web of Science, as well as database and repository aggregators such as Google Scholar and RCAAP, while the fieldwork (field visits, mapping the study area, sample collection and field tests) is underway. Laboratory tests, interpretation of results and risk assessment will be carried out later. The ongoing research is part of the preparation for the PhD Thesis in Civil Engineering entitled "Study of ravines in collapsible soils of Luanda, Angola". However, it is hoped that this study will contribute to an in-depth knowledge of water erosion in this type of soil and, consequently, generate measures to prevent/mitigate the negative impacts of soil erosion processes.

Keywords: *Soil erosion, barrocas, ravines erosion, red sands, collapsible soils*

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Acknowledgements. Thank you to the Portuguese Foundation for Science and Technology (FCT) for funding the SFRH/BD/151471/2021 - PhD scholarship.

Improvement of cladding wall panels on reinforced concrete precast buildings in seismic prone areas

Liana Ostetto[†,⋆,1], Romain Sousa[2], Paulo Fernandes[3], Hugo Rodrigues[1]

1. RISCO, Department of Civil Engineering, University of Aveiro, Aveiro, Portugal
2. RISCO, Vigobloco SA, Portugal
3. CERIS, ESTG, Department of Civil Engineering, Polytechnic of Leiria, Leiria, Portugal

⋆ Corresponding author; lianaostetto@ua.pt; † Presenting author; Civil engineering.

Abstract. Recent earthquakes exposed the main vulnerabilities of precast reinforced concrete (PRC) industrial buildings, highlighting structural and nonstructural weaknesses, mostly related to the deficient transfer of horizontal loads at the connections between elements [1]. PRC building design approaches assume that cladding panels are non-structural elements, ignoring their interaction with the structure. The connections of cladding panels to PRC buildings were the source of several non-structural damages reported, making it an element of significant importance. The poor behavior of these connections causes the collapse of the cladding panels, which can result in significant economic losses and impact on society.
The work carried out so far has been based on the development of a simplified macro-element to assess the seismic capacity of cladding-to-column connections and interaction with the main structure [2]. A seismic assessment of existing industrial PRC buildings in Portugal was carried out, as well as the influence of horizontal diaphragms at the roof level on the seismic behavior of PRC industrial buildings [3]. In addition, an experimental campaign was carried out to characterize this connection configuration existing in Portugal, with quasi-static in-plane and out-of-plane cyclic tests were carried out, simulating the effect of actions expected during a seismic event. The next task is to calibrate the numerical models.
The results showed the importance of including these non-structural elements in numerical models, these connections have a significant contribution and should be considered. The proposed method represents a contribution to support the design, assessment and retrofit of industrial PRC buildings, aiming to improve the performance and efficiency of this type of building. In conclusion, with the experimental investigation, it was possible to understand the behavior of this type of cladding-to-column connection commonly used in Portugal, obtaining indications of its seismic performance, as well as key parameters for the calibration of numerical models.

Keywords: *Industrial PRC buildings, cladding panels, connections, experimental campaign, seismic behavior.*

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Acknowledgements. This work was supported by the Foundation for Science and Technology (FCT)-Aveiro Research Centre for Risks and Sustainability in Construction (RISCO), Universidade de Aveiro, Portugal [FCT/UIDB/ECI/04450/2020]. The first author acknowledged FCT Fundação para a Ciência e a Tecnologianamely through the PhD grant of the first author with

reference 2020.08152.BD.

Assessment and retrofitting of existing reinforced concrete beam-column joints and validation of the corresponding Eurcode 8-3 recommendations

Peyman Sabbahfar[†,⋆,1], Hugo Rodrigues[1]

1.

⋆ Corresponding author; † Presenting author; Civil engineering.

Abstract. The current knowledge of the seismic behaviour of new reinforced concrete (RC) structures still needs to cover some validation gaps [1]. An example of this is need for validation of seismic safety methodologies and seismic actions, present in the draft standard EN 1998-3:2021 (EC8 for existing structures). Example of this, is the lack of experimental results on RC elements with plain or deformed bars without proper seismic design and detailing under earthquake loading [2]. In the scope of this research, an experimental study will be developed, in particular in the full-scale testing beam-column joints testing and integration of experimental test from other sources provide information and support numerical modelling and parametric studies and validation of Eurocode 8-3 expressions, and on the development/upgrading of the numerical and empirical models to analyse the cyclic response of structures, including the strengthening system, and validate the assessment expressions present in the draft standard EN 1998-3:2021.The seismic behaviour of RC structures has been widely studied over the last decades, but experimental evidence is still very limited concerning the response of existing structures [3]. The global seismic behaviour of the RC building structures is directly related to the behaviour of local elements such as columns, beam-column joints, beams, infills and others. This project aims to develop and validate experimentally innovative seismic strengthening strategies for existing RC structures [4]. Thus, the main objectives are: 1) Characterization of the seismic behaviour of non-conforming existing RC structures. 2) Validation of the methodology and equations available in the draft EN1998-3:2021 concerning the seismic assessment of existing RC structures. 3) Study, development, implementation, and validation of innovative seismic strengthening strategies for existing structures, and 4) Development and calibration of numerical models capable of simulating the behaviour of the tested specimens.

Keywords: *retrofitting, beam-column, reinforced concrete, RC, seismic strengthening*

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Use of belitic cement produced from waste in the production of mortar

Ana Ramão[†,⋆,1], António Figueiredo[1], Regina Modolo [2], Romeu Vicente [3], Victor Ferreira [3]

1. DECivil - Research center for risks and sustainability in construction RISCO
2. PPGECă- NucMaT
3. DECivil - Research center for risks and sustainability in construction - RISCO

⋆ Corresponding author; anaramao@ua.pt; † Presenting author; Civil engineering.

Abstract. Belitic cement clinkers have been extensively investigated. According to Ribeiro et al. [1], this ciment provides better workability, greater strength, and durability in mortars when compared to Portland cement. Considering that only two raw materials are used in the production of belitic cement, limestone, and clay, the sludge generated in the cutting and polishing process of ornamental rocks, which contains a predominance of quartz, calcite, and alumina, has been investigated as a substitute for clay and the CaCO3 sludge generated in paper pulp production as a substitute for limestone [1,2]. These sludges generate significant environmental impacts such as soil contamination, siltation of water bodies, and consequently a reduction of biodiversity of aquatic species. The main objective of this work plan is to evaluate the use of belitic clinker produced from industrial solid waste in the production of mortar, to improve the performance of the material from the perspective of promoting the circular economy. The methodology will be carried out in 5 stages: (i) Systematic mapping of the literature on this subject based on Petersen's methodology [3]; (ii) Production of belitic cement from calcium carbonate sludge and sludge from the processing of ornamental rocks, using the formulation developed by Ribeiro [1]; (iii) Evaluation of mortar produced with the belitic cement; iv) Evaluation of the durability and thermal conductivity of the mortar produced with ecological belitic using an accelerated aging chamber; and (v) Analysis of the source of waste generation, using strategies of the cleaner production, with a view to the continuous improvement of processes from the perspective of promoting circular economy. This research contributes to the optimization of processes involving solid waste management to mitigate the negative environmental impacts related to the extraction of non-renewable natural resources. In this context, is proposed an innovative cement belitic by valorizing waste materials.

Keywords: *Belitic cement, industrial solid waste, cleaner production, circular economy*

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Acknowledgements. The Authors wish to acknowledge the support Aveiro Research Centre for Risks and Sustainability in Construction(RISCO), Universidade de Aveiro, Portugal.

Assessment of the wildland-urban interface index to the context of portuguese villages

Dener SIlva[†,⋆,1], Tiago Miguel Ferreira[2], Hugo Rodrigues[1]

1. RISCO, Department of Civil Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
2. College of Arts, Technology and Environment, School of Engineering, University of the West of England (UWE Bristol), Bristol BS16 1QY, UK

⋆ Corresponding author; dener.silveira@ua.pt; † Presenting author; Civil engineering.

Abstract. The coexistence with fires has always been part of human life. However, climate change and human interventions have made wildfires more severe, and although their occurrence is a natural phenomenon, the interval between massive events is becoming shorter, with impressive numbers of environmental and human losses just in the last decades (Gill, Stephens, & Cary, 2013). Rural settlements are known as places where the richness of heritage and cultural values are frequently more vulnerable, with their remaining populations and traditions under a constant threat of disappearing (Syphard, Keeley, Massada, Brennan, & Radeloff, 2012). The landscape of Portugal's mainland, as it is in many other countries, concentrates on many villages that have faced difficulties with maintaining the population. The villages are frequently populated by elder people with lesser mobility conditions, and also, an important number of uninhabited houses that are usually poorly conserved. The alliance of these facts sets a dangerous exposition of the Wildland-Urban Interface (WUI) to the fires, and its assessment and protection are critical for the preservation of those settlements. Pursuing the understanding of WUI areas, the proposed study applied a methodology of WUI assessment (Caballero, 2019) through the implementation of the algorithm that uses aerial images of the Portuguese territory. The methodology had not been tested on the Portuguese territory, to do so, we proposed to compare the obtained results with the burnt areas from the massive wildfire of Pedrogão Grande (Leiria) in 2017 (Ribeiro, Rodrigues, Lucas, & Viegas, 2020). As a result, maps of WUI affectation were generated, visually pointing to villages with higher severity compared to the others, as well as the comparison to the ground truth scenario. Finally, the generated WUI maps from the WUIX methodology will be presented as a way to visualize the results pointing to the precision of the acquired values.

Keywords: *Portuguese rural villages; wildfires; fire vulnerability assessment; wildland-urban interface; Pedrogão Grande wildfire*

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Acknowledgements. The Authors wish to acknowledge the contribution provided by the following research projects: Project MTS/BRB/0086/2020Sustainability-led approaches for the rehabilitation and revitalisation of the cultural built heritage of Montesinho Natural Park funded by national funds (PIDDAC) through FCT/MCTES. The first and third authors acknowledge the support by the Foundation for Science and Technology (FCT)Aveiro Research Centre for Risks and Sustainability in Construction (RISCO), Universidade de Aveiro, Portugal (FCT/UIDB/ECI/04450/2020).

Challenges in research of numerical modelling of shoreline evolution

Margarida Ferreira[†,1], Carlos Coelho[1], Paulo A. Silva[2]

1. RISCO Universidade de Aveiro
2. CESAM Universidade de Aveiro

⋆ Corresponding author; † Presenting author; Civil engineering.

Abstract. To mitigate coastal erosion and enhance the resilience of coastal territories to the effects of climate change, effective long-term measures need to be planned. Numerical models can be utilized to predict the evolution of the coastal systems, thereby supporting decision making processes, as well as the planning and management of coastal zones. However, due to the complexity of describing all coastal processes and timescales, most models focus on specific processes (Larson, 2005; Hoagland et al., 2023). They are generally divided into cross-shore numerical models, which simulates the evolution of cross-shore profiles due to sediment transport within the profiles, related with short to medium-term events (days to months), and shoreline evolution models, that allow for long-term analysis (years to decades), but they typically only consider longshore sediment transport.

With the aim of contributing to the enhancement of numerical modelling capabilities for the evolution of coastal zones over a medium to long-term timeframe, a new numerical model was developed. This model integrates both cross-shore and longshore sediment transport processes. Following the recommendation presented by Hanson et al. (2003), the model to integrate these two components of sediment transport is based on merging the results of two existing simplified numerical models: LTC (Coelho, 2005), which simulates shoreline evolution due to longshore sediment transport processes, and CS-Model (Larson et al., 2016), which computes cross-shore sediment transport.

The application of the proposed method yielded promising results, indicating the potential of the model for medium to long-term projections. Overall, it was found that both cross-shore and longshore sediment transport significantly influence shoreline evolution. Therefore, it is crucial to integrate the effects of both components of sediment transport. The model's outputs enable the interpretation and control of various morphological parameters critical for coastal management, such as dune, beach berm, and sandbar volumes, as well as shoreline and dune toe positions.

Keywords: *Sediment dynamics; Coastal erosion; Coastal management; LTC - Long Term Configuration; CS Model*

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Acknowledgements. The authors gratefully acknowledge the financial support provided to Ana Margarida Ferreira through the PhD grant 2021.07269.BD.

BIM and modular construction - A review of the potential uses in design phase

Márcio Carvalho[†,⋆,1], Rui Oliveira[2], Hugo Rodrigues[1]

1. Aveiro University
2. Polytechnic Institute of Bragança

⋆ Corresponding author; marcio.carvalho@ua.pt; † Presenting author; Civil engineering.

Abstract. Modular construction has been gaining increasing prominence in the construction industry, driven by the growing urbanization and the need to explore new construction systems in response to frequent labor shortages, resource optimization, and a lack of quality control in construction. The set of very specific and deeply rooted characteristics of traditional construction, coupled with the costs associated with modular construction, pose a barrier to opting for modular construction systems, a situation that needs demystification. This type of construction offers numerous advantages related to production, quality, speed, comfort, and a positive contribution to sustainability, but it contains unique characteristics that need consolidation to streamline processes and enhance simplicity in usage.This paper examines the integration of Building Information Modeling (BIM) in modular construction during the design phase, in addition to identify the technologies and methods currently using, as DfMA (Design for Manufacture and Assembly), ML (Machine Learning), CDE (Common Data Environment) and others, trying integrate this concepts in the design phase of this construction system. Collaboration among construction professionals and data integration throughout all project stages are crucial elements for the successful combination of BIM and modular construction. This proposed approach introduces various current tools based on the BIM methodology for the specific development of projects for this type of construction system, relying on literature review and input from industry experts. Additionally, the paper identifies promising research areas and opportunities to further refine this integration, aiming to improve efficiency and quality in the construction industry.

Keywords: *Modular Construction, Building Information Modelling, Industrialization, Design Phase*

Mechanical characterization of masonry walls through the application of in-situ flat-jack tests

Jorge Fonseca[†,1], Hugo Rodrigues [⋆,1], Aníbal Costa[1]

1. RISCO, Departamento de Engenharia Civil, Universidade de Aveiro, Campus Universitário de Santiago 3810-193 Aveiro, Portugal

⋆ Corresponding author; hrodrigues@ua.pt; † Presenting author; Civil engineering.

Abstract. The mechanical characterization of national load-bearing masonry is not an easy task given the high heterogeneity of the construction types and materials used throughout the country. The determination of the mechanical characteristics of masonry in situ can only be carried out through indirect methods that require validation or through destructive testing. In recent years, 175 in-situ flat-jack tests have been conducted to support conservation and rehabilitation efforts, both in civil buildings and national historical monuments, from north to south Portugal, with a focus on the historic city center of Lisbon. The results of the mechanical characterization tests obtained through flat-jack tests were categorized based on the typology defined in [1] for each test's construction type, and the mechanical properties were determined according to EN 1998-3 standards. This study proposes a summary table with average values for the properties of some types of masonry based on flat-jack tests.

Keywords: *mechanical characterization, masonry, flat jack tests, in situ, conservation*

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Acknowledgements. Jorge Fonseca acknowledges Foundation for Science and Technology (FCT) for the PhD grant, with reference 2022.13794.BD.

SUSTAINABLE TRANSITION IN URBAN WATER MANAGEMENT: THE CONTRIBUTION OF URBAN WATER COMMUNITIES

Sara Bona[†,⋆,1], Ricardo Gomes[2], Armando Silva-Afonso[1], Fernanda Rodrigues[1]

1. University of Aveiro, 3810-193 Aveiro, Portugal
2. Polytechnic University of Leiria, Campus 2 Morro do LenaAlto do Vieiro, 2411-901 Leiria, Portugal

⋆ Corresponding author; † Presenting author; Civil engineering.

Abstract. Freshwater, although a constantly renewing natural resource, faces limitations in its availability and is under increasing pressure in several regions, including the Mediterranean basin. In the face of water scarcity and climate change, principles such as water efficiency, nature-based solutions (NbS) and the circular economy are emerging as essential pillars for urban water management. In this context, this research aims to develop an innovative model to promote water-sensitive urban communities, inspired by advances in the energy sector. Integrating water/environmental engineering advances and natural solutions, the model will be validated in Portugal. Comprehensive analyses are being carried out on the sizing, management and implementation of local hybrid solutions, which combine existing infrastructures with decentralised and flexible approaches. The integrated approach embraces new paradigms of the urban water cycle and considers the transversal dynamics that govern the sector. Key actions include improving water efficiency, introducing alternative water sources, utilising wastewater, recovering and valorising by-products and managing rainwater. Preliminary results highlight that active control of water losses significantly improves the efficiency of urban networks [1]. In addition, the implementation of NbS for stormwater management demonstrates its multifunctional capacity compared to conventional structures, contributing to natural water retention, pollution reduction, aquifer recharge and improved urban aesthetics and biodiversity [2], [3]. The aim is to improve the performance of public water and drainage systems, contributing to sustainability and guiding future public policies. In addition, the research aims to contribute to the regeneration of natural ecosystems, aligning with the Sustainable Development Goals (SDGs) approved by the United Nations, especially SDGs 6, 11, 12 and 13. Strengthening global efforts towards the sustainable management of water and urban ecosystems is hoped to promote progressive resilience in the face of constantly evolving challenges and achieve more resilient, equitable and sustainable urban development.

Keywords: *Urban Water Communities; Water Efficiency; Nature-based Solutions; Integrated Water Management; Sustainable Cities*

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Acknowledgements. This work was partially supported by the Foundation for Science and Technology (FCT) Aveiro Research Center for Risks and Sustainability in Construction (RISCO), University of Aveiro, Portugal [FCT/UIDB/ECI/04450/2020]. This research work was funded by the Foundation for Science and Technology (FCT) under Doctoral Grant 2021 MPP2030-FCT, MIT Portugal Program [PRT/BD/152847/2021], awarded to the first author. (S.B.).

Measurement and comparison of thermal properties of soils in Portugal using needle and plane source methods for use in shallow geothermal energy application

Rajendra babu Roka[†,⋆,1], Ana Vieira [1], Antonio Figueiredo [1], Caludino Cardoso[1]

1.

⋆ Corresponding author; † Presenting author; Civil engineering.

Abstract. Shallow geothermal energy systems are evolving as an alternative source of energy for building space heating and cooling with notable contributions to carbon emission reduction. In this context, proper soil thermal characterization is crucial for determining the potential of these systems use and their energy efficiency evaluation (Roka et al., 2023). This work presents a detailed study of the thermal conductivity, thermal diffusivity and volumetric heat capacity including some physical properties of Fontainebleau sand, samples retrieved from Aveiro and Lisbon city. The thermal tests were performed in transient conditions using three-needle probes and a plane sensor. The respective results were compared. Moreover, analysis of the effect of several factors such as particle density, degree of saturation, soil density, water content, heat flux intensity and heating time on thermal conductivity values. Two samples of Fontainebleau sand were systematically tested in fully dry and fully saturated conditions under different control variables like heating time, and injected heat flux at a controlled room temperature of 250C. In addition, six intact samples from Aveiro and one sample from Lisbon were also tested in the laboratory at a room temperature of 250C. The study provides some insights regarding the thermal conductivity values obtained by four different sensors. Thermal conductivity values obtained by TLS-100 vCp are higher than any other probes. Significant relationships were established between the physical properties and thermal properties of soils. Assessment of physical properties with mineral contents can give further insight into the variability in thermal conductivity values.

Keywords: *Shallow geothermal energy, soil thermal conductivity, transient line source, transient plane source*

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Acknowledgements. The authors are grateful for the financial support provided by the Foundation of Science and Technology (FCT) to the first author with PhD grant number (2022.10333.BD); equipment and laboratory support from project GeoSustained (PTDC/ECI-CON/1866/2021) and National Laboratory of Civil Engineering (LNEC).

Communication sciences and technologies

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Digital Platforms of Information for People with Dementia: challenges and good practices

Diana Ferreira[†,1], Eduarda Cysneiros[1], Inês Sucena[1], Rita Branco[2], Rita Oliveira[3], Oksana Tymoshchuk[⋆,3], Joana Quental[2]

1. Department of Communication and Art
2. ID+
3. DigiMedia

⋆ Corresponding author; oksana@ua.pt; † Presenting author; Communication sciences and technologies.

Abstract. In recent years, neurodegenerative diseases, particularly dementia, have gained increasing attention [1][2]. Dementia affects the quality of life of those diagnosed but also profoundly impacts their families and caregivers [3]. In this context, digital technologies have begun to play an important role, enabling the creation of platforms (mobile applications and websites) that become spaces for disseminating information, emotional support, and practical resources.

This project was developed as part of Students@Digimedia in collaboration with the DECOHDE project team: "Design for a Humanised Communication of Dementia"[4].

This study benchmarks digital platforms dealing with the specificities of dementia and targeting both people with dementia and their families and/or caregivers. The aim is to analyse how these platforms are designed and developed to meet the specific needs of these target audiences, highlighting their characteristics, functionalities, and potential impact.

The study was carried out in five distinct stages: i) broad review of platforms about dementia; ii) definition of the analysis strategy; iii) data collection and selection; and iv) analysis of the selected platforms.

The search for platforms began using keywords such as "application,website,"and "dementia,"in Portuguese and English, on search engines and digital application distribution services. The project team included platforms in languages other than Portuguese and English.

First, the platforms related to dementia were listed33 platforms (22 apps and 11 websites). Next, the exclusion criteria were applied: i) platforms whose target audience is not people with dementia, ii) platforms addressing a specific type of dementia (e.g., Alzheimer's), and iii) platforms in languages not fully understandable by the team. Five platforms were selected for analysis, applying these criteria.

In the last stage of the process, an in-depth analysis of each of the selected platforms was conducted, namely, platform typology, type of content, platform objective, design components (including layout, typography, colours, and iconography), communication and language, target audience, and positive and negative points.

This study is intended to help define the functional requirements for a prototype of an information platform aimed at people with dementia, on meaningful activities for this group.

Keywords: *Digital Platforms; People with Dementia; Mobile application; Design components*

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Acknowledgements. The project DECOHDE is funded by the FCT Foundation for Science and Technology (ref. 2022.03295.PTDC).

Who, what, when, where, why how Communication Science and Technology students shape their presence in online platforms

Mónica Aresta[†,*,1], Jónatas Roque[2], Pedro Sousa[2]

1. DigiMedia Research Center, Department of Communication and Art, University of Aveiro
2. Universidade de Aveiro

* Corresponding author; † Presenting author; Communication sciences and technologies.

Abstract. Who, what, when, where, why how Communication Science and Technology students shape their presence in online platforms
Keywords: Online presence; Social media engagement; Digital communication behaviors; online participation
Nowadays, the pervasive influence of social media on various aspects of life, including education, employment, and social relationships, has led to an increased interest in gaining insights into students' online behaviours. Given the potential implications of digital footprints on privacy, reputation, and wellbeing, examining the nuances of online presence construction is essential for fostering digital literacy and responsible digital citizenship among students, and have the potential to inform educational strategies, career development initiatives, and social interventions.
As digital platforms continue to evolve and proliferate, a research question arises: How do Sciences and Communication Technologies (CTC) students navigate and shape their online presence within these digital spaces? This exploratory project seeks to analyze the use of social networks by CTC students, investigating how these networks influence their online presence. Specifically, it will examine who uses them, what they share, when they share, in what context, and for what reasons. The study aims to shed light on the dynamics of CTC students' online engagement, encompassing aspects such as content sharing, interaction patterns, and motivations.
The 5Ws Social media in CTC project has the following objectives:
1. To investigate the ways in which social networks influence the digital experiences of CTC students.
2. To analyse the intricate dynamics of CTC students' online presence, including content sharing, interaction patterns, and motivations.
3. To provide insights that facilitate the development of more informed and effective communication approaches tailored to the specific needs and preferences of CTC students.
Data is being collected through a case study approach, utilizing both quantitative questionnaires and qualitative focus groups. This methodological diversity ensures a holistic understanding of CTC students' online behaviors, capturing quantitative trends and qualitative insights into their experiences and perceptions within digital spaces.
The findings are expected to have implications across multiple domains, namely to facilitate more informed and effective communication approaches tailored specifically to the needs and preferences of CTC students. These insights can inform educational practices, guide policymaking, and shape industry strategies. Ultimately, by bridging the gap between theory and practice, this study aims to empower stakeholders to navigate the evolving landscape of digital communication with greater insight and efficacy.

Keywords: *Online presence; Social media engagement; Digital communication behaviors; online participation*

Who, what, when, where, why how Communication Science and Technology students shape their presence in online platforms

Aresta[1], Mónica[2], Jónatas Roque[2], Pedro Valente

1. DigiMedia Research Center, Department of Communication and Art, University of Aveiro
2.

⋆ Corresponding author; † Presenting author; Communication sciences and technologies.

Abstract. Nowadays, the pervasive influence of social media on various aspects of life, including education, employment, and social relationships, has led to an increased interest in gaining insights into students' online behaviours. Given the potential implications of digital footprints on privacy, reputation, and wellbeing, examining the nuances of online presence construction is essential for fostering digital literacy and responsible digital citizenship among students, and have the potential to inform educational strategies, career development initiatives, and social interventions.
As digital platforms continue to evolve and proliferate, it is evident that an understanding of how Sciences and Communication Technologies (Ciências e Tecnologias da Comunicação, CTC) students navigate and shape their online presence within these digital spaces is still an interesting subject. In this context, this exploratory project aims to analyse the use of social networks by CTC students, gaining insight into how these networks influence their online presence, including who uses them, what they share, when they do so, in what context and for what reason, thus shedding light on the dynamics of CTC students' online engagement, encompassing aspects such as content sharing, interaction patterns, and motivations..
The 5Ws Social media in CTC project has the following objectives:
1. To investigate the ways in which social networks influence the digital experiences of CTC students.
2. To analyse the intricate dynamics of CTC students' online presence, including content sharing, interaction patterns, and motivations.
3. To provide insights that facilitate the development of more informed and effective communication approaches tailored to the specific needs and preferences of CTC students.
Data is being collected a comprehensive mixed-methods approach, integrating both quantitative questionnaires and qualitative focus groups. This methodological diversity ensures a holistic understanding of CTC students' online behaviours, capturing both quantitative trends and qualitative insights into their experiences and perceptions within digital spaces.
The findings are expected to have implications across multiple domains, namely to facilitate more informed and effective communication approaches tailored specifically to the needs and preferences of CTC students. These insights can inform educational practices, guide policymaking, and shape industry strategies. Ultimately, by bridging the gap between theory and practice, this study aims to empower stakeholders to navigate the evolving landscape of digital communication with greater insight and efficacy.

Keywords: *nan*

Social digital games in online communities: the impact on older adults digital competences

Francisco Regalado[†,1], Ana Veloso[2], Carlos Santos[3]

1. DeCA
2. DigiMedia, Department of Communication and Art, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal.
3. Universidade de Aveiro, Departamento de Comunicação e Arte, Campus Universitário de Santiago, 3810-193 Aveiro

[⋆] Corresponding author; [†] Presenting author; Communication sciences and technologies.

Abstract. As the worlds population ages (WHO 2021), digital technologies also become essential for everyone (Eurostat, 2023). Digital games and online communities are part of this (r)evolution, thus creating a new challenge: designing experiences that cater to the interests and needs of older adults, who are often neglected by popular products (Nedeljko et al., 2021). While research shows that these media are benefitial for active and healthy ageing (Sauvé & Kaufman, 2019), there's a lack of studies exploring the synergy between them to improve older adults' digital competences.
To address this gap, this research study resorts to an exploratory and mixed-method approach, following a three-phase Development Research Framework. Aiming to answer the question "How can social digital games in online communities impact older adults' digital competences?", this study is aligned with sustainable development goals SDG#3, SDG#4, and SDG#10, and guided by the DigComp 2.2 Framework (Vuorikari et al., 2022), a pivotal European framework defining essential competences for lifelong learning. Overall, this project aspires to foster digital and social innovation that promotes greater inclusion of ageing populations in the digital challenges of contemporary society.
Phase-1 included a systematic literature review on this researchs main topics, and a questionnaire to further characterize Portuguese older adults relationship and habits with social digital games which has received 400 responses. Phase-2 involved more than 30 sessions with older adults at Laboratório do Envelhecimento Ílhavo, Portugal, to understand their habits, preferences, and interactions with digital games. Additionally, two empathetic workshops were conducted: (i) involving 44 experts, aimed at employing game-ideation techniques to advance game proposals; and (ii) involving eight experts, focused on directly addressing the different domains of DigComp.
Currently, in Phase-3, and the focus for RSummit24, a game prototype is being developed for miOne (http://mione.altice.pt/). This game, based on collected data, focuses on security, encouraging users to discover new strategies and critically analyze password practices. It includes social strategies like a discussion area and help requests. The impact of the game on older adults competences will be assessed.
Expected research contributions are: (i) formulating a model for designing social digital games to enhance older adults digital competences; (ii) achieving international significance through a product tailored to broader audiences via a European Ph.D.; and (iii) providing insights into aging, digital games, digital platforms and online communities, and digital competences acquisition.

Keywords: *social digital games, older adults, online communities, digital competences, miOne*

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Acknowledgements. To acknowledge the valuable contribution of all the experts who participated in the workshops. Additionally, acknowledge the participants of the Ageing Lab [Laboratório do Envelhecimento] without whom this work would not have been possible. This work was supported by FCT Foundation for Science and Technology (Fundação para a Ciência e Tecnologia), I.P. nr. 2021.06465.BD, and DigiMedia Research Center, under the project UIDB/05460/2020.

Computer engineering

Bessel Functions As Activation Functions for Neural Networks

Diogo Monteiro Martins[†,⋆,1], Nelson Vieira[2], Pétia Georgieva[3]

1. University of Aveiro
2. Department of Mathematics
3. DETI, Institute of Electronics and Informatics Engineering of Aveiro (IEETA), Aveiro, Portugal

⋆ Corresponding author; diogomm3@ua.pt; † Presenting author; Computer engineering.

Abstract. In recent years, the field of artificial intelligence has seen rapid advancements, particularly in the domain of neural networks (NNs). Activation functions play a crucial role within this field, influencing the ability of NNs to model complex patterns and make accurate predictions. While traditional activation functions such as ReLU, sigmoid, and TANH have been extensively studied and applied, there remains significant potential for novel activation functions to enhance neural network performance further. The primary emphasis of our research revolves around exploring the application of Bessel functions as activation functions within the context of Neural Networks and compare it to the performance of standard activation functions. By leveraging the unique mathematical properties of Bessel functions, we aim to explore their impact on neural network behavior and performance, potentially offering new pathways for improvement in AI and machine learning applications. Until know, this novel approach has been applied to two benchmark datasets and promising results have been found. Firstly, a fully-connected NN has been applied to a Hand-Written Digits dataset, where the Bessel has shown a performance on the level of both the sigmoid and ReLU. For the second problem, a Convolutional Neural Network was used in the binary classification problem of the Happy House image dataset. For this case the usage of Bessel functions as activation resulted in a superior performance when compared to the results obtained by both the ReLU and Sigmoid.The application of Bessel funcstions as activation is still under research, and furhter work has already been planned. More complex datasets, such as CIFAR-10, and STL-10 will be tested, as well as more complex architectures within the field of NNs.

Keywords: *Activation Functions, Bessel Functions, Neural Networks, Convolutional Neural Networks, Machine Learning*

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Acknowledgements. The work of Roberto Figueiredo was developed in the framework of the Thematic Line PICS - Inverse Problems and Applications in Health Sciences through CIDMA - Center for Research and Development in Mathematics and Applications, and FCT - Fundação para a Ciência e a Tecnologia, within projects UIDB/04106/2020 (DOI: https://doi.org/10.54499/UIDB/04106/2020) and UIDP/04106/2020 (DOI: https://doi.org/10.54499/UIDP/04106/2020), and supported by the research grant BI LtPICS-2024AA.

Vision Transformer Architectures For Critical Events Detection in Brain CT.

Hélio Salomão Pesanhane[†,⋆,1], Hélio Salomão Pesanhane[†,⋆,2], Augusto Silva[2]

1. EETA - Instituto de Engenharia Electrónica e Telemática de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro
2. IEETA - Instituto de Engenharia Electrónica e Telemática de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro

⋆ Corresponding author; pesanhane@ua.pt; † Presenting author; Computer engineering.

Abstract. Stroke or cerebrovascular accidents can be either ischemic or hemorrhagic. Ischemic strokes account for 80% of cases, whereas hemorrhagic strokes constitute the remaining 20%. Hemorrhagic stroke can be further categorized into Intraparenchymal, Intraventricular, Subarachnoid, Subdural, Epidural, all of these constitute intracranial hemorrhage (ICH). Intracranial hemorrhage is life-threatening and requires prompt treatment within 24 h for a chance of recovery. Accurate stroke diagnosis relies primarily on CT scans, which can be subjective and time consuming. Several studies have utilized CT images for stroke classification and detection; however, existing algorithms are limited to 2D images and CNN models. This study proposes a hybrid architecture that combines CNNs and Vision Transformers to improve stroke detection accuracy and efficiency in CT images. The proposed methodology includes a comprehensive literature review, novel hybrid architecture, volumetric reduction attention layer, mechanism for effective feature concatenation, and SWOT analysis.

Keywords: *computer vision, deep learning, stroke classification, stroke detection, stroke segmentation, convolution neural network.*

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Acknowledgements. I am grateful for the opportunity to work on the esteemed project titled "Vision Transformer Architecture for Critical Events Detection in Brain CT,"which was generously offered by my supervising professor. This significant task provided me with the chance to explore research extensively and expose me to a wide range of cutting-edge concepts.

A Modular Framework to Monitor Interaction in Multimodal Interactive Spaces

Fábio Daniel Rodrigues Barros[†,⋆,1], Samuel Silva[2], Bernardo Marques[2], António Teixeira[3]

1. IEETA, DETI
2.
3. Institute of Telecommunications, Aveiro

⋆ Corresponding author; fabiodaniel@ua.pt; † Presenting author; Computer engineering.

Abstract. In today's world, the interaction between humans and machines has deeply integrated into our daily lives. As we move towards an increasingly interconnected future, researchers are exploring multimodality to enhance the naturalness, efficiency, and adaptability of human-machine interactions (Barros et al. 2023). In this sense, multimodal systems play a crucial role in gathering information from diverse input sources such as speech, gestures, and tactile interactions potentially enabling a more comprehensive understanding of human intentions, in line with the versatility and naturalness of human-human communication, towards improved user experience and task performance across multiple domains. (Almeida et al. 2019) However, as these systems become more sophisticated, they become challenging to develop and evaluate. The diversity of devices, modalities, and interactions, as well as their asynchronous and transient nature make monitoring and debugging these systems a daunting task resulting in sheer amounts of data that cannot just be collected in a log file. In this regard, a systematic approach to monitoring these systems can play a key role during research of novel features, and the development and evaluation of new multimodal systems. This work proposes a modular framework for interaction monitoring, capable of collecting, and storing data relating to the interaction flows in complex multimodal systems. The proposed solution was developed at infrastructure level, for multimodal interaction architectures making it possible that any application or interaction modality connecting to interactive ecosystem will be agnostic to the monitoring framework, but will, nevertheless, be automatically monitored. This contribution also works as a steppingstone for other important aspects of multimodal system design and development including the support for more sophisticated approaches to the evaluation of such systems profiting from the data gathered by the proposed framework.

Keywords: *Human-Computer Interaction, Multimodal Interaction, Multimodal Ecosystems, System Development and Refinement*

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Optimization of geometry and texture for 3D reconstructions using RGB-D data

Tiago Madeira[†,⋆,1], Miguel Oliveira[2], Paulo Dias[1]

1. Institute of Electronics and Informatics Engineering of Aveiro, Department of Electronics, Telecommunications and Informatics
2. Institute of Electronics and Informatics Engineering of Aveiro, Department of Mechanical Engineering

⋆ Corresponding author; tiagomadeira@ua.pt; † Presenting author; Computer engineering.

Abstract. Three-dimensional (3D) reconstruction is the creation of 3D models from the captured shape and appearance of real objects. It is a long-term topic of investigation and an active research subject in both computer graphics and computer vision fields (Kang et al., 2020), with numerous systems and algorithms, having gained importance in various areas, such as architecture, robotics, autonomous driving, medicine, agriculture, and archaeology. Indoor 3D models have great potential in object tracking and interaction, scene understanding, virtual environment rendering, indoor localization, and route planning, amongst others (Li et al., 2018; Zhou et al., 2018). The current state of 3D reconstruction of real-world scenes is still not adequate for many applications that require photorealistic quality, such as virtual reality (VR) and augmented reality (AR) experiences, and other human-centered applications. Furthermore, the best current solutions are very expensive, presenting high capital and logistical costs. The generation of indoor space models poses specific challenges due to the naturally complex layout of indoor structures, the intricate interactions between objects, clutter, and occlusions (Naseer et al., 2018). Sensor noise and outliers further complicate the reconstruction process, particularly in the presence of materials such as glass or mirrors, which are notoriously difficult to scan (Zhang et al., 2018). All these factors, and the complex relationship between illumination, materials, and captured appearance across the environment, make it quite challenging to produce indoor models automatically and robustly. This PhD aims to study and propose optimization-based methods for 3D reconstruction, resulting in complete virtual models with photorealistic quality. There are numerous variables, such as 3D geometry, texture, camera poses and intrinsic properties, surface material, and lighting, that may be optimized. Hence, despite considerable efforts devoted to scene reconstruction, the problem remains challenging, given the extraordinarily large solution space. Our research has shown promising results in colour correction leveraging geometric data, and in the detection of reflective surfaces, allowing for the removal of noise in the model and realistic rendering of the light paths. Additionally, to gauge progress and showcase our results, we explored several objective metrics and their potential for textured 3D mesh quality assessment, comparing their performance in terms of correlation to the human visual perception of quality. Future work will involve the integration of these modules in a full 3D reconstruction pipeline, correcting texture and geometric anomalies to improve the quality and fidelity of the final reconstruction.

Keywords: *Computer Vision, 3D Reconstruction, Optimization, Color Correction, Material Estimation, Perceptual Metrics*

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Acknowledgements. This work has been funded by National Funds through the FCT - Foundation for Science and Technology, in the context of the PhD scholarship 2020.07345.BD and project UIDB/00127/2020, supported by IEETA.

Contextualized augmented reality situated visualization

Nuno Cid Martins[†,⋆,1], Paulo Dias[2], Beatriz Sousa Santos[1]

1.
2. Institute of Electronics and Informatics Engineering of Aveiro, Department of Electronics, Telecommunications and Informatics

⋆ Corresponding author; † Presenting author; Computer engineering.

Abstract. The global market for Augmented Reality (AR) indicates this area is becoming very important. In this reality, humans can access and interact with both digital and real content, augmenting the information captured by their senses. To take advantage of the users environment, dealing with all its context information, AR applications can use Situated Visualization (SV). This type considers all the visualizations that are relevant in the physical context in which they are displayed, enriching the AR experience. Nowadays it is increasingly more important for society to obtain additional information on what is being dealt with at any given moment to make more informed decisions. While some perspectives on the SV model have been proposed, a comprehensive systematization of the entire SV model is yet to be established. Therefore, an extended SV model, incorporating new perspectives and updated concepts, is proposed in [1], as well as design and implementation guidelines for AR-based SV systems.
Decision Support Systems (DSS) have been improved by a variety of methods originating from several scientific fields, such as information science and artificial intelligence. As AR is becoming more affordable and widespread, using it as a tool for SV becomes viable in effective decision-making. With this, the users have contextual, relevant, and appropriate information that fosters more informed choices. As new challenges and opportunities arise, it is important to understand the relevance of intertwining these fields. Hence, based on literature analysis, the main concepts involved in using SV through AR to support better decision-making processes is introduced in [2]. Practical examples are presented, addressing and discussing current areas of application, benefits, challenges, and opportunities. A set of guidelines for the design and implementation of DSS based on situated AR are also proposed.
SV for AR brings forth challenges that could be problematic if not well tackled. The biggest challenge when using SV combined with AR is the egocentric viewpoint limitation of the user. The challenge is to see or collect information outside the AR screen or current viewpoint while avoiding or mitigating any alterations to the users position. A literature survey addressing how to overcome this challenge is presented in [3] and [4], followed by the proposal of new approaches.
Finally, according to previous work, a DSS application using AR and SV to increase air quality awareness and choosing the less polluted path, mitigating the AR egocentric limitation, is described and evaluated in [5].

Keywords: *augmented reality, situated visualization, decision support system, evaluation*

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The use of transfer learning based framework for fault forecasting in cellular networks

Nooruddin[†,1], Daniel Corujo[⋆,1], Rui L. Aguiar[1], Francisco J. Ferrão[2]

1. Instituto de Telecomunicações in the Universidade de Aveiro
2.

⋆ Corresponding author; dcorujo@ua.pt; † Presenting author; Computer engineering.

Abstract. With the advent of 5G, people have witnessed the fastest growth and advancement in wireless technology in the engineering field, impacting both public and private networks. Such dynamic changes in the field of wireless communication are reshaping the way people interact and utilize networks. Besides several benefits of wireless networks, both public and private networks face several challenges, including fault identification and classification in a timely manner. Therefore, fault classification is an essential aspect of networking planning and management for both public and private sectors. Recently, researchers have attempted to exploit Machine Learning (ML) and Deep Learning (DL) techniques for fault classification. However, such DL and ML methods encounter limitations, such as the requirement for large amounts of labeled data. Additionally, traditional methodologies are typically specialized for specific scenarios and may require retraining when applied to new wireless network applications. Unfortunately, training from scratch demands significant computational resources and enough training data, making it a time-consuming and costly endeavor for both public and private network operators.Currently, researchers are trying to implement TL for fault detection and classification, but a research gap persists due to the lack of available public datasets for faults regarding cellular networks. In light of these limitations, this work proposes a TL-based approach for fault identification and classification in network management, applicable to both public and private networks. Our approach is to train DL/ML models (CNN, DCNN, Autoencoder+LSTM) from scratch and then use them for other public and private network settings, mainly focusing on private networks. The main focus of this model is to use TL to detect the faults encountered by both public and private networks. It will efficiently apply the gained knowledge to the fault classification task by utilizing DL/ML models. The proposed method will compare the results of the mentioned models trained from scratch with TL-based models so that we can assess how much computational time we can reduce in terms of achieving the same accuracy.

Keywords: *Cellular Networks, Transfer Learning, Deep Learning, public and private networks, Wireless Networks, and Forecast Faults.*

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Acknowledgements. This work was supported by the European Unions Horizon Europe MSCA-DN programme through the SCION Project under Grant Agreement No. 101072375.

Closed generative question answering using transformers and knowledge graphs

Richard Jonker[†,⋆,1], Sérgio Matos[2]

1. Institute of Electronics and Informatics Engineering of Aveiro (IEETA), Portugal
2. Department of Electronics, Telecommunications and Informatics (DETI) and Institute of Electronics and Informatics Engineering of Aveiro (IEETA), Portugal

⋆ Corresponding author; richard.jonker@ua.pt; † Presenting author; Computer engineering.

Abstract. Question Answering (QA) systems have witnessed remarkable advancements with the emergence of Large Language Models (LLMs) and the integration of Knowledge Graphs (KGs). LLMs, such as GPT (Generative Pre-trained Transformer), have enabled closed generative QA, revolutionising the field by generating answers to questions without explicit context. However, the challenge of incorporating external knowledge for enhanced accuracy and explainability persists. This presentation explores the synergy between LLMs and KGs to address this challenge and create explainable QA systems. We provide a comprehensive overview of recent developments in the field, focusing on the integration of LLMs and KGs to improve QA performance and interpretability. Our review encompasses key research contributions, including pretraining strategies for LLMs on diverse textual data, fine-tuning techniques for QA tasks, and methods for integrating KGs into the QA pipeline. We analyse the effectiveness of these approaches in enhancing QA performance, especially in scenarios where external knowledge is essential. Furthermore, we discuss evaluation methodologies and benchmarks used to assess the performance of explainable QA systems, highlighting areas for future research and improvement. We also examine the interpretability of generated answers, emphasising the role of KGs in providing supporting evidence and explanations. Through a comprehensive synthesis of existing literature, this review paper provides insights into the current state of explainable QA systems, identifies research gaps, and offers directions for future research. By elucidating the potential of LLMs and KGs in QA, we aim to contribute to the ongoing advancement of AI-powered question answering technology.

Keywords: *Large Language Models, Knowledge Graphs*

Acknowledgements. I acknowledge the use of ChatGPT (https://chat.openai.com/) to refine the academic language and accuracy of my own work.

A comprehensive platform for testing and validating network applications

Rafael Direito[†,⋆,1], Diogo Gomes[1]

1. Universidade de Aveiro

⋆ Corresponding author; rafael.neves.direito@ua.pt; † Presenting author; Computer engineering.

Abstract. The 5G system aims to offer an environment for applications and vertical markets, which can benefit from the novel services and advanced interfaces introduced by 5G advancements. Recently, the European research community coined the term Network Application (5G-PPP, 2022). Within the 5G system, a Network Application is seen as a collection of services that offer specific functionalities to various vertical industries and their use cases. However, the development of such applications is still not trivial, as it requires strict cooperation between software developers and network operators. The gap between the software and the network ecosystems is large, and novel methodologies and procedures to develop softwarized Network Applications are needed. An example of this gap is the lack of testing and validation methodologies to attest to the quality of Network Applications.

Therefore, this work presents an approach for automating the testing and validation of Network Applications that fully adheres to DevSecOps principles, contrasting with the semi-automated testing methodologies that have been applied until recently (Rosa, R. V., Bertoldo, C., & Rothenberg, C. E., 2017)(Su, C., Zhao, J., Chen, M., & Gao, Z., 2022). By bridging the gap between DevSecOps methodologies and the 5G ecosystem, we provide Network Application developers with better tools to ensure the correct development of these applications.

The platform envisaged by this work concentrates on the innovations of conducting experiments and tests across several domains. Furthermore, it provides software support tools designed to implement DevSecOps methodologies for testing and validating Network Applications in a secure and trusted environment. Besides providing novel testing tools, the proposed system also offers a vast collection of test cases that can be employed to test and validate Network Applications from various specific verticals. Finally, this system also considers the collection of important monitoring data that enables Network Application developers to be aware of the impact of their applications on the infrastructure that shall host them.

Keywords: *Network Applications, Testing, CI/CD, DevSecOps, Automation, NFV*

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Acknowledgements. This work is supported by the H2020 European Project 5GASP (grant agreement No. 101016448)

Computer science - MAP-i

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

A method to reconstruct persistent human viral sequences cooperatively

Maria J. P. Sousa[†,⋆,1], Diogo Pratas[2]

1. IEETA/LASI - Institute of Electronics and Informatics Engineering of Aveiro, University of Aveiro, Portugal, DETI - Department of Electronics, Telecommunications and Informatics, University of Aveiro, Portugal.
2. IEETA/LASI - Institute of Electronics and Informatics Engineering of Aveiro, University of Aveiro, Portugal, DETI - Department of Electronics, Telecommunications and Informatics, University of Aveiro, Portugal, Department of Virology, University of Helsinki, Finland.

⋆ Corresponding author; mj.sousa@ua.pt; † Presenting author; Computer science - MAP-i.

Abstract. The demand for accurately reconstructed viral genomes has risen due to the increasing availability of diverse human viral sequenced samples. This demand is especially high in clinical and forensic contexts, where specialised tools are required to handle challenging data situations, such as low-depth coverage and high mutation rates.

To enhance the reconstruction of the viral genomes, we have developed a novel cooperative method, CoopPipe, capable of improving the reconstruction of human DNA viruses through the collaboration between several reconstruction programs publicly available. This method is able to classify and reconstruct viral genomes, pinpoint the specific regions of a viral genome reconstructed by each tool considered, and generate an accurate consensus sequence for each virus.

CoopPipe was evaluated using 62 nearly-synthetic datasets containing the viruses B19V, HPV68, MCPyV and VZV, as well as contamination and mitochondrial DNA. To assess the performance of CoopPipe under different scenarios between 0% and 15% of SNPs were added to the viral genomes. The sequencing process of these datasets was simulated with depth coverages between 2x and 40x.

The results obtained revealed a notable improvement in the reconstruction of the viral genomes contained in the datasets, averaging 5.62% in terms of the identity, 7.55% in terms of the Normalized Compression Semi-Distance and 10.07% in terms of the Normalized Relative Compression in relation to the best-performing tool for each viral genome.

The sensitivity of CoopPipe and its ability to work with diverse types of data, including low-depth coverage and fragmented data, is promising for reconstructing real-life clinical samples and ancient DNA viruses. The improvements made to the reconstruction represent a substantial difference in the development of accurate diagnoses and the search for personalised clinical treatments. The CoopPipe is fully reproducible and publicly available at https://github.com/viromelab/CoopPipe.

Keywords: *Computational Biology, Genomics, Bioinformatics, Virology, Computational Virology.*

Acknowledgements. This work was partially funded by National Funds through the FCT (Foundation for Science and Technology), in the context of the project UIDB/00127/2020. M.S. has received funding from the FCT - reference UI/BD/154658/2023. D.P. is funded by national funds through FCT, I.P., under the Scientific Employment Stimulus - Institutional Call reference CEECINST/00026/2018.

Cultural studies

Manual de Qualquer Artista de Teatro: a inclusão enquanto um desafio permanente.

Ferreira[1], T. A.

1. Doutorando

* Corresponding author; † Presenting author; Cultural studies.

Abstract. Nesta comunicação apresento o livro Manual de Qualquer Artista de Teatro como o resultado da investigação realizada no segundo ano curricular do Programa Doutoral em Estudos Culturais.
Sob o título Tensionalidades da Disciplina no Ofício do Ator, a proposta de investigação centra-se no desenvolvimento de vias epistemológicas e práticas que possibilitem maior inclusão de corpos, realidades e poéticas alheias às práticas artísticas teatrais vigentes. Como tal, estudam-se as conjunturas europeias atuais no que à inclusão concerne, coloca-se em questão a inocência de pretensões ideológicas sob a bandeira de uma ética inclusiva única (pautada pelo ar dos tempos) e apresentam-se alternativas teórico-práticas a estas formas de pensar, agir e criar instituídas neste campo artístico.
No mesmo sentido, seguiu a ação do projeto Time To Change (2022-2024), do qual resulta o livro referido e ao qual está acoplada a minha investigação de doutoramento. Neste projeto co-financiado pela Comissão Europeia, no qual estiveram envolvidas entidades portuguesas (Sic Esperança, IRENNE, Terra Amarela, Pais21) espanholas (Globers) e italianas (Young Effect) , reuniu-se um conjunto informações que foram sintetizadas e apropriadas no Manual De Qualquer Artista de Teatro. Informações essas que partiram de vários encontros multinacionais centrados na discussão e desenvolvimento de práticas teatrais inclusivas que envolveram profissionais do teatro e jovens cujo início do seu percurso teatral é limitado por condicionantes físicas, cognitivas, socioeconómicas ou culturais.
Evocando assim alternativas teóricas e práticas, o livro a ser apresentado surge como uma proposta de pensamento sobre as práticas teatrais enquanto um desafio constante de inclusão, propondo roteiros para processos artísticos e espetáculos que apresentem possibilidades além das limitações presentes nas vigências estéticas e éticas que se vão sedimentando.

Keywords: *Teatro; Inclusão; Estética teatral; Práticas artísticas inclusivas; Participação artística.*

Mulheres nas Bandas Militares em Portugal : Um estudo exploratório junto da Banda da Armada.

Beatriz Yaunner[†,1]

1. Universidade de Aveiro

* Corresponding author; † Presenting author; Cultural studies.

Abstract. Este projeto é um estudo qualitativo e exploratório, elaborado a partir do quadro teórico dos Estudos Culturais (Avtar 2007; Butler 2009; Bourdieu 1989;Foucault 1979 ; Hall 2013) que tem por objetivo principal compreender de que maneira se articulam nas mulheres da Banda da Armada as variáveis género e performance musical, em contexto fortemente atravessado por relações de poder, como é o caso do militar. Existem muitos mitos a cerca de um músico profissional: a figura do virtuose, o dom divino ou que através de um treinamento sistematizado, com muitas horas de prática e repetições todos seriam capazes de alcançar o sucesso profissional, quando na verdade, algumas pessoas, pela sua posição social, tem maiores oportunidades para desenvolver o seu talento. (Lewis, 2020, p.176).Uma das posições sociais à qual a autora se refere é o género. Tanaka (2018) afirma que, quando falamos de mulheres na música estamos nos referindo a uma minoria que só nessa última década vem impondo sua visibilidade e tendo a coragem de enfrentar o sistema hegemônico com mais veemência (Tanaka, 2018, p.13).Entre 1970 e 1980 ganha impulso o conceito de musicologia feminista (Cabedo 2009), a partir do qual se inicia um movimento para responder a lacunas como: onde estariam as mulheres durante todos os períodos da história música? o que faziam? qual a sua importância?
A carreira militar é uma oportunidade recente para as mulheres (Carreiras 1999, Monte 2020), sobretudo nas funções técnicas, como é o caso de tocar um instrumento. Somente em 2002, foi realizado o primeiro concurso na Banda da Armada portuguesa, aberto à participação de mulheres (Pereira 2008).O interesse académico pela temática das bandas civis e filarmónicas é recente, como afirma Pestana et al (2020), e a ligação entre as bandas civis e militares se deve principalmente ao fato de que a origem dos músicos militares reside justamente nas bandas civis e filarmónicas. Isto explica-se pelo fato de que as bandas funcionam como escolas de música por todo o país, inclusive nas localidades mais afastadas das capitais e dos grandes centros urbanos. (Correia 2006, Pereira 2008).
A investigação divide-se em três fase Revisão de Literatura; Trabalho de Campo; Análise e tratamento dos dados compilados e redação da tese.
Como principal resultado espera-se um conhecimento mais aprofundado das principais dificuldades e constrangimentos na integração das mulheres em bandas militares e produzir de forma colaborativa um manual de boas práticas, que possa ajudar a superar essas dificuldades.

Keywords: *Música e Género, Mulheres na Música, Mulheres Militares; Bandas de Música, Bandas Militares*

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"Woof! I would love to see your private pics" bears on the map: digital and social queer dynamics in São Paulo

Alexandre Rodolfo Alves de Almeida[†,⋆,1]

1. CLLC

⋆ Corresponding author; araalmeida@ua.pt; † Presenting author; Cultural studies.

Abstract. This study investigates the dynamics between digital communication technologies and the Bear community, a subculture within the LGBTQ+ spectrum characterised primarily by men, homosexual or bisexual, with distinctive physical attributes, such as body and facial hair, as well as a more voluminous body constitution, which can be either fat or muscular. This group represents a challenge to traditional norms of gender and sexuality. The focus of the research is to understand how these individuals relate, create communities, and resist social and gender norms in the urban context of São Paulo. Employing a methodological approach that combines quantitative and qualitative techniques, including online survey and content analysis of in-depth interviews, the study seeks to offer a comprehensive and detailed understanding of the experiences, perceptions, and practices of the Bear community. The research culminates in the creation of a rhizomatic cartography of this community, highlighting its central points, lines of segmentarity, and lines of flight. This work not only sheds light on less explored aspects of queer life but also questions conventional concepts of space, identity, and community. Furthermore, it proposes a critical analysis of the role of digital technologies in the formation of identities and in the practice of resisting normativities, both within the Bear community and in broader contexts.

Keywords: *cultural studies, bear studies, queer studies, cartography, São Paulo*

Acknowledgements. This research was financially supported by the Fundação Para a Ciência e a Tecnologia (FCT), I.P., with funds from the national budget. Reference: UI/BD/151280/2021.

Research Summit 2024
Research Forum of the University of Aveiro
$16–19^{th}$ July 2024, Aveiro. Portugal

Aborto em pauta: argumentos (de)coloniais sobre a criminalização da prática no Brasil

Lana de Araújo Gomides[†,1], Maria Manuel Baptista[2], Rui Alexandre Grácio[1]

1. Departamento de Línguas e Culturas
2. CLLC, Departamento de Línguas e Culturas, Universidade de Aveiro, 3810-193 Aveiro

[⋆] Corresponding author; [†] Presenting author; Cultural studies.

Abstract. Sob as contribuições dos Estudos Culturais, esta escrita (des)constrói caminhos de análise e reflexão sobre as relações coloniais de poder perpetuadas sobre os corpos femininos através do Decreto-lei nž 2.848, de 7 de dezembro de 1940, previsto no Código Penal brasileiro, que diz respeito à criminalização do aborto no Brasil. Logo, o objetivo é identificar as relações de poder que existem nos argumentos favoráveis e não favoráveis à descriminalização da prática. Mediante um pano de fundo cristão, as discussões sobre a pauta revelam valores religiosos e moralizantes atrelados aos interesses do sistema capitalista, de tal modo que as mulheres pobres, pretas e indígenas são intensamente desfavorecidas perante a legislação atual. Com a ascensão de um governo de extrema-direita em 2019, a articulação de um discurso antigênero não apenas dificultou avanços nos direitos sexuais e reprodutivos, como também ressignificou o conceito de dignidade humana. Ainda, as leis estão organizadas para disciplinar e proteger as mulheres que se adequam aos estereótipos de feminilidade e em consonância com o sexo biológico. Ao mesmo tempo em que há práticas coloniais que sedimentam hierarquizações, é possível empreender uma leitura de corpos de fronteira que operam fora das margens ou na contrahegemonia quando se recusam a seguir os papéis sociais vinculados à maternidade, protestam contra a governabilidade que restringe a interrupção da gravidez e promovem dissidências na criação da prole. Diante do exposto, a investigação analisa os posicionamentos de duas organizações brasileiras, uma favorável e outra contrária à descriminalização do aborto, expressos durante entrevistas em profundidade entre seus líderes e a autora. Cabe ressaltar que o artigo não revelará o nome das organizações, visando preservar a privacidade das pessoas entrevistadas. As categorias de análise focadas no auditório universal, nos tópicos de argumentação e nas estratégias argumentativas, de Chaïm Perelman (1992), são os métodos utilizados para reconhecer elementos que sustentam as articulações de ambos os grupos nesses diálogos transcritos, bem como suas comunicações verbais e não verbais disseminadas nas redes sociais. Em relação aos resultados obtidos, entre as comunicações da organização não favorável à descriminalização é notória uma persuasão que opera através da via psicológica, baseada em valores religiosos. Já a organização favorável à descriminalização recorre à lógica da informação com o intuito de convencer seu auditório por meio de mensagens probatórias (Barthes, 1990).

Keywords: *aborto; argumentação; comunicação; dignidade humana; Estudos Culturais.*

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Acknowledgements. Este trabalho foi financiado pela Fundação Para a Ciência e a Tecnologia (FCT). Referência da bolsa: 2022.13479.BD

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Unveiling Gender Dynamics: A historical exploration of feminism in China

Lanfeng Zhou[†,⋆,1], Maria Manuel Rocha Teixeira Baptista [2]

1. Universidade de Aveiro, 3810-193 Aveiro
2. Departamento de Línguas e Culturas

⋆ Corresponding author; † Presenting author; Cultural studies.

Abstract. For centuries, Chinese feudal society perpetuated a patriarchal structure, relegating women to a marginalized role, effectively erasing their presence from historical narratives. As Antonio Gramsci(1971) articulated in his concept of organic intellectuals, throughout Chinese history, intellectuals have emerged advocating for cultural hegemony, with philosophers from various Chinese schools playing a pivotal role in shaping societal norms, including those regarding women's status.(Alves, 2007)Therefore, it is imperative to acknowledge the emergence of dissenting voices against this hegemonic order. Towards the last years of the Qing Dynasty, feminist movements arose, aiming to revolutionize the socio-political fabric of ancient China. Initially spearheaded by men, these movements were highly related to the nation's evolution, emphasizing the pivotal role of motherhood. (Mizuyo, 2010) The peak of the feminist movement occurred during the May Fourth Revolution period. Nevertheless, during the Mao Zedong era, feminism was often dismissed as a narrow Western capitalist ideology, supplanted by the proletarian womens liberation movement. The endorsement of the initial programmatic document on womens issues in China symbolized the ascendancy of Marxist principles concerning women's liberation. (Wang & Gao, 2016) The pivotal 1995 World Conference on Women in Beijing catalyzed widespread discussions on gender in China. In light of these historical developments, the question arises: have these movements genuinely catalyzed female consciousness, or do they merely reinforce a construct shaped by male perceptions of femininity? How might this impact the portrayal and representation of women? For Chinese feminists, this dilemma remains a formidable challenge.This study aims to contextualize and critically analyze the mentioned historical influences and current trends related to the roles of women in Chinese society. To achieve this, a comprehensive literature review will be conducted, exploring historical and political documents as well as contemporary studies on gender issues in China.

Keywords: *Gender issue; China; Feminism; Women's Liberation; Cultural Hegemony*

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Acknowledgements. I acknowledge the significant contributions of the Languages, Literatures and Cultures Centre (CLLC) that has consistently provided invaluable resources, expert guidance, and a supportive community, playing a crucial role in my continuous growth and development in these areas. I express my sincere gratitude to the staff and educators at CLLC for their unwavering dedication and expertise.

O ensino de mandarim e a diplomacia cultural

Jingwen Zhang[†,1]

1. University of Aveiro

[⋆] Corresponding author; [†] Presenting author; Cultural studies.

Abstract. Introdução: A partir dos anos sessenta do século XX, o governo chinês tem executado uma série de diplomacia cultural (por exemplo, a iniciativa Uma Faixa, Uma Rota), com o intuito de promover o desenvolvimento cultural e o conhecimento da China pelos outros países. Neste contexto, o ensino de mandarim começou a ser popular fora da China, dependendo de uma série das medidas da diplomacia cultural da China, tal como o estabelecimento dos Institutos Confúcio. Aproveitando a maré, uma febre de aprender mandarim também entrou em força em Portugal. A língua chinesa, como um instrumento de comunicação, torna-se cada vez mais importante nas relações China-Portugal. O principal objetivo deste estudo reside em analisar o ensino de mandarim e a diplomacia cultural da China em Portugal, especialmente na Universidade de Aveiro, e, ao mesmo tempo, investigar quais os desafios e problemas surgidos no estudo de casos, tentando oferecer considerações e respostas modestas.
Problema abordado: A transformação dos recursos culturais em vantagens na diplomacia cultural é ainda insuficiente e, na divulgação da cultura estrangeira, a ênfase continua a ser colocada na cultura tradicional e a forma dos intercâmbios culturais é relativamente homogénea.
Solução sugerida para o problema: Alargar as formas de diplomacia cultural e incluir mais elementos culturais no ensino de mandarim.
Metodologia: A metodologia utilizada neste estudo será o estudo de caso, com uma recolha de dados de recursos primários e secundários através de entrevistas, questionários e análise documental, privilegiando a pesquisa qualitativa.

Keywords: *China-Portugal, diplomacia cultural, ensino de mandarim, Instituto Confúcio*

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Acknowledgements. Gostaria de expressar minha sincera gratidão a todos que contribuíram para a realização deste trabalho.

Design

Designing micro-architecture solutions to enhance subjective experiences in heritage spaces.

Gaelle Pillault[†,⋆,1], Tenna Doktor Olsen Tvedebrink[2], Fátima Pombo [1]

1. ID+
2. Department of Architecture, Design and Media Technology

⋆ Corresponding author; gaelle.pillault@ua.pt; † Presenting author; Design.

Abstract. Micro-architecture, although not formally recognised within design disciplines, emerges from the intersection of architecture and furniture design. Often associated with small-scale habitats, modular or ephemeral structures, micro-architecture offers new perspectives on how to design and use habitable spaces, whether public or private. These characteristics are of major interest to our research, which views micro-architecture as a transdisciplinary approach capable of addressing functional needs for adapting to diverse spaces and contemporary concerns such as bodily engagement, human interaction, and material innovation.
In the process of transformation of industrial heritage buildings interiors, often converted for cultural purposes, micro-architecture appears as an innovative strategy for rearrange spaces. In these sites where imagination and interpretation are dominant, intimate reactions influenced by personal dispositions and cultural contexts of visitors arise (Fuchs 2009; Ingold 2021). This highlights the role of subjectivity in the visitor experience and the need to design spaces accessible to all, that welcome, value, and respect diversity (Pillault et al., 2024). Our research illustrates how micro-architecture can enhance affective experiences by transforming space and enhancing bodily engagement. It emphasizes the importance of the body in heritage experiences (Waterton 2014), drawing on Gibson's ecological psychology that sees affordances as interaction opportunities, and phenomenology, emphasising the embodied interaction with the environment as essential to experience the world. Through original design, micro-architecture can encourage corporeal movements and dynamic interaction with the environment. Strategic use of varied forms and materials can evoke specific emotions and create unique spatial experiences, engaging users on cognitive, emotional, and bodily levels, potentially strengthening connections with the built heritage.
In this research, we apply the 'Research through Design' methodology to explore the interactions between users and heritage spaces, by developing prototypes, which will evolve through an iterative process based on feedback. This approach should improve the impact of micro-architectural interventions in the repurposed industrial environment.

Keywords: *Micro-architecture, Design, Embodiment, Emotions, Phenomenology, Repurposed Industrial Buildings*

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Acknowledgements. This work is financed by national funds through the FCT Fundação para a Ciência e a Tecnologia, I. P., under the scope of the project UIDB/04057/2020

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Product biography: handicrafts as a path to sustainable fashion in Portugal

Mariana Oliveira[†,⋆,1], Cláudia Albino[1]

1. Campus Universitário de Santiago, 3810-193 Aveiro Portugal

⋆ Corresponding author; † Presenting author; Design.

Abstract. The search for more sustainable production processes relate to the need for a circular economy is one of today's most pressing issues. In the fashion industry, one of the most polluting in the world (McKinsey & Company and GFA, 2020), craft techniques stands out as a way to create a more humane and environmentally friendly production. In Portugal, some brands and projects are pursuing this productive structure (Albino, 2017; Carvalho, 2020; Coutinho, 2022) as a way of reviving ancestral practices that were being lost because of the rapid dynamics with which fashion has been organized, from the 15th century to the present day (Lipovetsky, 2010).

In this context, it is necessary to investigate how the stages of these productions take place, identifying the contributions and prospects of their products for the circularity of the Portuguese fashion sector. To this end, the research in question uses literature review on the concepts of circular design, fashion design and sustainability, design and craftsmanship in Portuguese fashion, sustainable materials and techniques. This in-depth study of the subject is integrated with a multiple case study with designers and fashion brands working to create a more sustainable, artisanal production in an industry governed by the obsolescence of trends and products in a globalized world.

Thus, this research aims to allow fashion artefacts to tell their own stories and enhance business culture towards innovation and sustainability through the biography of the products themselves, the results of which will be made tangible in an exhibition. Then it proposes identifies the weaknesses and potential of these production processes from the perspective of circular design, pointing to the imminent saturation of the fashion system and preparing the national industry for a slowdown, which is indispensable for a good positioning of the demands for sustainability at a global level.

Keywords: *Design, Fashion, Sustainability, Handcraft, Portugal.*

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Acknowledgements. The authors gratefully acknowledge the financial support of the Portuguese Foundation for Science and Technology (FCT) through the Ph.D. grant 2023.02142.BD

Perspectives for the future of the workplace: furniture design for a collaborative and flexible work experience.

Rita Cruz[†,⋆,1], Teresa Franqueira[2], Fátima Pombo[2]

1.
2. Department of Communication and Art, University of Aveiro, Aveiro, Portugal.

⋆ Corresponding author; ritamccruz@ua.pt; † Presenting author; Design.

Abstract. Last decades, technology has progressively allowed greater mobility, making it possible to work anywhere and not just in the office, requiring only a laptop and mobile phone. Nomadism and the reduction of tools and objects needed to work, contributed to the emergence of new ways of work, more collaborative and increasingly less formal (Gillen, 2019). The covid-19 pandemic evidenced and accelerated, the already foreseen, change to a more hybrid work model. Furniture design plays a fundamental role in this context ensuring flexibility, dynamic and multifunctional workplaces providing the stability and functionality of workflows (Tuncel & Kayan, 2018).

For the Research Summit 2024, under the theme 50 Years of Research at the UA: Challenges for the future, it discusses the perspectives for the future of the workplaces and how furniture design can help to create a more collaborative work experience.

The research includes an analysis of the three pairs of parameters - function/comfort, materials/sustainability and flexibility/form -, in relation to the study of several visits made to a set of collaborative workplaces (coworking's, companies and business incubators) and trade fairs dedicated to workplace furniture (Cruz & Pombo, 2023) (Cruz et al., 2021). This analysis reflects how flexibility and modularity furniture is the issue for the future of workplaces. The possibility to create agile and spontaneous work environments are align with people ambitions to meet their different needs, supporting and facilitate moments of collaboration, interaction, sharing, socialization and everything between. With different scenarios and resources to create areas for teamwork (meetings, workshops, brainstorming, etc.), living and leisure areas and even private areas to promote concentration, the workplace design should foster harmony and requires the wellbeing of employees in order to create a more creative and interactive experiences that we cannot have at home.

The doctoral research, to be completed this year, presents the project of a modular furniture system for collaborative workplaces allowing to easily create diverse configurations that meet different purposes in the workplace, and transform workplaces into environments that nurture creativity, collaboration and wellbeing. The proposal is also in line with circular economy, sustainable production standards, and gives relevance to the materials to ensure a proper level of acoustics and comfort. To finalize the project, it is included the execution of furniture prototypes in partnership with GUIALMI (Empresa de móveis metálicos S.A.).

Keywords: *collaborative workplaces, furniture design, hybrid work, creative experience, materials*

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Acknowledgements. This work is financed by national funds through the FCT Fundação para a Ciência e a Tecnologia, I.P., under the scope of the project SFRH/BD/146306/2019. This work is financed by national funds through the FCT Fundacao para a Ciencia e a Tecnologia, I.P., under the scope of the project UIDB/04057/2020.

Education

Didactic sequence using GeoGebra Classroom to support the learning of Statistics by Portuguese Secondary School students.

Carolina Martins[†,1], Vanda Santos[2], Daniela Pedrosa[3]

1. Departamento de Educação e Psicologia
2. Research Center for Didactics and Technology in Training for Trainers (CIDTFF), Department of Education and Psychology, University of Aveiro, Campus Universitario de Santiago, 3810-193, Aveiro, Portugal
3. Escola de Educação e CIDTFF

[⋆] Corresponding author; [†] Presenting author; Education.

Abstract. The integration of technology in the teaching of Mathematics has been advocated over time and included in the guideline for mathematical education in Portugal (Carvalho e Silva et al., 2023; Henriques & Nascimento, 2013; NCTM, 1991, 2014; Ponte, 2003) as dynamic tools that support the teaching-learning process. The GeoGebra software was selected for its interactive access to Geometry, Algebra, Statistics and Calculus content within the realm of Mathematics Educations (Dwijayani, 2019; Tavares & Lopes, 2019). One of the strategies recommended by the National Council of Teachers of Mathematics (NCTM) advocates for the use of mathematical and technological tools to facilitate students learning processes, asserting that tools aid in understanding mathematical ideas, reason, and mathematically communicate their thinking (NCTM, 2014). Dwijayani (2019) and Mainali (2020) support this approach as it promotes a visual comprehension of concepts by bridging mathematical language with graphical representations.The study applied the GeoGebra Classroom tool in twenty 50-minute sessions focusing on Statistics, a subject traditionally known for its expository nature and abstract concepts (Tavares & Lopes, 2019), to simplify statistical procedures, providing more time for data analysis and decision-making (Tavares & Lopes, 2019). GeoGebra Classroom serves as a holistic tool combining all the functionalities of GeoGebra Classic, giving teachers the flexibility to create and share custom materials with their class while actively engaging with students (Astafieva et al., 2021; Pinheiro & Santos, 2023). Moreover, the effective implementation of GeoGebra Classroom enhances mathematical communication by promoting student collaboration in sharing discoveries, dynamically discussing solutions, and fostering accessibility.

This study aims to understand how the utilisation of GeoGebra Classroom and the application of task exploration and investigation tasks on this platform can be integrated into mathematics classes, specifically in the study of Statistics, and evaluate the evolution of students mathematical communication through the analysis of their responses to tasks and oral presentations. To achieve these goals, a didactic sequence was developed for tenth-grade students in secondary school in the Mathematics subject, focusing on Univariate Statistics.

Tasks were designed to encapsulate each concept studied, to be worked on in dynamic groups that fostered student discussion. Concurrently, students autonomously engaged in tasks encompassing statistical procedures relevant to the unit under study within the GeoGebra Classroom, utilising a group work approach.

The initial exploratory tasks yielded insights into students challenges, both in terms of mathematical communication and content assimilation, shedding light on the impact of GeoGebra Classroom on their learning progression.

Keywords: *dynamic geometry system; statistic; learning environment; math communication*

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Acknowledgements. Financially supported by National Funds through FCT Fundação para a Ciência e a Tecnologia, I.P., under the projects UIDB/00194/2020, UIDP/00194/2020 and the scientific initiation grant with the reference UIDB/00194/2020.
Vanda Santos work is funded by national funds through the FCT -Foundation for Science and Technology, I.P., within the scope of the project UIDB/00194/2020 and in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of the article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19.

Autonomy and curricular flexibility in practice: results of the exploratory phase

Marcia Pinto[†,⋆,1], Manuela Gonçalves[1]

1.

⋆ Corresponding author; marciahpinto@ua.pt; † Presenting author; Education.

Abstract. As part of the research entitled 'Autonomy and Curricular Flexibility (ACF) in practice: a case study', which aims to analyse and understand the development of educational policy regarding the autonomy of/for public schools in Portugal (Cosme, 2018; DL n.ž 55/2018), in a specific School Grouping (SG), this communication will present how the process of entering the local context of the research took place. Throughout this school year, and characterising phase 1: Exploration, of the study, we entered the field of research and, through participant observation, monitored various activities carried out at the SG relating to the Domains of Curricular Autonomy (DCA), which allowed us to understand how the policy of autonomy and curricular flexibility has been processed in the context under investigation (Lima, 2020). The way in which the school has been developing this policy was discerned through informal conversations with its leaders (top and middle) and the school's structuring documents were analysed (Cechinel et al., 2016). In the meantime, the school is undergoing a process of internal restructuring due to the change of headmaster, which in the future will allow a comparative analysis to be made of the new documents that will be produced.
Observation of the DCA's activities has shown that they appear to be an expression of autonomy for the school. This is because the activities were developed in conjunction with the educational community (teachers, students, members of society), seeking to provide answers to questions arising from the SG's environment and appropriate to its local context, in line with what is proposed in the ACF regulations. The research will continue for another two years, and in the next stage (phase 2: development of the empirical research) it will be deepened with semi-structured interviews and questionnaires to the participants, where it is hoped to obtain data that will allow us to deepen and cross-check the information, in order to understand if and how the process of translating the ACF policy at the level of the SG materialises its autonomy (Barroso, 2022).

Keywords: *School Management and Administration, School Autonomy, Educational Policies, Case Studies*

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Acknowledgements. This work is financed by National Funds through FCT - Fundação para a Ciência e a Tecnologia, I.P., within the scope of the research grant with reference 2023.00228.BD (Marcia Pinto) and CIDTFF, projects UIDB/00194/2020 (https://doi.org/10.54499/UIDB/00194/2020) and UIDP/00194/2020 (https://doi.org/10.54499/UIDP/00194/2020).

As interações docentes na formação contínua de professsres no âmbito do Projeto Escolas Bilíngues Interculturais de Fronteira: Um estudo exploratório

Andrea Ulhôa[†,1], Maria Helena Araújo e Sá[1]

1. UA/DEP/CIDTFF

⋆ Corresponding author; † Presenting author; Education.

Abstract. Este estudo faz parte da nossa investigação, que está a decorrer no âmbito do Projeto Escolas Bilingues Interculturais de Fronteira (PEBIF), empreendido pela Organização dos Estados Ibero-americanos em colaboração com os Ministérios da Educação de Portugal e de Espanha, com coordenação científica das Universidades Complutense de Madrid e de Aveiro. A formação contínua de professores, concebida numa ótica de investigação-ação-formação, constitui o principal pilar deste projeto, visando o desenvolvimento de processos formativos sensíveis à diversidade cultural e linguística da região fronteiriça, orientados pelos princípios teóricos da interculturalidade e do bi/plurilinguismo. O acompanhamento investigativo da 1ł edição do PEBIF decorreu entre maio de 2021 e outubro de 2022, envolvendo 37 professores-participantes de 10 escolas da fronteira luso-hispânica, as quais foram organizadas em 4 grupos de escolas-espelho situadas em Bragança-Zamora; Guarda-Miróbriga; Elvas-Badajoz-Cáceres; Vila Real de Santo António-Huelva, sendo que nossa investigação focaliza o grupo de Bragança-Zamora. O processo formativo, com 50 horas, possibilitou a produção de narrativas multimodais construídas a partir de diversos instrumentos de recolha de dados, como diários de investigação, gravações das sessões síncronas e relatórios reflexivos dos professores. Estas narrativas serão exploradas a fim de identificar e analisar os contributos do PEBIF para o desenvolvimento profissional e para a (re)significação da prática pedagógica dos professores em direção a uma educação intercultural e bilíngue nas escolas de fronteira. O objetivo deste estudo, em específico, é identificar e descrever as dimensões de interação emergentes entre os professores participantes do PEBIF, para compreender a natureza e complexidade das (inter)relações estabelecidas durante o processo formativo. A análise exploratória conduzida resultou na identificação de quatro dimensões: linguístico-comunicativa, relacional, sociocultural e curricular, as quais serão apresentadas, demonstrando como os professores se organizaram para criar um ambiente favorável ao trabalho colaborativo, com vistas à promoção de uma educação intercultural e plurilíngue nas escolas de fronteira.

Keywords: *Formação contínua de professores; Escolas de Fronteira, Interação docente, Interculturalidade, Bi/plurilinguismo.*

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Campus Universitário de Santiago

Acknowledgements. Trabalho financiado por Fundos Nacionais através da FCT Fundação para a Ciência e a Tecnologia, I.P. no âmbito da bolsa de investigação com a referência nž 2022.14501.BD e do projeto com a referência UIDB/00194/2020 (CIDTFF).

The development of a GreenComp-inspired Questionnaire: Bridging EduCITY projects aims to broader contexts

João Ferreira-Santos[†,⋆,1], Lúcia Pombo[1], Margarida M. Marques[1], Rita Rodrigues[1]

1. University of Aveiro - Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; joaomrsantos@ua.pt; † Presenting author; Education.

Abstract. To achieve an effective sustainability, it is important to create strategies or activities that surpass mere awareness-raising efforts (Wiek, et al., 2011; Redman & Wiek, 2021). These activities are important, but we need to understand their impact to make changes for sustainable development (Annelin & Boström, 2022). This paper outlines a questionnaire on the impact of EduCITY games and activities (https://educity.web.ua.pt/) in Education for Sustainability. It summarizes the extensive research process of questionnaire development, which involved stages like mapping existing instruments (Reichmann, et al., 2021), reviewing Sustainability Education assessment instruments (Annelin & Boström, 2022), and choosing GreenComp (Bianchi, et al., 2022), the European sustainability competence framework as base for the new questionnaire. This questionnaire has been developed within the specific context of EduCITY games and activities and can be used in other educational and training contexts. Moreover, this instrument has been adapted for use with the Portuguese population. This paper presents the process of developing this questionnaire, demonstrating the various stages involved in its development (Reichmann, et al., 2021; Creswell & Creswell, 2023). These include the collaboration of various national experts, the implementation of different pilots, the application of an initial version, and the subsequent validation process by international experts. The subsequent stages of questionnaire development involved a process of content analysis, including the examination of the content of the used statements and the use of software (JASP team, 2018) designed for the validation of this type of research instrument. These processes showed that the questionnaire was valid (Reichmann, et al., 2021; Creswell & Creswell, 2023). Regarding the reliability of the instrument, it is recommended that further research be conducted by applying the questionnaire to a larger number of participants. It would also be beneficial to apply the questionnaire in a longitudinal logic, rather than in a one-off study (Reichmann, et al., 2021). This would facilitate a more comprehensive understanding of the instrument's value and the activities it evaluates.

Keywords: *Competences for Sustainability; Sustainable Development; GreenComp; Questionnaire development; EduCITY*

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Pedagogical uses of generative artificial intelligence in higher education: an exploratory study

Pedro Matos[†,⋆,1], Margarida Rocha Lucas[2], Mónica Aresta[3]

1. Universidade de Aveiro, 3810-193 Aveiro
2. CIDTFF, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro Portugal
3. DigiMedia Research Center, Department of Communication and Art, University of Aveiro

⋆ Corresponding author; pedrojqmatos@ua.pt; † Presenting author; Education.

Abstract. This study addresses the growing integration of Generative Artificial Intelligence (GAI) in Higher Education (HE), driven by the need to prepare students for an increasingly digitized world (Lucas et al., 2022). Although promising, the implementation of GAI in HE raises concerns about the possibility of spreading misinformation and biased responses (Chan, 2023; Strzelecki, 2023). Despite the European Union's regulatory efforts, there are still gaps in the understanding and application of GAI in the Portuguese educational context (Santos, 2024). This project aims to fill this gap by gathering and systematizing good practices to guide the implementation of GAI in HE.Based on an interpretive approach, this case study at the School of Education of the Polytechnic Institute of Santarém (ESE-IPS) adopts a mixed methodology, combining qualitative and quantitative data. The first phase consists of drawing up a survey to identify the most commonly used GAI tools and the associated learning contexts. In the subsequent phase, practical workshops are conducted to explore the use of GAI as a pedagogical tool, involving students from different areas. The analysis of the data collected makes it possible, using content analysis, to identify categories of pedagogical use of GAI and to anticipate strengths and weaknesses. Also at this stage, all the transcripts (collected through field notes, interactions with tools, and focus groups) will be subjected to sentiment analysis (Krugmann & Hartmann, 2024) to analyze the steps, the structuring of the instructions and the students' impressions of using GAI as a pedagogical tool.In the final phase, the results are critically analyzed to provide recommendations on the appropriate use of GAI in HE. This study contributes to understanding how GAI can be effectively integrated into teaching and learning, highlighting its benefits and challenges.

Keywords: *Generative Artificial Intelligence, Higher Education, Text-Mining, Educational Practices, Sentiment Analysis*

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Peer observation as a collaborative teaching supervision strategy in higher education: An exploratory systematic literature review.

Ana M. João Perira[†,1], Maria João Loureiro[⋆,1], Margarida M. Marques[1]

1. CIDTFF

⋆ Corresponding author; mjoao@ua.pt; † Presenting author; Education.

Abstract. Collaborative supervision and peer observation can provide a valuable support to mitigate the lack of pedagogical preparation of many of the university teachers, a practice that is not common in Angola. As part of a doctoral project that aims to fill this gap, this study aims to understand how peer observation has been developed among higher education teachers and its influence on improving their practices. In this sense, we sought answers to the following questions i) How has peer observation been developed among higher education teachers? ii) What are the perceptions of the teachers involved in relation to potential improvements in their practices? To this end, an exploratory systematic literature review was carried out, searching for scientific articles published between 2014 and 2023, in English, Portuguese and Spanish, in the Scopus, Web of Science, Academic Search Complete and ERIC databases. The search resulted in a total of 248 records, but after eliminating duplicates and applying the inclusion and exclusion criteria, the corpus comprised 36 articles. The results reveal that the literature describes three models of peer observation: i) evaluative, carried out by a senior peer in relation to the observed, to assess performance; ii) collaborative, which takes place between colleagues; iii) developmental, in which a more experienced teacher assesses the one observed to promote his/her professional development. It was also possible to systematise the phases of peer observation, from preparation to reflection, and to have access to data collection tools that might be adapted to the context of our study. From the perspective of those involved, constructive feedback and reflective, reciprocal sharing are considered essential for developing new skills and for improving teaching practices.

Keywords: *Collaborative supervision; Teacher; University; Peer observation.*

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Acknowledgements. The authors gratefully acknowledge the financial support of the Foundation for Science and Technology (FCT): within the scope of the projects of the Research Center in Didactics and Technology in the Training of Trainers (UIDB/00194/2020 - https://doi.org/10.54499/UIDB/00194/2020 and UIDP/00194/2020 - https://doi.org/10.54499/UIDP/00194/2020 .
Margarida M. Marques' work is funded by National Funds through the FCT - Foundation for Science and Technology, I.P., within the scope of Scientific Employment

An EduCITY game in Vale de Ílhavo to preserve cultural heritage and traditions

Ana Teresa Rocha[†,1], Lúcia Pombo[⋆,2], Margarida M. Marques[3], Eliana Fidalgo[4], Sara Santos[4]

1.
2. University of Aveiro - Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
3. University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal
4. Ílhavo City Council

⋆ Corresponding author; lpombo@ua.pt; † Presenting author; Education.

Abstract. Vale de Ílhavo is classified as an Aldeia de Portugal due to its high cultural value, especially its typical Carnival with Cardadores (unique in the country) and its gastronomic value (padas and folar). An educational mobile augmented reality game, supported by the EduCITY app, was developed for Vale de Ílhavo, in a collaboration between the University of Aveiro and Ílhavo City Council. The aim of the development of this game is to value and preserve the local cultural heritage and traditions. The game challenges the users to follow a path through six points of interest and fifteen questions, allowing them to explore and learn about local history and activities. The game is aimed at the local community and tourists, of all ages, and was developed in Portuguese and English. Users will access information through multimedia resources integrated into the EduCITY app, including videos and augmented reality, where virtual information is superimposed on physical elements of the environment to be observed, analysed, and to answer correctly. An activity of exploration of the game with seniors is planned in order to collect evaluation data on the educational value of the game. This evaluation supports improvements to the game before its wider exploration within the Municipalitys educational/cultural programme. This work previews future collaborations to create other educational mobile augmented reality games in the citys iconic locations.
This work was developed within the Scientific Initiation Programme for Young Students in Education (PIC-Edu), promoted by the Centre for Research in Didactics and Technology in the Training of Trainers (CIDTFF). The EduCITY project (https://educity.web.ua.pt/) is financed by Portuguese funds through FCT - Foundation for Science and Technology within the framework of the EduCITY project PTDC/CED-EDG/0197/2021.

Keywords: *EduCITY app; Augmented reality; Educational mobile game; Vale de Ílhavo.*

External evaluation of schools and inclusive education: A systematic literature review

Jennifer Silva[†,1], Diana Oliveira[1], Alexandre Ventura[1]

1. Research Center on Didactics and Technology in the Education of Trainers, Department of Education and Psychology

⋆ Corresponding author; † Presenting author; Education.

Abstract. External evaluation of schools (EES) in non-tertiary education has gained prominence in national and international political agendas, emerging from decentralization policies and the accountability movement (Afonso, 2010; Jones et al., 2017). As a measure of New Public Management, EES is identified as a strategic instrument for improving the quality of education, aiming to ensure compliance with current legal regulations (Ehren et al., 2013). Alongside this dynamic, in recent years, the adoption of inclusive policies and practices has been a priority of governmental action in several countries, with the aim of addressing the individual needs of all students and promoting equity and social inclusion (Ainscow, 2005).This communication presents a systematic literature review (SLR), an integral part of the doctoral project "External evaluation of schools: Policies and leadership in the development of an inclusive school". Through an SLR, the aim was to map and understand the breadth and depth of existing studies about EES and its relationship with inclusive education (policies and practices). Twenty-two articles were selected from the Scopus, WoS, and ERIC databases, as well as from the SciELO portal and the RCAAP repository. In this selection, PRISMA guidelines were followed, and the analysis of the results was supported by the webQDA software.The SLR has shown that there is a lack of research on how EES contributes to the development of inclusive education, schools improvement and their sustainability, although there is evidence of an emerging research field, particularly in Portugal, in the current 3rd cycle of the External School Evaluation Program (ESEP), promoted by the Inspectorate-General of Education and Science (IGEC). In a broader context, it is observed that EES has essentially played an inductive role, guiding school leadership in implementing improvement measures based on the external evaluation reports produced by IGEC. However, challenges are also recorded, such as the resistance of some teachers regarding the adoption of differentiated and inclusive pedagogical strategies in the classroom. In this sense, it would be advantageous for the ESEP to adopt a more proactive approach to accountability and guidance for change, contributing to the promotion of training and provision of resources to schools. Some studies recommend empowering leaders to guide the school community in creating an inclusive educational environment. Similarly, they propose the integration of self-evaluation and external evaluation processes, transparent feedback, and active participation of leaders, teachers, and other stakeholders, aiming to promote the continuous improvement of inclusive practices in schools.

Keywords: *External evaluation of schools; Educational policies; Inclusion; Systematic literature review.*

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Acknowledgements. The authors gratefully acknowledge the financial support of the Portuguese Foundation for Science and Tecnology (FCT) under the projects of the Research Center on Didactics and Technology in the Education of Trainers (UIDB/00194/2020 - https://doi.org/10.54499/UIDB/00194/2020; and UIDP/00194/2020 https://doi.org/10.54499/UIDP/00194/2020); as well as through the doctoral scholarship (2023.00894.BD).

Electrical engineering

Machine learning approaches for complexity-aware UHD 360-degree video coding

Jose N. Filipe[†,⋆,1], Antonio Navarro[2], Pedro A. A. Assuncao[2]

1. Instituto de Telecomunicações
2. Instituto de Telecomunicacoes

⋆ Corresponding author; † Presenting author; Electrical engineering.

Abstract. The growing demand for video services, and omnidirectional video in particular, has significantly increased the share of video in global internet traffic, accounting for about 70% [1]. This surge drives the need for more efficient video coding standards. In response, JVET released the Versatile Video Coding (VVC) standard in July 2020, which natively supports omnidirectional video and offers coding gains of 30% to 60% compared to the previous HEVC standard [2]. However, VVC's increased coding efficiency comes with higher computational complexity, making it 5 to 8 times more complex than HEVC [2], thus posing challenges for its widespread adoption. Consequently, several low-complexity methods for VVC have been proposed [3], but few focus specifically on omnidirectional video.In order to tackle this, a thorough study of the ubiquitous omnidirectional projection (equirectangular projection, or ERP) was conducted, concluding that coding complexity tend to be higher near the equator and lower near the poles, due to the oversample that occurs in those regions [4]. Taking advantage of this, Extremely Randomised Trees (ERT) models were used to decide whenever a given Coding Unit (CU) should be split, or if it could be skipped, based on its spatial and contextual features. This resulted in a complexity reduction of 56.25% and corresponding BD-Rate increase of 1.37%. Currently, the usage of a novel tree-based method that, unlike traditional tree-based methods, takes advantage of linear combinations of features at each node, is being investigated, with the intention of improving the accuracy of the models, whilst reducing its computational complexity.Furthermore, in order to tackle the oversampling near the poles in the ERP frames, a novel projection is being developed, based on the rhombus form of the Collignon projection. This method would theoretically allow the representation of the same information, using fewer pixels (by uniformising the sample-rate across the frame), which in turn results in lower compression times.Another method to mitigate VVC complexity is to efficiently parallelize the coding process. A load-balancing scheme at the frame level has been proposed in [5]. This approach makes use of a combination of Principal Component Analysis and Extremely Randomised Trees models to predict the complexity of each Coding Tree Unit in advance. The frame is then divided into four slices, each with approximately the same total complexity, resulting in an 8.5% improvement over even splitting.

Keywords: *Video coding complexity, Versatile Video Coding, fast coding decisions, omnidirectional video*

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Acknowledgements. This work was supported in part by the Fundação para a Ciência e a Tecnologia (FCT), Portugal, through Ph.D. work under Grant 2020.06341.BD (https://doi.org/10.54499/2020.06341.BD), and by Programa Operacional Regional do Centro,project ARoundVision CENTRO-01-0145-FEDER-03065

Post-FEC BER assessment with optimized decoding latency for 400 Gbps transmission over a 1.8 km FSO field trial

Manuel M. Freitas [†,⋆,1], Marco A. Fernandes[1], Bruno T. Brandão[1], Paulo P. Monteiro[1], Gil M. Fernandes[1], Fernando P. Guiomar[1]

1. Instituto de Telecomunicações and University of Aveiro, Campus Universitário de Santiago, 3830-193, Portugal

⋆ Corresponding author; manuelfreitas@ua.pt; † Presenting author; Electrical engineering.

Abstract. Free-space optics (FSO) is rapidly advancing as a pivotal technology within the telecommunications landscape, delivering very high data throughput without the constraints of traditional physical infrastructures. It supports a diverse range of applications, from mobile networks (6G) to satellite communications, utilizing unlicensed optical carriers with virtually unlimited bandwidths that enable quick and flexible network setups. However, despite its substantial potential, FSO still faces multiple challenges, particularly atmospheric turbulence impacting outdoor communication fidelity (Guiomar et al. 2022).
Efforts to address these challenges have led to the exploration of both optical and digital turbulence mitigation techniques. On the optical side, dynamic pre-amplification and enhanced fiber coupling schemes have been key focuses. Digitally, adaptive signal transmission methods through bit-rate adaptation and error control strategies, notably tailored forward error correction (FEC) codes, have been employed. The integration of FEC codes, especially low-density parity-check (LDPC) codes from fiber-based systems, is considered advantageous for ensuring seamless transitions between fiber and wireless networks (Korevaar et al. 2023). FSO intrinsic low-propagation latency makes it an ideal solution for specific applications such as stock-trading and interbank transfers. However, the design of digital interfaces and the impact of FEC decoding time must be carefully managed to minimize overall system latency while ensuring reliability. In particular, the number of decoder iterations when using high-performance LDPC coding will strongly affect the overall system latency (Nagarajan et al. 2021).
In this paper, we present an in-depth experimental analysis of a 400Gbps FSO field trail over 1.8 km, assessing its post-FEC BER performance over a 24-hour continuous measurement period. The offline measurements are then analyzed to optimize the number of LDPC iterations required to achieve error-free transmission. We directly compare two different FSO reception schemes: one with pre-amplification in automatic power control (APC) mode and another without pre-amplification. Our findings demonstrate that pre-amplification shows reliability gains >70% and generally requires fewer FEC iterations to correct errors (Freitas et al. 2024).

Keywords: *Free-space optics, Atmospheric turbulence, Forward error correction, Low-density parity-check codes, Digital signal processing.*

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Solar power satellite with energy storage, from energy generation to wireless power transfer

Ricardo A. M. Pereira[†,⋆,1], Helena Ribeiro[2], Henrique Chaves[2], Ricardo Figueiredo[2], Amit Baghel[1], Sandra Correia[2], Hélder Morais[2], J. Martinho M. Oliveira[2], Rute André[3], Paulo André[4], Nuno Borges Carvalho[2]

1. University of Aveiro, Campus de Santiago, 3810-193, Aveiro
2. University of Aveiro, Campus de Santiago, 3810-193 Aveiro
3. Department of Physics, CICECO - Aveiro Institute of Materials, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
4. Instituto de Telecomunicações e Departamento de Engenharia Electrotécnica e de Computadores, Instituto Superior Técnico, Universidade de Lisboa, Av. Rovisco Pais, 1049-001 Lisboa, Portugal

⋆ Corresponding author; r.pereira@ua.pt; † Presenting author; Electrical engineering.

Abstract. Solar power satellite systems can revolutionize the energy generation and distribution of our society by generating solar energy in outer space for later transferring it down to Earth to any desired location. However, the large distance means the systems should be significantly large, requiring immense effort and investment, potentially making such systems impossible to realize. Researchers at the University of Aveiro proposed a novel system architecture capable of energy storage and where the beam transfer is achieved by focusing the energy via lensing. This system will be able to supply energy to targets even if there is no direct sunlight, such as a lunar bases on the dark side of the moon. Additionally, developments at UA on solar generation enable higher efficiency by including solar concentrators, while the use of quasioptics enables higher beam efficiency in the wireless power transfer subsystem. This was possible due to the newly designed corrugated horn antennas that can be additively manufactured without supports, as well as the miniaturized Fresnel lens, after which the thickness was reduced significantly. This project was awarded an ESA Ideas call, after which a large-scale demonstrator is being developed. Preliminary results achieved a beam transfer efficiency of 43%, well above the state-of-the-art, prompting the development of the larger demonstrator.

Keywords: *Wireless power transfer, solar power satellite, microwave, quasioptics, solar concentrators*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials (UIDB/50011/2020, UIDP/50011/2020, and LA/P/0006/2020) and Instituto de Telecomunicações (UIDB/50008/2020 and UIDP/50008/2020), financed by national funds through the FCT/MEC (PIDDAC), and when appropriate co-financed by FEDER under the PT2020 Partnership through European Regional Development Fund (ERDF) in the frame of Operational Competitiveness and Internationalization Programme (POCI). R.A.M.P. and S.F.H.C. thank FCT (SFRH/BD/145024/2019 and 2022.03740.CEECIND, respectively) and European Space Agency (ESA STAR AO 2-1790).

Modular phased array antennas for low earth orbit satellite constellations

Amélia Ramos[†,⋆,1], Tiago Varum[2], João N. Matos[3]

1. Universidade de Aveiro
2.
3. Instituto de Telecomunicações

⋆ Corresponding author; ameliramos@ua.pt; † Presenting author; Electrical engineering.

Abstract. The main goal was to obtain a transmission (Tx) and reception (Rx) system, with an electronically controllable radiation beam to communicate with LEO satellites. Technologies such as MMIC, adaptive beamforming and multilayer PCBs were combined to obtain 2 prototypes of antenna modules with 16 radiating elements each, at low cost and with a high spectral efficiency.In fact, the prototypes are Ka band switchable circularly polarized array modules operating in a wideband between 27.5 GHz and 30 GHz (Tx) and between 17.7 GHz up to 20.2 GHz (Rx). The radiating part of the phased array transmitter was obtained by designing a linearly polarized squared patch element and then, using the sequential rotation technique, circular polarization was assured. Then, each radiating element was integrated in a super heterodyne radio-frequency architecture in a multilayer printed circuit board to guarantee the scalability of the module under test, meaning that a total of 9 substrate layers were necessary to provide the Intermediate Frequency (IF) and Local Oscillator LO distribution, along with the required chips placement. The control of the radiant beam, both in terms of polarization (right circular or left circular) and beam formatting (direction of maximum radiation and other characteristics) is done digitally through a Python interface developed on a 16-channel synchronous FPGA.In the end, measurements allowed to conclude that the transmitter phased array behaves with a decay factor and scan loss as the state-of-the-art with scanning angles up to ś50ř.

Keywords: *Phased-Array, LEO Communications, Satellite Communications, K-band, Beamforming.*

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Deep learning-based channel estimation for the 5G+ physical layer

Fábio Daniel Lopes Coutinho[†,⋆,1], Hugerles Sales Silva[2], Petia Georgieva[1], Arnaldo da Silva Rodrigues de Oliveira[1]

1. Universidade de Aveiro
2. Universidade de Brasília

⋆ Corresponding author; † Presenting author; Electrical engineering.

Abstract. The advent of sixth-generation (6G) wireless communication technology opens doors for innovative research into machine learning (ML) techniques in wireless networks. These techniques can enhance performance by tackling the inherent complexity of wireless communication systems, thus meeting evolving user demands. To capitalize on the benefits of ML-based algorithms, developing robust ML-based channel estimation algorithms is essential for efficient information recovery. In this context, we propose a new ML-based algorithm for the estimation of channel and hardware impairments, specifically tailored for high-frequency 6G scenarios [1]. Additionally, real-time hardware implementation of these ML-based algorithms at the network edge is essential to reduce latency imposed by data transfer to cloud. Thus, we have investigated the impact of neural network architecture [2] and bit quantization [3] on local and global performance to determine affordable resource requirements at the network edge.

Keywords: *channel estimation, deep learning*

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Timely and reliable localization based on optical camera communication

Miguel Rêgo[†,⋆,1], Pedro Fonseca[1], Luís Nero Alves[1]

1. Department of Electronics, Telecommunications and Informatics, University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Electrical engineering.

Abstract. The problem of indoor positioning has long been researched. Technologies such as GPS do not give enough accuracy in these scenarios, and existing alternatives have either low accuracy or high installation and maintenance costs. As a promising candidate, Visible Light Positioning (VLP) has been increasingly explored, where modulated visible light sources are used as beacons for the position estimation [1]. A camera is used as the receiver, which provides high accuracy at a low cost [2]. In order to estimate the position, it is necessary to identify each fixture, which can be done with rolling shutter based optical camera communication (OCC), allowing us to capture a modulated light signal across the rows of an image [3]. This can be used to transmit simple packets of data, such as an identifier, as well as implementing optical wireless links with applications in 6G wireless networks and Internet of Things scenarios [4].This work aims to improve the state-of-the-art on camera-based VLP, by proposing techniques to increase accuracy and robustness. Specifically, the objective is to explore OCC techniques that increase the maximum communication distance, by exploring new modulation schemes and information recovery techniques, and localization algorithms for improved accuracy and timely position estimation, extending the existing techniques to larger scenarios. This will be achieved through sensor fusion, image correlation and machine learning, using inertial measurements and statistical prediction. This will be combined with a reduced processing time, guaranteeing the system timely behavior.So far, we have obtained an average positioning error of 7.4 cm for a setup with a height of 2.7 m, and proposed an algorithm to increase the maximum communication distance by 2.5 fold [5]. We also proposed an algorithm to increase the accuracy when using circular transmitters and studied the impact of measurement uncertainties on the positioning error.

Keywords: *indoor positioning, optical communications, camera, rolling shutter, robotics*

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Acknowledgements. This work was raised under the frameworks of the COST Action NEWFOCUS (CA19111), supported by COST (European Cooperation in Science and Technology). The work of Miguel Rêgo was supported by the Fundação para a Ciência e Tecnologia (FCT), through the European Social Fund, under the PhD Grant UI/BD/154900/2023.

First Step Towards the Always-On Operation of Mobile Service Robots, Using Intelligent Algorithm

Mojgan Ghanbari[†,⋆,1], Amaro F. de Sousa[1], Sh. Rasekh[2], Pedro Fonseca[1]

1. DETI-Departamento de Eletrónica, Telecomunicações e Informática, University of Aveiro, Aveiro, Portugal
2. Department of Materials and Ceramic Engineering, CICECO-Aveiro Institute of Materials, University of Aveiro, 3810-193, Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Electrical engineering.

Abstract. Service robots are increasingly employed across various domains, offering a wide array of applications with capability of enhancing their provided service by using network of robots. These robots exhibit cooperative behaviour, whether operating individually or in a multi-robot setup, to efficiently accomplish the task [1]. Moreover, their design can be adapted for each mission e.g. wireless or wired energy source, mobility, etc. Therefore, for energy autonomy mobile robots the energy availability is essential to sustain prolonged operation periods, leading to the challenge of the periodical recharge. Addressing this challenge has prompted diverse approaches, e.g. sizing the battery to optimizing the energy consumption efficiency, management systems. Among them replenishing energy within the system via intermediatory charging gain huge attention where the wasted time for recharging is eliminated. Mathew et al. [2] employed mobile charging stations alongside robots group with predefined routes. These stations rendezvous with the patrolling robots at specified points along their paths. Ding et al. [3] addressed a similar challenge but with mobile depots instead of charging stations. These depots strategically deposit batteries along the trajectories of surveying robots where they swap their battery. However, to knowledge of author, no work has been reported in which service robots recharges without any interruption in their tasks.This work, to address the mentioned challenge, novel approach of using shuttle robot (ShR) that recharge the service robots (SRs) while they are performing their tasks, is proposed. In that regard, we developed and implemented an Intelligent algorithm based on decision making of ShR for providing the energy for targeted SRs. These SRs have their preplanned rout and tasks while ShR calculates and makes intelligent real-time decision-making optimization of choosing: SR; meeting point and path planning. The result of this algorithm in the simulation confirmed, in this scenario, the always-on of all the SRs.

Keywords: *Mobile robots, Intelligent mobile network, Power management, Optimization*

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Acknowledgements. Mojgan Ghanbari, acknowledge financial support from FCT through the Ph.D. grant ref: UI/BD/153382/2022. Sh. Rasekh acknowledges the support of the Research Employment Contract FCTCEECIND/02608/2017.

Optimization of hybrid wireless sensor networks protocols and topologies

Atiya Fatima Usmani[†,⋆,1], Luis Nero Alves[1], Pedro Fonseca[2], Stanislav Zvanovec[3]

1. DETI-Departamento de Eletrónica, Telecomunicações e Informática, University of Aveiro, Aveiro, Portugal
2. 3Department of Electronics, Telecommunications and Informatics, DETI - Institute of Telecommunications, University of Aveiro 3810-193, Portugal
3. Czech Technical University

⋆ Corresponding author; atiyafatimausmani@ua.pt; † Presenting author; Electrical engineering.

Abstract. Due to its crowded spectrum, RF technology is unable to keep up with the growing demands of data traffic. A growing alternative to radio frequency technology represents optical wireless communication (OWC) [1]. OWC networks have unregulated spectrum and are not plagued by congestion, which boosts system capacity. The OWC relies on the visible light (VL), infrared (IR), and ultraviolet (UV) portions of the spectrum. Among the OWC technology types are Li-Fi, Free Space Optics (FSO), Optical Camera Communication (OCC), Visible Light Communication (VLC), and others.
Due the simple implementation of OCC LED transmitters and camera receivers which are already found in cars and smartphones, OCC technology, a subset of VLC technology is one of the most promising OWC technologies [2]. Because of this, OCC is readily available, affordable, and accessible. OCC technology has many uses, including patient monitoring, indoor positioning, localization, and other applications in the medical field. However, there are a few issues that the OCC technology must deal with, including data rates and synchronization.
The objective of the work is to implement a hybrid scenario with VLC , OCC and RF links across the network of Optical Wireless Sensors. Communication between sensors and access points will rely on OCC/VLC links, communication between access points will then be performed by VLC/RF links. Access points will include image acquisition and processing means intended for scenario monitoring and localization. As a result, we plan to use and research the OCC and VLC setup in our work. Establishing these links and optimizing the WSNs would be the work objective. This implies that different modulation and encoding schemes will be investigated. [3]

Keywords: *Optical Wireless Communication, Visible Light Communication, Optical Camera Communication*

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Acknowledgements. Atiya Fatima Usmani, acknowledge financial support from Marie-Sklodowska Curie Action (MSCADN) funding through the Ph.D. grant OWIN6G(Optical and Wireless Sensors Networks for 6G Scenarios, grant no. 101119624)

Optimization of CV-QKD systems for field deployment

Margarida Almeida[†,⋆,1], Armando N. Pinto[2], Nuno A. Silva[1]

1. Instituto de Telecomunicações, Campos Universitário de Santiago, 3810-193 Aveiro, Portugal
2. Department of Electronics, Telecommunications, and Informatics, University of Aveiro, Campos Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; mralmeida@ua.pt; † Presenting author; Electrical engineering.

Abstract. Continuous-variables quantum key distribution (CV-QKD) allows the secure distribution of symmetric cryptographic keys using off-the-shelf equipment [1]. The use of higher-order discrete modulation (DM) in CV-QKD allows a simple implementation [and can approximate the theoretically optimal performance of Gaussian modulation [2]. Higher-order DM-CV-QKD has been experimentally demonstrated secure [3]. However, due to the computational expense and complexity involved in digital signal processing and post-processing, most experimental demonstrations [3] do not account for the reconciliation of the data for key extraction, misleading the achievable key rates [2,3]. We have studied the security bounds of DM-CV-QKD systems considering the true reconciliation efficiency and the frame error rate (FER) of the system, showing that the minimization of the FER does not assure the maximization of the key rate. The maximization of the extraction key rate must consider a proper signal-to-noise ratio (SNR) optimization accounting for the reconciliation step. Moreover, the choice of the reconciliation method must also consider the requirements of each reconciliation method in terms of the amount of information transmitted on the classical channel. Since, due to the bandwidth limitations of the optical link, such may limit the achievable key rates, as we analyze in [4]. In systems using optical fiber, the random birefringence of the fiber inevitably disturbs the state of polarization (SOP) of the quantum signal, impacting the overall secret key rate. In [5], we analyze the effect of the SOP fluctuations on the estimation of the channel parameters and compare the resulting secret key rate with the theoretical value considering the polarization drift in the channel. Conventionally, the parameter estimation step is provided assuming a perfect channel without polarization drift. By doing so, the estimation of the channel parameters is highly degraded with the increase of the SOP fluctuations. This results in a sub-estimation of the secret key rate, decreasing the performance of the system. As future work, we will study the security of the CV-QKD system considering polarization diversity heterodyne detection, as implemented in the laboratory, to measure both polarization components of the signal. This, aided by digital signal processing methods to combine both polarization components, is expected to improve the estimation of the channel parameters and the overall secret key rate. Experimentally, we are improving the implementation of the DM-CV-QKD system for symmetric keys extraction focusing on characterizing and reducing the noise sources in the system.

Keywords: *Quantum Key Distribution; Continuous Variables; Discrete Modulation; Polarization Drift; Polarization Diversity Detection; Experimental Implementation.*

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Acknowledgements. This work was supported in part by Fundação para a Ciência e a Tecnologia (FCT) through national funds, by the European Regional Development Fund (FEDER), through the Competitiveness and Internationalization Operational Programme (COMPETE 2020) of the Portugal 2020 framework, under the PhD Grant UI/BD/153377/2022, projects QuantumPrime (PTDC/EEI-TEL/8017/2020), and co-funded by the Europen Defence Industrial Development Program (EDIP) under the project DISCRETION (S12.858093).

Energy systens and climate changes

Numerical modelling of the electrochemical biogas conversion system for green liquid fuel production

Fardous Ajeeb[†,⋆,1], Antonio C.M. Sousa[2]

1. Aveiro universty
2. Aveiro university

⋆ Corresponding author; fardousajeeb@ua.pt; † Presenting author; Energy systens and climate changes.

Abstract. Reduction of greenhouse gas emissions is a world priority taking into consideration the impending consequences of climate change. The use of fossil fuels must be gradually eliminated in industry and transportation, among others. Therefore, several renewable energy methods such as bioenergy, wind, and solar energy systems are being implemented or actively pursued. In this process, significant attention is given to the production of high-energy-density synthetic liquid fuels derived from renewable sources that can be used in long-distance transportation such as aviation and shipping. This is the focus of the present PhD project in which numerical simulations will be conducted to evaluate and to improve a novel electrochemical device, which converts biogas into carbon-neutral synthetic liquid fuels. The simulations will be based on a computational fluid mechanics (CFD) platform using different models. The overall system therefore converts two potential greenhouse gases (the main constituents of biogas CH4 and CO2) into sustainable C-neutral liquid fuels without the CO2 fraction of the original biogas. Thus, in this project will be evaluated by numerical simulation two different integration schemes; Concept 1: the direct biogas reforming products (CH4+CO2) are immediately separated by a new electrochemical method, then they are fed into the Fischer Tropsch Synthesis device to obtain the fractions of long-chain hydrocarbon products, and Concept 2: the direct biogas reforming products (CH4+CO2) are immediately separated and electrochemically compressed at high pressure, then the remaining compressed H2 participates in the distributed feed in the Fischer Tropsch Synthesis device to obtain the fractions of long-chain hydrocarbon products, and it will identify the best method for overall system integration, based on the balance of mass, momentum, energy, and species at each stage of the process. Particular attention will be given to assessing the heat transfer process at the electrode porous elements of the electrochemical reactor. Kinetics will use models that are capable of capturing the relevant features of the chemical reactions. The required data, including transfer coefficients, will be obtained from the open literature, and eventually complemented by a companion experimental program.

Keywords: *Hydrogen, liquid fuels, electrochemical, model.*

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Acknowledgements. This work is supported by the IC&DT project LiquidGreen - Production of green liquid fuels through electrochemical conversion of biogas with reference 2022.09319.PTDC and is being conducted at TEMA - Department of Mechanical Engineering, University of Aveiro.

Anaerobic co-digestion of palm and cassava residues for biogas production in the northern region of Angola

Flávio C. Silva[1], Luís A. C. Tarelho[1], Nilson Sebastião Machili[†,⋆,2]

1. University of Aveiro, Department of Environment and Planning, Campus Universitário de Santiago, Aveiro,3810-193, Portugal
2. PhD Program in Energy Systems and Climate Change, Department of Environment and Planning

⋆ Corresponding author; † Presenting author; Energy systens and climate changes.

Abstract. Angola is the third largest cassava producer in Africa, with approximately 200 million tons per year (Jornal de Angola, 2024), and also boasts several palm farms, such as those in the village of Chapa, which produces approximately 50 tons of palm fruit per month. Cassava consumption and palm oil production have increased significantly due to global population growth (R. Addai et al., 2024; Nadia Farhana Azman et al., 2023), resulting in the generation of large amounts of waste. In Angola, for example, cassava waste (kisaca) and palm oil extraction waste (dendê) end up in open landfills, often subject to incineration. This practice poses a threat to public health and environmental safety and contributes to global warming due to greenhouse gas emissions (HA Aziz et al., 2012; S Srigirisetty et al., 2017). Therefore, there is a need to redirect these wastes to mitigate environmental pollution and, at the same time, utilize them as renewable resources, as they have ideal characteristics for biofuel production (Vanegas et al., 2024; Isabela Simões Soares et al., 2024). In this regard, anaerobic co-digestion emerges as a sustainable technology to reduce the negative impacts of organic waste by transforming it into biogas (CH4 and CO2) (J.M. Ochando-Pulido et al., 2024). To achieve this, it will be necessary to optimize the process on a laboratory scale to enable its environmentally efficient and economically viable large-scale application. Operational conditions will be tested to maximize methane production and minimize microbiological inhibition. It is expected, therefore, to establish a high processing capacity on a real scale and ensure the quality of the produced biogas to determine its appropriate applications.

Keywords: *anaerobic co-digestion, waste treatment, biogas, methane, POME, cassava DA.*

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Catalyst synthesis for the production of CO and H2 mixtures by gasification of biomass and waste derived fuels

Mariela R. S. Billy[†,⋆,1], Luís A. C. Tarelho[2], Aleksey A. Yaremchenko[3]

1. Department of Environment and Planning
2. University of Aveiro, Department of Environment and Planning, Campus Universitário de Santiago, Aveiro,3810-193, Portugal
3. CICECO-Aveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro

⋆ Corresponding author; † Presenting author; Energy systens and climate changes.

Abstract. Climate change constitutes an enormous challenge that humanity is facing and which requires new strategies for using natural resources, more efficiently and with less impact on the environment. On the one hand, it is necessary to act to reduce the use of fossil fuels and the respective emissions of CO2 and other gaseous pollutants. It is important to ensure more efficient use of natural resources and reduce the generation of waste in the various value chains. Biomass gasification is the most attractive technology for producing mixtures of H2 and CO (Xiaoling Jin et al., 2023). However, it appears that problems persist in terms of gas quality. In this context, the development of suitable catalysts in order to guarantee efficient destruction of tars and also in terms of maintaining the catalyst's activity is of upmost relevance. A combination of optimized operating conditions with efficient catalysts is fundamental for production of H2- and CO-rich mixtures.
In this work, it is intend to develop an efficient catalyst based on biochar, dolomite and nickel, mechanochemical treatment, and impregnation approaches. Next, direct gasification (air) of residual forest biomass im mixtures with refused-derived fuels (RDF) will be carried out in a pilot scale bubbling fluidized bed (BFB), where air will be used as a gasification agent, temperatures of 800 and 850řC, and equivalence ratio in range 0.25 to 0.28. The catalyst will be tested in a fixed bed catalytic reactor integrated into the high-temperature zone of the BFB. The product gas will be characterized with/without passage through the fixed bed of the catalyst, thus allowing the evaluation of the catalyst's performance in improving gas quality. The expected results include the destruction of tars and increased production of gas mixtures rich in H2 and CO.

Keywords: *Biomass, RDF, gasification, catalysts, bubbling fluidized bed (BFB)*

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Use of biochar for CO2 neutralization in the refining industry in Angola

Esmaelda F. Machili[†,⋆,1], Luís A. C. Tarelho[2], Paula Quinteiro[3], Ana Dias[4]

1. PhD Program in Energy Systems and Climate Change, Department of Environment and Planning
2. University of Aveiro, Department of Environment and Planning, Campus Universitário de Santiago, Aveiro,3810-193, Portugal
3. Centre for Environmental and Marine Studies (CESAM), Department of Environment and Planning
4. Centre for Environmental and Marine Studies (CESAM), University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Energy systens and climate changes.

Abstract. Carbon sequestration and climate change mitigation has become increasingly relevant in the face of global environmental challenges. The use of biochar has been explored as a potential solution for carbon sequestration and reduction of greenhouse gas (GHG) emissions. This carbonized material (biochar) has unique properties that make it promising for carbon capture and soil sequestration, contributing to climate change mitigation and soil quality improvement (ARIAS, 2022; BARROS et al., 2019). Of particular interest in Angola, the refining industry is a significant source of CO2 emissions to the atmosphere, and no measures have been taken to mitigate this environmental problem. In this project, we aim to conduct an analysis focused on the viability of biochar as a solution to offset CO2 and other greenhouse gas emissions in the refining industry. This approach aims to provide an assessment of the potential use of biochar for CO2 sequestration in the refining industry, with the goal of promoting carbon neutrality and contributing to environmental sustainability in Angola.
To this end, biochar will be produced under different pyrolysis conditions and then the theoretical potential of biochar for carbon sequestration will be evaluated. Based on data on carbon and other greenhouse gas emissions from Angola's refining industry, the potential for mitigating these emissions will be determined based on the carbon sequestration achieved by biochar.
This research is expected to contribute to the advancement of scientific knowledge on the use of biochar to mitigate emissions in the refining industry and achieve carbon neutrality.

Keywords: *Biochar, carbon sequestration, refinery, carbon emissions*

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Sustainability indicators framework for the bicycle industry

Beatriz Pereira Triane[†,⋆,1], Ana Isabel Miranda[1], Margarida C. Coelho[2], Sandra Rafael[3]

1. Department of Environment and Planning, Campus Universitário de Santiago, Aveiro,3810-193, Portugal
2. Department of Environment and Planning/Centre for Mechanical Technology and Automation / LASI Intelligent Systems Associate Laboratory, Campus Universitário de Santiago, Aveiro,3810-193, Portugal
3.

⋆ Corresponding author; beatriztriane@ua.pt; † Presenting author; Energy systens and climate changes.

Abstract. The bicycle industry plays a crucial role in sustainable mobility, fostering a cleaner and healthier mode of transportation. This study proposes a sustainability indicators framework for the two-wheel industry through the development of an integrated indicator, analyzing the externalities of the sector. The case study will be focused on the 2-wheel industry in Portugal. Initially, a state-of-the-art study was conducted on this sector in the context of sustainability, legislation, and standards in the main databases. A scientific literature review demonstrated that in the last five years, there has been a growth in scientific research on the bicycle industry covering areas such as innovation, sharing, delivery services, electric bicycles, recycling, life cycle analysis, and tourism. However, there is a gap in research focusing on bicycle manufacturing or its components and in assessing sustainability performance in the sector. The few works on this theme highlight indicators such as the amount of waste generated and recycled, stock quantity and freight cost, carbon footprint, and total energy consumption per source. Following this study, an integrated sustainability indicator will be developed, which will be preliminarily applied in a case study in bicycle industries in Portugal for validation. After analyzing the results, the final sustainability framework will be proposed. The anticipated results aim to guide bicycle industries towards more sustainable production aligned with sustainability practices and standards, facilitating compliance with existing regulations.

Keywords: *Sustainability, indicators, bicycle industry, externalities, cost*

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Acknowledgements. This study was funded by the PRR Plano de Recuperação e Resiliência and by the NextGenerationEU funds at Universidade de Aveiro, through the scope of the Agenda for Business Innovation AM 2 R Agenda Mobilizadora para a inovação empresarial do setor das Duas Rodas (Project no 15 with the application C 644866475 00000012). The authors would also like to acknowledge the Portuguese Foundation for Science and Technology (FCT)/MCTES for the financial support to CESAM (UIDP/50017/2020+UIDB/50017/2020 + LA/P/0094/2020), through national

Micromobility in the City: What about the Safety of Vulnerable Road Users?

Andreia da Costa Martins[†,1], Margarida Coelho[1]

1. Universidade de Aveiro

⋆ Corresponding author; † Presenting author; Energy systens and climate changes.

Abstract. Ensuring urban mobility means providing greater fluidity to urban space and making the city more accessible to those who inhabit it, ensuring a better quality of life for the population. In this sense, micro mobility has emerged in recent years and refers to personal transport that involve small, light duty vehicles, which are mainly designed for short, urban trips. This mobility trend aims to fill gaps in the transport system and offer more efficient and sustainable alternatives for urban travel, especially in congested urban areas [1].

In recent years, road accident safety has been a major concern, with the World Health Organizations Global Status Report on Road Safety 2018 showing that around 1.35 million people die in road accidents each year [2]. Of particular concern is the fact that about 23 percent of all road traffic deaths are related to two-wheeler (TW) accidents [2]. As personal mobility devices (PMDs) have been widely adopted, the accident rate also increased [3]. Especially electric scooters that have greater speed can be affected by a greater number of accidents, compared to conventional PMDs [4].

Because the movements are often not restricted by lanes, the two-wheeler uses lateral road space more freely and shows obvious multilateral interactions (multi-interaction) with others, bringing issues that endanger traffic safety. Also, the speed of the PMDs should be controlled by recognizing the condition of the road surface [5]. A precise estimation of its impacts on traffic operation and safety is necessary [6].

This work is part of a doctoral research and explored the different factors that cause accidents involving vulnerable road users, namely users of e-scooters, through a literature review on the Scopus database. Furthermore, Artificial Intelligence (AI) techniques that are being used to help in understanding accident factor (such as, characterizing road surfaces) and predicting road safety indicators and trends were also revised.

Keywords: *Safety of Vulnerable Road Users; Traffic Accidents; Micromobility; E-Scooters; Artificial Intelligence*

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The evolution of city-scale emissions inventories: Smart solutions to assess the impact of road traffic on air emissions

João Ginja[†,⋆,1], Saverio De Vito[2], Margarida C. Coelho[3]

1. IDAD - Institute of Environment and Development, Campus Universitário, 3810-193 Aveiro, Portugal.
2. ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development, P.le E. Fermi, 1, Napoli, 80055, Italy
3. Department of Environment and Planning Centre for Mechanical Technology and Automation (TEMA), University of Aveiro, Campus Universitário de Santiago, Aveiro, 3810-193, Portugal. LASI Associate Laboratory of Intelligent Systems, Guimarães, Portugal.

⋆ Corresponding author; joao.ginja@ua.pt; † Presenting author; Energy systens and climate changes.

Abstract. Despite climate and energy policies, greenhouse gas (GHG) emissions from transport have increased by more than 33% between 1990 and 2019. This trend is expected to reverse, but not sufficiently to meet the EUs climate neutrality targets. Vehicle emissions are still a significant source of air pollution, impacting air quality and human health. Measuring and communicating emissions is a fundamental action for mitigating climate change, improving air quality, and formulating policies. In this context, cities play an important role in reducing GHG emissions.The present work reviews the evolution of city-scale methods for GHG and air pollutants inventories, for road transport emissions. Additionally, discusses the most relevant applications of artificial intelligence methodologies allowing the prediction of emissions trends and the assessment of mitigation measures. The evaluation carried out allowed the identification of different existing limitations in developing city-wide GHG inventories, particularly due to the complexity of implementing existing protocols (Erickson & Morgenstern, 2016), or the existence of gaps, and lack of precise information (Arioli et al., 2020; Baltar de Souza Leão et al., 2020). The emergence of artificial intelligence (AI) and Machine Learning (ML) tools has made it possible to more effectively explore different information and the relationships between different data, for instance for microscopic approach to modelling emissions with a regional traffic model (Tu et al., 2019), or assessment of mitigation strategies (Franco et al., 2023).This work proposes the development of a method and a platform, including Machine Learning, to assess emissions from road transport. The model to be developed considers the use of indirect data, and results from inventories already reported, to estimate emissions, minimizing the uncertainties of the estimates, with application in cities, both in a developing country and in the European Union.

Keywords: *greenhouse gases, inventory, city, road transport, atmospheric emissions, machine learning*

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Optimal conditions for biomethane production: the potential of biochar in the anaerobic co-digestion of OFMSW and livestock waste

Maria Tacianne Lima Araujo[†,⋆,1], Flávio G. C. S. Silva[2], Luís A. C. Tarelho[3]

1. Doctorate in Energy Systems and Climate Change - Department of Environment and Planning at the University of Aveiro (Ph.D. Student)
2. Centro de Estudos do Ambiente e do Mar, Departamento de Ambiente e Ordenamento
3. Centre for Environmental and Marine Studies (CESAM)

⋆ Corresponding author; † Presenting author; Energy systens and climate changes.

Abstract. The energy transition offers possibilities for valuing waste instead of merely treating it. The production of biogas by anaerobic co-digestion (AcoD) of the organic fraction of municipal solid wastes (OFMSW) and livestock waste will be the subject of this work. Addition of biochar produced from forest residues to the bioprocess will be studied, hypothesizing its benefit in the development of biofilms, improvement in the agronomic quality of digestate and methanization of substrates, aligned with the recommendations of the Biomethane Action Plan 2024-2040.
Research already carried out in this subject shows contradictory results and several gaps in knowledge, especially regarding the lack of correlation between microbial mechanisms and biochar properties in the performance of anaerobic digestion. Therefore, this study aims to optimize this process and produce biomethane with high added value.
For this purpose, sampling and characterization of the substrates and biochar produced at two different temperatures will be carried out, to be used in the tests, which will initially consist of batch biodegradability assays, to establish optimal operating conditions; and, subsequently, continuous or semi-continuous assays will be implemented, based on the conditions selected in the batch tests, to investigate the long-term stability of the process, considering the variability and seasonality of the substrates. Biogas purification processes will also be applied to obtain biomethane with an energy value equivalent to natural gas.
Finally, a technical-economic evaluation and carbon balance will be made. The challenges of process integration, use of biochar as a catalyst and seasonality of substrates constitute the main scientific innovations that are intended to be achieved.

Keywords: *Anaerobic co-digestion; OFMSW; Biochar; Biomethane.*

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Acknowledgements. The authors gratefully acknowledge the support of the Centre for Environmental and Marine Studies (CESAM) of the University of Aveiro.

Modeling Tomorrow's Mobility: An Integrated ABM-LCA Framework for Evaluating Shared Automated Electric Vehicles

Mariana Vilaça[†,⋆,1], Gonçalo H.A. Correia[2], Margarida C. Coelho[3]

1. Department of Mechanical Engineering/Centre for Mechanical Technology and Automation LASI Intelligent Systems Associate Laboratory, University of Aveiro, Portugal
2. Department of Transport Planning, Faculty of Civil Engineering and Geosciences University of Delft, The Netherlands
3. Department of Environment and Planning/Centre for Mechanical Technology and Automation LASI Intelligent Systems Associate Laboratory

⋆ Corresponding author; mvilaca@ua.pt; † Presenting author; Energy systens and climate changes.

Abstract. As the urge for sustainable transportation solutions becomes increasingly crucial, Shared Automated and Electric Vehicles (SAEVs) emerge as potential game-changers. Yet, a comprehensive understanding of their environmental impact remains elusive. This study addresses this gap by proposing a novel approach that integrates Agent-Based Modeling (ABM) and Life Cycle Assessment (LCA). While LCA provides an in-depth approach to assessing environmental impacts, its static nature and reliance on predetermined assumptions may overlook the dynamic complexities of human decision-making within mobility systems. By simulating individual agents' behaviours, ABM provides the ability to capture human behaviour, vehicle deployment strategies, and the dynamic nature of mobility systems, ultimately contributing to a more comprehensive assessment of future mobility scenarios. This analysis extends across municipal, subregional, and regional scales, offering a holistic understanding of the potential environmental implications of SAEVs in diverse settings.Findings revealed that while SAEVs may reduce short-term environmental impacts, their long-term sustainability is limited. For instance, when examining short-term impacts based on daily passenger-kilometer traveled, SAEVs exhibit considerable reductions in Global Warming Potential (GWP), with reductions of 88%, 86%, and 8% observed at municipal, subregional, and regional scales, respectively. However, a more comprehensive assessment considering a 100-year perspective reveals a more variable scenario, where GWP reductions can range from a maximum of 33% to an increase up to 1324%, contingent upon geographic scale and specific operational setups. These differences are due to vehicle lifespan and the need for fleet replacement over the years, especially in scenarios of shared vehicles with high use intensity. In the long term, regardless of operational setup, certain impact categories such as particulate matter, toxicity, land use, and mineral resources show no potential for reduction. This underscores the importance of considering a broader spectrum of environmental impacts beyond GWP.

Keywords: *Agent-based Modelling (ABM); Dynamic Life Cycle Assessment (D-LCA); Shared mobility; Automated and Electric vehicles*

Acknowledgements. M. Vilaça acknowledges the Portuguese Science and Technology Foundation (FCT) Scholarship 2020.04468.BD (https://doi.org/10.54499/2020.04468.BD). M. Vilaça and M.C.Coelho research is supported by UIDB/00481/2020 and UIDP/00481/2020 - FCT; and CENTRO-01-0145-FEDER-022083 Centro Portugal Regional Operational Programme (Centro2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund. Finally, the authors would like to extend their sincere appreciation to Metro Mondego, SMTUC, and CIM Coimbra for generously providing the data necessary for this research.

Integrated assessment of road traffic noise and pollutant hotspots: advancements in modeling and analysis

Antonio Pascale[†,⋆,1], Claudio Guarnaccia[2], Margarida C. Coelho[3]

1. Department of Mechanical Engineering / Centre for Mechanical Technology and Automation (TEMA), University of Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, Portugal LASI Intelligent Systems Associate Laboratory Guimarães, Portugal
2. Department of Civil Engineering, University of Salerno, Via Giovanni Paolo II, 132, I-84084 Fisciano, Italy
3. Department of Environment and Planning / Centre for Mechanical Technology and Automation (TEMA), University of Aveiro Campus Universitário de Santiago, 3810-193, Aveiro, Portugal LASI Intelligent Systems Associate Laboratory Guimarães, Portugal

⋆ Corresponding author; a.pascale@ua.pt; † Presenting author; Energy systens and climate changes.

Abstract. This communication aims to present the Ph.D. project titled An Integrated Assessment of Road Traffic Noise and Pollutants Critical Hotspots through Advanced Models. The investigation addresses a gap in current methods for assessing road traffic-related noise and exhaust emissions. While specific models exist for exhaust emission evaluations based on vehicle motorizations, such models are lacking for noise emissions (Pascale et al., 2021). Therefore, the main objective of the doctoral study is to develop a Noise Emission Model (NEM) termed Vehicle Noise Specific Power (VNSP). VNSP estimates sound power levels (Lw) based on fuel type, aiming to capture the variability in noise emissions introduced by different types of motorizations (Pascale et al., 2020). Single pass-by tests, regulated by ISO 11819-1, are conducted to develop VNSP, employing seven probe vehicles (two diesel, two gasoline, two hybrid-electric, and one Liquid Petroleum Gas-powered). Coupled with a sound propagation model based on Sound Exposure Levels from passing vehicles, VNSP forms the basis of a Road Traffic Noise Model (RTNM), potentially capable of operating at a microscopic level by using single-vehicle kinematic data. VNSP and the Vehicle Specific Power methodology are used as algorithms for generating exhaust and noise emission maps, facilitating the identification of relative hotspots. The results indicate variations in noise emissions attributable to different fuel types, with fluctuations of up to 8 dB(A) in Lw (Pascale et al., 2023c). Additionally, the developed RTNM, using VNSP as its foundation, demonstrates accurate estimations of road traffic noise levels, comparable to the European reference model (Pascale et al., 2023a). The modular procedure for developing RTNM is also validated by testing it with six other NEMs, resulting in an average error below 1 dB(A) (Pascale et al., 2023b). Finally, the analysis of exhaust and noise emission maps reveals that hotspot locations may vary depending on congestion levels.

Keywords: *Vehicle Noise Specific Power; Road Traffic Noise Model; Noise Maps; Pollutants Maps*

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Acknowledgements. A. Pascale and M.C. Coelho acknowledge the financial support of the following projects: UIDB/00481/2020 (https://doi.org/10.54499/UIDB/00481/2020) and UIDP/00481/2020 (https://doi.org/10.54499/UIDP/00481/2020) FCT- Fundação para a Ciência e a Tecnologia; and CENTRO-01-0145-FEDER-022083 Centro Portugal Regional Operational Programme (Centro2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund. A. Pascale acknowledges the support of FCT for the Scholarship 2020.05106.BD (https://doi.org/10.54499/2020.05106.BD). C. Guarnaccia acknowledges the support of MOST Sustainable Mobility National Research Center, funded by the European Union Next-GenerationEU (PIANO NAZIONALE DI RIPRESA E RESILIENZA (PNRR) MISSIONE 4 COMPONENTE 2, INVESTIMENTO 1.4 D.D. 1033 17/06/2022, CN00000023).

Integrated impact assessment of liquid green fuels from electrochemical biogas conversion

Jayakrishnan K. Ravindran[†,⋆,1], Duncan P. Fagg[1], Margarida C. Coelho[1]

1.

⋆ Corresponding author; jayakrishnanravindran@ua.pt; † Presenting author; Energy systens and climate changes.

Abstract. As concern about climate change rises worldwide, sustainable alternatives are imperative. Green, energy-dense fuels from biomass seem to be a promising route to decarbonization. This study explores the impacts associated with liquid green fuels made through the electrochemical conversion of biogas.
Key areas of this research are:
1. Understanding the technical aspects of these fuels;
2. Quantifying the environmental impacts associated with producing and using these fuels.
3. Comparing the economic feasibility of these fuels with other alternatives;
4. Analyzing policies on these fuels and identifying the best ones for their implementation.

A review of biomass conversion technologies shows that, despite their potential to reduce greenhouse gas emissions, some contradictions exist regarding their sustainability. (Okeke et al., 2020) shows a reduction in environmental impacts while (Navas-Anguita et al., 2019) shows an increase in emissions using these fuels. This study aims to clarify the aforementioned discrepancies and provide a comprehensive understanding of the environmental impacts of these fuels.
The LCA approach, using the ReCiPe 2016 methodology, will be used to assess the lifecycle of these fuels. The system boundary includes raw material acquisition, fuel production, logistics, and use, the functional unit of the study is 1 MJ of energy produced, and is conducted on SimaPro.
Preliminary results show the global warming potential hotspots to be electricity from the grid (0.148 kg CO2 eq) and platinum used in the FT process (0.041 kg CO2 eq), while the process with the best environmental results is anaerobic digestion (-0.107 kg CO2 eq) per MJ of fuel produced.
This research aims to provide a better understanding of these fuels as well as future research directions in their LCAs. The findings of this study are expected to be used by policymakers and stakeholders to make informed decisions about the integration of these fuels into sustainable transport systems.

Keywords: *Liquid green fuels, Life cycle assessment, Electrochemical biogas conversion.*

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Environmental sciences and engineering

High-resolution inventory and projection of atmospheric emissions based on mega data and climate scenarios

Daniel Graça[†,⋆,1], Joana Ferreira[2], Diogo Lopes[1], Estela Vicente[1]

1. CESAM
2.

⋆ Corresponding author; † Presenting author; Environmental sciences and engineering.

Abstract.
Air pollution, along with climate change, poses the biggest environmental threat to human health, causing seven million premature deaths worldwide each year [1]. Air quality modelling (AQM) is an important tool for developing and evaluating air quality policy. However, results often have uncertainties, particularly in future simulations, due to factors such as inaccurate emission values caused by inadequate emission factors [3,4], inaccurate activity data [5], imprecise emission locations because of the coarse horizontal resolution of available inventories (between 0.1 and 0.5), and unsuitable temporal and speciation profiles applied to annual atmospheric emission values [5,6]. In recent years, the massive collection of big data has emerged as a solution to improve atmospheric emission inventories [7,8].
The main goal of this study is to develop a high-resolution emission inventory for Portugal under climate change scenarios (years 2050 and 2100) according to the Shared Socioeconomic Pathways (SSPs). The developed inventory is based on bigdata sets, machine learning algorithms and air quality numerical approaches covering both classic atmospheric pollutants (PM10, PM2.5, NOx) and greenhouse gases (CO, CH, NO).In this presentation, emissions of the public power sector for 2050 and 2100 according to the SSP2-4.5 scenario for Portugal will be presented. A comprehensive approach involving multiple data sources and methodologies was considered. For the year 2050, primary data includes annual energy consumption by fuel, sourced from Portuguese Environment Agency (APA) projections (IIR 2023), while for 2100, due to lack of information, the energy production is projected using datasets as population, Gross Domestic Product (GDP), urbanization rates, and projected activity between the years 2020 and 2050. Based on historical installed capacity data for each public power facility (in MW) and their geographical location, the energy production is spatial distributed over the Portuguese region. Additionally, these inputs are combined with climate projections from Coupled Model Intercomparison Project Phase 6 (CMIP6), incorporating daily meteorological parameters (i.e., precipitation, temperature, and wind speed) and calendar days (e.g., holidays, weekdays, and weekends) to predict the daily electricity production using machine learning algorithms. Finally, using the BigAir approach [9], emissions from the public power sector are quantified for the years 2050 and 2100.
The research findings will provide accurate projections of the atmospheric emissions in Portugal, aiding in the development of effective climate change mitigation strategies.

Keywords: *SSP scenarios, Air quality modelling, machine learning, exposure and health decision Support*

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This work was financially supported by the project BigAir - Big data to improve atmospheric emission inventories (http://doi.org/10.54499/PTDC/EAM-AMB/2606/2020), funded by national funds through FCT - Foundation for Science and Technology.

AI-Guided Optimization of TiO2/CNTs Composite Synthesis Using Genetic Algorithms (GA)

Sara Zandi[†,⋆,1], M. Elisabete V. Costa[2], Mohammadreza Kamali[3], Isabel Capela[4]

1. Department of Environment and Planning, Center for Environmental and Marine Studies, CESAM, University of Aveiro, 3810-193 Aveiro, Portugal Department of Materials and Ceramics Engineering, Aveiro Institute of Materials, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal.
2. Department of Materials and Ceramics Engineering, Aveiro Institute of Materials, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal.
3. Process and Environmental Technology Lab, Department of Chemical Engineering, KU Leuven, 2860 Sint-Katelijne-Waver, Belgium
4. Department of Environment and Planning, Center for Environmental and Marine Studies, CESAM, University of Aveiro, 3810-193 Aveiro, Portugal.

⋆ Corresponding author; † Presenting author; Environmental sciences and engineering.

Abstract. The integration of titanium dioxide (TiO2) with carbon nanotubes (CNTs) has yielded advanced composite materials with superior properties for diverse applications. These TiO2/CNTs composites exhibit large specific surface area (SSA), electrical conductivity, and photocatalytic activity, making them appropriate for wastewater treatment, energy conversion, and storage (Akhter et al., 2024). This study presents a novel approach to optimize TiO2/CNTs synthesis by a sol-gel method based on genetic algorithms (GA) via artificial intelligence (AI) (Martínez-Vargas et al., 2023). TiO2/CNTs composites are here synthesized by adding a TiO2 organic precursor to a suspension of CNTs under stirring and sonication, followed by a microwave heat treatment of the precipitate to obtain a crystalline composite. A first examination of the synthesis process revealed that experimental conditions including the initial concentration of CNTs, the sonication duration, the microwave exposure time, and the synthesis temperature are key parameters that affect the synthesis process, thus conditioning the SSA and the synthesis yield of the CNTs composites. The characterization of the composites by X-ray diffraction (XRD) for phase analysis, BrunauerEmmettTeller (BET) analysis for SSA evaluation, Zeta potential measurement for surface charge assessment, and Fourier-transform infrared (FTIR) spectroscopy for chemical bonding identification allowed to map the main effects of the various synthesis parameters on the composite properties. The obtained results showed that the SSA of the TiO2/CNTs composites varied from 15 to 264 m2/g despite the SSA of the initial CNTs being 229 m2/g, whereas the corresponding yield results varied between 33 and 58.1%, respectively. The use of GA via AI facilitated an iterative optimization, allowing to identify a combination of synthesis conditions (e.g., irradiation time and temperature: 4 min and 160 řC respectively) leading to optimized values of SSA and yield, i.e. a SSA of 323 m2/g and a yield of 58.6%. These results underscore the impact of experimental adjustments of the manipulated variables on controlling the nanocomposite's characteristics. It is also worth mentioning that the use of microwave for the calcination step allowed to reduce the thermal budget as compared to the conventional furnace heat treatment, thus reducing greenhouse gas emissions and lowering environmental impact. This more sustainable synthesis process aligns with the growing demand for eco-friendly manufacturing practices. Concluding, the present study demonstrates the effectiveness of GA in tailoring synthesis parameters that lead to enhanced TiO2/CNTs composite properties.

Keywords: *Artificial Intelligence; Genetic Algorithms; Titanium Dioxide; Carbon Nanotubes; Nanocomposite.*

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Acknowledgements. Sara Zandi acknowledges FCT for financial support, under the scholarship 2021.07172.BD. This work was also developed within the scope of the project CESAM Centre for Environmental and Marine Studies, POCI-01-0145-FEDER-007638 (FCT Ref. UID/AMB/50017/2020), and to the project. In addition, thanks are due, for the financial support to CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MEC (PIDDAC). Thanks, are also due to the financial support from the PDM program, KU Leuven.

Economic Analysis of Supplemental Strategies for Efficient Hydrogen Production from Cheese Whey via Dark Fermentation: A Levelized Cost of Hydrogen (LCOH) Study

Behrouz Nemati[†,⋆,1], Mohammadreza Kamali[2], M. Elisabete V. Costa[3], Isabel Capela[4]

1. Department of Environment and Planning, Center for Environmental and Marine Studies, CESAM, University of Aveiro, 3810-193 Aveiro, Portugal Department of Materials and Ceramics Engineering, Aveiro Institute of Materials, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal.
2. KU Leuven, Department of Chemical Engineering, Process and Environmental Technology Lab, J. De Nayerlaan 5, 2860, Sint-Katelijne-Waver, Belgium.
3. Department of Materials and Ceramics Engineering, Aveiro Institute of Materials, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal.
4. Department of Environment and Planning, Center for Environmental and Marine Studies, CESAM, University of Aveiro, 3810-193 Aveiro, Portugal.

⋆ Corresponding author; behrouz.nemati@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract.
In response to the growing demand for sustainable energy sources, bio-hydrogen production from cheese whey via dark fermentation presents a promising avenue (Ordoñez-Frías et al., 2024). Literature reports have shown that supplements incorporation is among the most effective methods for enhancing hydrogen production in this process (Vieira et al., 2023). In this regard, identifying the most effective supplementation strategy is crucial for maximizing the efficiency and economic viability of the bio-hydrogen production process. This study aims to address this challenge by investigating the synergistic effects of ash, biochar, and geopolymer supplements on hydrogen production, while also evaluating their economic implications through Monte Carlo-based Levelized Cost of Hydrogen (LCOH) analysis (Masihy C. et al., 2024). The results obtained in this study revealed that utilizing ash as a supplement stands out as a prime strategy for maximizing hydrogen production. Nonetheless, employing a blend of ash, biochar, and geopolymer emerges as the most cost-effective practice. This is due to the pivotal role of ash in pH regulation, fostering an ideal environment for bacteria to efficiently ferment lactose in cheese whey, thereby maximizing hydrogen output. Additionally, biochar amplifies hydrogen production by providing a spacious habitat for bacteria, absorbing inhibitory compounds, stabilizing pH, and facilitating electron transfer, resulting in more effective hydrogen yields from cheese whey. Furthermore, geopolymer materials offer an extensive surface area and optimal conditions for bacteria, hastening their activity in generating hydrogen from cheese whey. This expedited process owes its success to heightened microbial growth, nutrient retention, and stable operational conditions provided by geopolymer. In conclusion, the detailed economic analysis allowed to underscore the importance of considering production yields, synergistic effects, and economic efficiency in supplement selection for hydrogen production processes, hence demonstrating the superior cost-effectiveness of the combined supplementation approach as compared to individual additives.

Keywords: *Biohydrogen; Dark Fermentation; Cheese Whey Effluent; Monte Carlo Simulation; Supplementation.*

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Acknowledgements. Behrouz Nemati acknowledges FCT for financial support, under the scholarship 2020.05304.BD. This work was also developed within the scope of the project CESAM Centre for Environmental and Marine Studies, POCI-01-0145-FEDER-007638 (FCT Ref. UID/AMB/50017/2020), and to the project. In addition, thanks are due, for the financial support to CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MEC (PIDDAC). Thanks, are also due to the financial support from the PDM program, KU Leuven.

GREEN PORT RESILIENCE STRATEGIES FOR SUSTAINABLE GROWTH AND DEVELOPMENT, A REVIEW AND DEFINITION OF KEY ELEMENTS

Frank Oswald[†,1], Fatima Lopes Alves[1], Seyedeh Azadeh Alavi Borazjani[⋆,1]

1.

⋆ Corresponding author; † Presenting author; Environmental sciences and engineering.

Abstract. With increasing regulations from global bodies like the International Maritime Organisation (IMO) and port authority perspectives, as well as growing customer demand for responsible handling practices, a green port resilience strategy becomes more and more relevant for container-port operators. According to the World Association for Waterborne Transport Infrastructure (PIANC), the green port concept reflects this demand by introducing key elements, including a long-term vision that prioritizes an acceptable environmental footprint, transparent stakeholder participation, and stakeholder-approved strategies for growth. Green port strategy is a comprehensive approach to reduce the environmental impact of maritime operations and enhance the sustainability of port activities.
The paper identifies the most important key elements for a robust sustainability strategy in relevant literature and latest port-sustainability reports. It describes them conceptually to provide sustainable growth and development. Moreover, the paper develops possible solutions and management tools on how to implement the strategies into the daily business. They can be applied to build next-generation green smart ports, using the NEXUS Agenda funded by the Recovery and Resilience Plan as an example.
The research outcomes are, based on the three categories Tools, Strategies and Stakeholders overall eight strategy-elements. Besides Health, Safety, Security and Environment, Operational Efficiency, Energy Efficiency, Certification/Regulatory- Compliance, Biosecurity/Biodiversity, Stakeholder Engagement and Collaboration, Climate Change Adaption/Mitigation and finally GHG/Carbon Footprint. Finally, leading- and legging key performance indicators (KPI) for each strategy are developed.

Keywords: *Green port, Port sustainability, Sustainable development*

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Adding biochar to soil makes it softer? - A case study in central Portugal.

Liliana Beatriz Simões[†,⋆,1], Antun Jelincic[2], Vasco Santos[2], Nelson Abrantes[3], Frank Verheijen[2], Ana Catarina Bastos[2]

1.
2. Centre for Environmental and Marine Studies (CESAM), Department of Environment and Planning, University of Aveiro, Campus Universitario de Santiago, 3810-193 Aveiro, Portugal
3. Centre for Environmental and Marine Studies (CESAM), Department of Biology, University of Aveiro, Campus Universitario de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; lilianabeatriz@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Soil is an important non-renewable resource, that provides multiple ecosystem services, including habitat provision to biodiversity. Biochar (pyrolyzed biomass) application to soil was shown to improve soil structure, soil water retention, and enhance carbon storage in soil, even though effects are dependent on biochar type, application rate, and soil characteristics (Blanco-Canqui, 2021; Jeffery et al., 2011; Verheijen et al., 2010). In this case study, we aimed to evaluate the effect of biochar on soil penetration resistance (PR; N/cm2), relevant to borrowing and nesting conditions by pollinator and soil invertebrate communities. The study area is located in Covilhã, in central Portugal, on a sown biodiverse pasture with a sandy loam texture. Biochar incorporation was done at a 4% (w/w) application rate, until a depth of 20cm, in a total of 20 plots (10 un-amended controls and 10 biochar amended soil) of 9m2 (3x3m) each. This was done in September 2022 followed by sowing the plots with a legume-rich biodiverse seed mixture for cattle grazing.
After vegetation was established in February 2023, soil PR was measured monthly, until the senescence of plants in July, at 3 replicate measurements per plot, measuring the force needed to penetrate the soil from the surface to 40cm depth, in 10cm intervals.
Our results generally showed that PR values decreased in all plots after a rain event and increased with drier soil conditions. The first 10cm of topsoil had similar PR values between biochar and control plots, in all measuring times. Below the 10cm depth, biochar plots showed lower PR values in all measurements. Our results suggest that biochar reduces soil compaction which can improve burrowing and ground-nesting conditions for soil invertebrate and pollinator communities, particularly during the long drying seasons.
The area is still being monitored during the second growing season (2024) and results suggest a similar pattern to that obtained in the first (2023).

Keywords: *Penetration resistance, Soil compaction, Ground-nesting, Borrowing*

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Acknowledgements. We acknowledge FCT/MCTES for the funding of project POLLINATE (https://doi.org/10.54499/PTDC/EAM-AMB/1509/2021), of L. B. Simões (2022.09866.BD), of F. Verheijen (https://doi.org/10.54499/CEECIND/02509/2018/CP1559/CT0004), as well as of CESAM

(UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020) through national (OE) funds. A.C. Bastos was funded by OE, through FCT in the scope of the framework contract foreseen in art. 23ž DL57/2016 (numbers 4, 5, 6) of August 29th August, amended by Law 57/2017 of July 19th July (https://doi.org/10.54499/DL57/2016/CP1482/CT0006).

Long-term assessment of air quality under climate change in urban areas a suitable and optimized modelling tool

João Luiz Martins Basso[1], Joana Cardoso Ferreira[1], Vera Rodrigues[1]

1. Centre for Environmental and Marine Studies (CESAM)

⋆ Corresponding author; joaobasso@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Air pollution is still a big concern in European cities and may worsen in the future due to climate change (CC) [1]. This evidences the importance of defining integrated mitigation and adaptation strategies, based on a comprehensive knowledge on air quality (AQ) and CC at urban scale, for health protection. Meteorological conditions often play an important role in local AQ through accumulation [2] or transport and dispersion of pollutants, influencing the formation of secondary species. Many Gaussian models have been applied, mainly to explore and provide the AQ information needed on regulatory use and research [3] [4]. However, most recent studies do not explore the impact of future CC scenarios in urban areas. Gaussian models still have limitations in characterizing the spatial and temporal variability of meteorological parameters and cannot handle complex chemistry. This work aims to contribute to this goal through the development of an AQ modelling tool, suitable to simulate future AQ and health, under different CC scenarios. The tool will consider the relevant physical (better representation of meteorological parameters) and chemical (secondary pollutants formation) processes occurring in urban areas, in new modules to be implemented in the URBAIRő second generation gaussian model, at high spatial and temporal resolutions, and will be optimized to run long term periods at least running time. The preliminary results showed that under CC conditions associated with higher emissions, AQ may worsen in some areas for some pollutants (PM2.5 and NO2). In contrary, the results under CC scenarios associated with lower emissions show that AQ may improve over time.The tool will be applied to different case studies, i.e. Guimarães (Portugal) and Torino (Italy) urban regions due to area size and type, and air pollution concerns. Outcomes, published in high impact journals, will serve both scientific and policy communities.

Keywords: *Meteorological conditions, gaussian models, modeling tool, climate change scenarios, resolutions*

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Acknowledgements. To my advisors who guided my in this process and to the DISTENDER that has received funding from the

European Union’s Horizon EU research and innovation program under grant agreement Nr 101056836.

Climate Justice in Adaptation to Hydrological Risks in Transition Water Areas The Case Study of the Aveiro Region.

Pedro Alexandre Silva[†,1], Myriam Lopes[⋆,2], Peter Cornelis Roebeling[3]

1.
2. CESAM - Centro de Estudos do Ambiente e do Mar
3. Departamento de Ambiente e Ordenamento

⋆ Corresponding author; myr@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Transitional waters, such as estuaries, deltas, and lagoons, are critical ecosystems that serve as buffers between terrestrial and marine environments. These areas are increasingly threatened by hydrological hazards, including flooding, sea level rise, and salinization, exacerbated by climate change. This research aims to investigate the intersection of hydrological hazards and climate justice in transitional waters, focusing on the social, economic, impacts on vulnerable communities in the Aveiro Region. This study will encompass a detailed literature review to establish a theoretical framework, followed by data collection from selected transitional water bodies. Hydrological data will be gathered from scientific databases, local government reports, and satellite imagery, while socio-economic data will be obtained through national statistics, local surveys, and NGO reports. Stakeholder interviews and community surveys will be conducted to assess local perceptions of hydrological hazards and their impacts. Geospatial analysis using GIS tools will map hazard-prone areas and identify vulnerable communities. Case study analysis will provide in-depth insights into significant impact scenarios. Data analysis will combine quantitative methods for identifying trends and correlations with qualitative methods for understanding community experiences and perceptions. The research will evaluate the extent to which climate justice principlesdistributive, procedural, restorative, intergenerational, recognition, and corrective justiceare integrated into current policies (Alba et al., 2020; Sarkoç Yldrm, 2020; Strange et al., 2024). Expected outcomes include a comprehensive understanding of hydrological hazards in transitional waters, identification of vulnerable communities, and an assessment of climate justice integration in policies. The study aims to provide recommendations for improving policy frameworks to enhance climate justice and resilience in Aveiro Region.

Keywords: *Climate change- Hydrological hazards- Socio-economic impacts- Policy frameworks -Resilience*

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Electro-Fenton process applied to the treatment of brines in a context of industrial symbiosis

Luana Sarinho[†,1], Pedro Carvalho[2], Maria Isabel Nunes[⋆,3]

1. CESAM Centre for Environmental and Marine Studies, Department of Environment and Planning, University of Aveiro, 3810-193, Aveiro, Portugal
2. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193, Aveiro, Portugal.
3. CESAM Centre for Environmental and Marine Studies, Department of Environment and Planning, University of Aveiro, 3810-193, Aveiro, Portugal.

⋆ Corresponding author; isanunes@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Saline wastewater, also known as brine, is an aqueous solution saturated with sodium chloride (NaCl) and is generated by several industries (Sarinho et al., 2023). In particulary, codfish preservation methods have relied on drying and salting techniques, which, however, produce saline wastewaters as a byproduct (Giwa et al., 2017). Conventional treatment processes are ineffective in reducing significatively the organic load of these brines given their high salt content (25 30 % wt. NaCl) (Panagopoulos, 2022). On the other hand, treated codfish brines hold potential to be used in other industrial processes - circular economy, such as the pickling stage in tanneries (Martinho et al., 2015). This work aimed to employ the electro-Fenton (EF) process, using iron electrodes, to treat contaminated brine from the codfish industry, envisaging its later use in the pickling stage of the tannery industry (industrial symbiosis). The operating variables - current density, electrolysis time and oxidant (H2O2) concentration - were optimized with the total organic carbon (TOC) as the response variable. Optimal operating conditions were determined to be: 275 Am-2 current density, 6.2 min electrolysis time and 91 mM H2O2 concentration, resulting in a 68 % removal of TOC. Additionally, the quality of diluted treated brines (7.5 8.0 % wt. NaCl) was tested in hide pickling trials and compared with virgin brine. The treated brines did not compromised the quality of the wet-blue leathers, which is a promising result when considering a symbiosis between the codfish and the tannery industries. However, the elevated anodic dissolution (Feš = 3.56 mM) may increase the process cost. To mitigate this, the cost can be reduced by using scrap metals (circular economy) as sacrificial electrodes.

Keywords: *circular economy; electrooxidation; saline residues; tannery; waste valorisation*

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Acknowledgements. This work is financed by Portugal 2020 through European Regional Development Fund (ERDF) in the frame of CENTRO2020 in the scope of the project SimBioSalt, CENTRO-01-0247-FEDER-069712. The work was developed within the scope of the project CICECO Aveiro Institute of Materials, UIDB/50011/2020 & UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MEC (PIDDAC) and CESAM (UIDP/50017/2020 +

UIDB/50017/2020 + LA/P/0094/2020), financed by national funds through the FCT/MCTES. J.P. Ribeiro acknowledges FCT Fundação para a Ciência e a Tecnologia, I.P. for his PhD Grant (SFRH/BD/141133/2018).

ATOMS: Air quality management framework combining modeling and monitoring through data fusion

Miguel Rosa[†,⋆,1], Diogo Lopes[1], Vera Rodrigues[1], Jan Armengol[2]

1. CESAM Centre for Environmental and Marine Studies, Department of Environment and Planning, Campus Universitario de Santiago, 3810-193 Aveiro, Portugal
2. Barcelona Supercomputing Center, Barcelona, Spain

⋆ Corresponding author; miguelrosa@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. According to recent projections, the growing trend of urbanization is expected to worsen due to socioeconomic factors, with 68% of the worlds population expected to live in urban areas by 2050 (United Nations, 2018). Besides lowering the overall quality of life, the overcrowding of cities results in higher traffic levels, and energy and heating needs, thereby diminishing air quality and increasing the number of individuals exposed to atmospheric pollutants (Li et al., 2019; Oliveira et al., 2022). In urban areas, the most critical pollutants are particulate matter (PM10 and PM2.5) and nitrogen dioxide (NO) due to high concentrations and their substantial impact on human health.
Despite recent efforts to improve urban air quality modeling, uncertainties persist, especially in characterizing emissions and modeling turbulent phenomena (Lopes et al., 2024). While sensor networks and reference stations play key roles in air quality monitoring, their spatial coverage remains limited (Schneider et al., 2017). To address these limitations, data fusion techniques combine numerical outputs with observations to mitigate model uncertainties while achieving full spatial coverage.
This study aims to develop real-time air quality mapping tools for urban areas, by identifying appropriate air quality models and algorithms for preprocessing observations and developing state-of-the-art data fusion methods. The developed framework will be tested in the urban areas of Aveiro (PT) and Barcelona (ES) to provide unprecedented reliable and high-resolution AQ maps.
This research will greatly contribute to advancing research knowledge on urban atmospheric monitoring, enhancing the current use of both monitoring sensor networks and urban air quality models and supporting policymakers by improving air quality assessment. Additionally, it aligns with the United Nations Sustainable Development Goals (SDG), specifically responding to SDG 3 (Good Health and Well-Being) and SDG 11 (Sustainable Cities and Communities).

Keywords: *Critical air pollutants; Data integration; Sensors; Spatial coverage; Urban areas*

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Acknowledgements. This work was funded by the project BigAir - Big data to improve atmospheric emission inventories (http://doi.org/10.54499/PTDC/EAM-AMB/2606/2020), funded by national funds through FCT - Foundation for Science and Technology. The authors also acknowledge financial support to CESAM by FCT/MCTES (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020), through national funds.

Preliminary exploration: evaluating the feasibility of implementing urban gardens on private properties in Chilpancingo, Mexico.

Max López-Maciel[†,⋆,1], Peter Roebeling[1], Elisabete Figueiredo[2], Rick Llewellyn[3]

1. Department of Environment and Planning, Center for Environmental and Marine Studies, CESAM, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Social, Political and Territorial Sciences Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP), University of Aveiro, 3810-193 Aveiro, Portugal.
3. Commonwealth Scientific and Industrial Research Organisation (CSIRO), Agriculture Food, Waite Campus, Urrbrae SA 5064, South Australia

⋆ Corresponding author; max@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. This study focuses on the potential adoption of urban gardens among property owners in Chilpancingo, Mexico. Urban gardens, also considered Nature-based solutions (NBS), represent an innovative approach to sustainable urban living, offering benefits such as access to fresh vegetables and fruits, environmental conservation, and community engagement (UNaLab 2019). To assess the potential for adoption of urban gardens by property owners in Chilpancingo, the Adoption and Diffusion Outcome Prediction Tool (ADOPT) was developed and applied based on inputs related to the population's characteristics, innovation's attributes, and community networks (López-Maciel et al. 2023; López-Maciel et al. 2022). An elicitation process based on a workshop setting (López-Maciel et al. 2019) was conducted with stakeholders representing academia, the municipality, and the general population. Results show a gradual uptake of urban gardens, with an estimated peak adoption of 18% expected within 13 years and a near-peak adoption of 95% within 10 years.Sensitivity analyses reveal various influential factors affecting adoption levels. These factors can be categorized into two groups: those related to the characteristics of the innovation and those related to the community's adoption process. The first group emphasizes aspects such as profit orientation, environmental orientation, enterprise scale, relative upfront cost of innovation, future profit benefit, risk exposure, and ease and convenience. These aspects primarily determine the perceived benefits and feasibility of adopting urban gardens. The second group includes factors that influence the rate at which adoption occurs. These factors encompass short-term constraints, trialability, advisory support, group involvement, and relevant existing skills and knowledge. This group focuses on the practicalities and support systems that facilitate or hinder the adoption process.Overall, this predictive analysis provides preliminary insights for policymakers, urban planners, and community stakeholders seeking to promote sustainable practices and enhance the quality of urban life in Chilpancingo, Mexico. By understanding the key factors that influence the adoption of urban gardens, stakeholders can develop targeted strategies to address barriers and leverage facilitators, thereby promoting wider adoption and maximizing the benefits of urban gardening initiatives.

Keywords: *Nature-based solutions, adoption, urban resilience, climate change, adaptation.*

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Acknowledgements. The authors acknowledge the financial support of the Portuguese Foundation for Science and Technology (FCT) under the grant FCT/ECIU (PRT/BD/154933/2023). We also acknowledge financial support to CESAM by FCT/MCTES (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020) through national funds.

PM10 and bound elements in a bakery environment

Leonardo Furst[†,⋆,1], Yago Cipoli[1], Getúlio Igrejas[2], Manuel Feliciano[3], Célia Alves[1]

1. CESAM
2. CEDRI
3. CIMO

⋆ Corresponding author; leonardo.furst@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Particulate matter (PM) is the most significant air pollutant, and it is one of the leading factors contributing to the global disease burden [1]. Usually, the main source of PM in bakeries is flour dust, which can pose respiratory health risks to workers if not properly controlled [2]. This study was carried out in a bakery belonging to a Portuguese supermarket franchise. A low-volume gravimetric sampler was used to sample PM10 in quartz filters. The filters were used to determine PM10 concentration and bound elements trough XRF (x-ray fluorescence). The average PM10 concentration was 73.1 ug/m3, above the guideline value of 45 ug/m3 recommended by the World Health Organisation. Typically, the limit for occupational exposure to flour dust is assessed based on inhalable dust (<100 um), and the Scientific Committee on Occupational Exposure Limits (SCOEL) recommends that keeping inhalable dust concentrations below 1 mg/m3 would protect most labours from diseases. The bakery presented elevated levels of S (162), Cl (200), K (176), Ca (1324), Ti (31.9), Cr (24.5) and Mn (19 ng/m3). Bread fermentation is the possible main source of S, given that yeasts can generate various products, including alcohols, carbonyls, phenols, esters, and compounds containing sulphur [3]. The presence of Cl is mainly due to the use of chlorinated cleaning products. Ca and K are more related to the composition of wheat flour, which may have a high content of these elements [4]. Cr and Mn are common elements released by stainless steel [5]. Ti is usually related to crustal material, originating from soil. Possible sources include the constant movement of workers, causing resuspension, and the titanium present in the flour and metal alloys. These findings emphasise a recurrent problem and the importance of implementing effective measures to mitigate occupational exposure to flour dust in bakeries.

Keywords: *Gravimetric sampling, Retail store, Particulate matter, Flour, Indoor air quality*

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Acknowledgements. The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support by national funds FCT/MCTES to CESAM (UIDP/50017/2020, UIDB/50017/2020 and LAP/0094/2020), SusTEC (LA/P/0007/2020), CIMO (UIDB/00690/2020), CeDRI (UIDB/05757/2020 and UIDP/05757/2020) and to PhD fellow students Leonardo Furst (https://doi.org/10.54499/2020.08461.BD) and Yago Cipoli (SFRH/BD/04992/2021).

Machine learning algorithms applied to risks mitigation and climate change adaptation in Timor-Leste

Shannon Viegas[†,1], Sílvia Coelho[⋆,1], Myriam Lopes[1]

1. Universidade de Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, Portugal

⋆ Corresponding author; silviacatarina@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Climate change leads to higher temperatures, shifting precipitation patterns, and frequent extreme weather events such as floods and droughts, significantly impacting Timor-Leste (Zennaro et al., 2021). Traditional methods struggle with predictions, but machine learning can effectively analyze these events in risk-prone areas. Major environmental issues in Timor-Leste include deforestation, soil erosion, vulnerability to extreme weather, poor water quality, waste treatment, and loss of biodiversity (Secretary of State, 2010). With expected increases in rainfall and heatwave intensity (Mycoo et al., 2022), this research aims to use machine learning to predict floods and droughts, assess key environmental areas, and propose risk mitigation and climate change adaptation strategies.
A mixed approach is used: quantitative and qualitative analysis. The first part is quantitative and based on observed weather station data in Timor-Leste for the analysis of the historical period. Variables used for analysis are precipitation, temperature, wind direction, and wind intensity (Andrade et al., 2018). Satellite-simulated model data are also used for historical and projected scenarios for comparison. Floods and droughts are identified through ETCCDI extreme climate indices and assessed based on bias, Pearson correlation, MAE, and RMSE between observations and projections. Considering multiple future scenarios is essential to planning for mitigation and adaptation against climate change in Timor-Leste.
Based on the climate analysis, the second qualitative part is to develop a national, regional, and operational strategic plan for mitigation and adaptation against climate change and variability. This research is in line with sustainable development goals 6, 11, and 13, which aim to ensure the availability and sustainable management of water resources, make cities and human settlements resilient, and take action against climate change impacts by 2030. Incorporating this study for a small island country such as Timor-Leste would be beneficial to the development of similar island states to combat climate change.

Keywords: *Machine learning, Climate change, Extreme events, Temperature and precipitation, Environmental impact*

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Potential of bio-based materials and solutions to decarbonize buildings at the building project phase

Ana Karolina Santos[†,⋆,1], Ana Isabel Machado[2], Victor Ferreira[3], Ana Cláudia Dias[2]

1. Department of Environment and Planning, University of Aveiro, Campus Universitário de Santiago, Aveiro, 3810-193, Portugal
2. Centre for Environmental and Marine Studies (CESAM), Department of Environment and Planning, University of Aveiro, Campus Universitário de Santiago, Aveiro, 3810-193, Portugal
3. RISCO, Department of Civil Engineering, University of Aveiro 3810-193 Portugal

⋆ Corresponding author; akgs@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. The construction industry plays a significant role in global carbon emissions, with at least 6% attributed to embodied emissions in building materials. To align with the European Green Deal goals, new European buildings should prioritize decarbonization strategies. Biobased materials, as forest-based products, and biobased solutions, such as green roofs, are an alternative approach to decrease buildings embodied carbon footprint (ECF) and to contribute to climate change mitigation as green roof vegetation absorbs CO2 (Arehart et al, 2021). Additionally, biochar into green roof substrates can further enhance the capacity of buildings to play as carbon sinks (Liao et al, 2022).Current methods for measuring ECF at the initial stage of building projects lack accuracy in evaluating the ECF of specific materials integrated into the project. This study aims to develop a new calculation methodology to determine the potential of biobased materials after its implementation in two building projects. Additionally, the effectiveness of biochar from Portuguese forests invasive species on green roof substrates will be assessed. A sample of a commercial extensive green roof substrate will be tested under different biochar rate (7-10%, 15-20%, no biochar (w/w)). The substrate will be analysed for carbon content, soil water content, and pH (Sorrenti et al, 2019). Plant performance will be analysed regarding plant Relative Growth Rate, plant leaf area, days to first flower, above and underground biomass (Liao et al, 2022). The best green roof substrate will undergo a life cycle assessment to calculate its ECF. Then, potential of this green roof as a biobased solution to decarbonize building projects will be determined through the developed calculation methodology. This study fosters sustainability thinking in decision-making of the architectural and building design field by emphasizing transparency through the use of Environmental Product Declarations for collecting ECF data and advocating a circular economy for forest waste.

Keywords: *Embodied Carbon Footprint; LCA; Building Projects; Biobased Materials; Green Roofs; Decision-making.*

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Acknowledgements. The authors declared that this study does not have any financial support provided by projects or scholarships.

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Environmental impact assessment of the production and assembly of an electric bicycle

Paulino Duarte[†,⋆,1], Paula Quinteiro[1]

1. Centre for Environmental and Marine Studies (CESAM), Department of Environment and Planning

⋆ Corresponding author; paulinoduarte@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. The European Union through, the Green Deal and commitments from the Paris Agreement, aims to achieve carbon neutrality by 2050, positioning itself as the leader in sustainability efforts and achieving the main goal of being the first carbon-neutral continent (EC, 2019). Transportation contributes to 25% of the European Union's greenhouse gas emissions, with road transport responsible for 72% in 2019. A strategy to mitigate these emissions involves transitioning to low-emission transport modes (EEA, 2022). Electric micromobility has emerged as a more sustainable means of city travel than motorcycles and automobiles moved by fossil fuels. This occurs particularly in developed countries grappling with city centre jams and in many developing countries where powered two-wheelers represent a major component of the traffic (Kontar et al., 2022). However, the environmental sustainability of electric bicycles remains poorly studied (Sun et al., 2023). Under the scope of the agenda AM2R (Recovery and Resilience Plan) and aligned with the Sustainable Development Goals 11 (Sustainable cities and communities) and 13 (Climate action), this project aims to assess the environmental performance of electric bicycle components, their assembly, use and end-of-life based on Life Cycle Assessment (LCA) methodology to ensure the environmental sustainability of electric bicycles. LCA consists of the compilation and evaluation of the inputs, outputs and corresponding environmental impacts of a product throughout its life cycle, i.e. from raw material acquisition up to end-of-life (ISO, 2006). The results of the defined case studies (e.g. battery, frame, chain, assembly, wheel) will generate new insights to improve the energy and environmental performance of e-bicycle processes (decision-making), supporting the ramping up of clean energy transition. In addition, based on a societal-economic approach, strategies to promote the end users acceptance of electric bicycles will be developed.

Keywords: *Life Cycle Assessment, E-bike, Battery, Transport, Climate Change, Carbon Neutrality*

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Acknowledgements. This study is funded by the PRR - Recovery and Resilience Plan and by the NextGenerationEU funds at Universidade de Aveiro, through the scope of the Agenda for Business Innovation, namely AM2R Agenda Mobilizadora para a inovação empresarial do setor das Duas Rodas (Project no 15 with the application C 644866475 00000012). The authors would like to acknowledge the Portuguese Foundation for Science and Technology (FCT)/MCTES for the financial support to CESAM (UIDP/50017/2020+UIDB/50017/2020 + LA/P/0094/2020), through national funds. Thanks also due to PRR for the research grant granted to Paulino Duarte (BI/UI64/11322/2024). Paula Quinteiro also thanks to the research contract

CEECIND/00143/2017, doi:10.54499/CEE CIND/00143/2017/CP1459/CT0003.

Modelling and Assessment of Nitrogen Deposition in Portugal

André Barreirinha[†,⋆,1], Michael Russo[1], Sabine Banzhaf[2], Alexandra Monteiro[1]

1. Centre for Environmental and Marine Studies (CESAM), 3810-193 Aveiro
2. Institute for Meteorology ,Carl-Heinrich-Becker-Weg 6-10 Room 121 (Altbau) 12165 Berlin

⋆ Corresponding author; † Presenting author; Environmental sciences and engineering.

Abstract. Portugal has some of the most nitrogen-sensitive ecosystems in Europe. However, while in other European countries, mostly in North-Western Europe, a considerable amount of research is being performed on the topic of nitrogen deposition, very few studies focus on this issue in Portugal. A lack of infrastructure to monitor nitrogen concentrations and deposition in the country, together with a lack of policies to enforce nitrogen emission reductions poses an imminent risk, as ammonia is the most critical pollutant to fulfil Portugal's emission ceiling goals (Ferreira et al., 2017; Hettelingh et al., 2017; Sutton et al., 2011).
A significant portion of the deposition assessments conducted on this topic use chemical transport models (CTM). Among these models, LOTOS-EUROS is regarded as one of the most advanced, and is one of the few with a compensation point parametrization (Manders et al., 2017). However, applying this model to a Mediterranean area requires some adaptation since deposition parameters in the model are mostly based on studies from North-Western Europe (Erisman & Schaap, 2004)This thesis aims to enhance the LOTOS-EUROS model to address air quality and nitrogen deposition issues in Portugal. With this in mind, the distribution of nitrogen deposition and critical load exceedances will be assessed. In addition, the main emission sources were identified through a source apportionment study. Finally, the impacts of emission reduction measures and climate change scenarios on nitrogen concentrations and deposition will also be assessed. This work will provide a fine-tuned model setup to the Portuguese reality, which will enable the accurate representation of current and future deposition rates and will be a staple in Mediterranean nitrogen deposition studies. Additionally, it will support the decision-making process to reduce ammonia emissions.

Keywords: *Chemistry transport model, Dry deposition, Wet deposition, Ammonia, Reactive nitrogen*

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Acknowledgements. This work was funded by the European Union's Horizon Europe research and innovation program under the grant agreement No. 101079134 (FONDA). The authors also acknowledge financial support to CESAM by FCT/MCTES (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020), through national funds.

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Remote sensing-based assessment of burned coastal pine woodlands recovery and carbon sink potential

Tiago v.d. Worp da Silva[†,⋆,1], Bruna R. F. Oliveira[1], Luísa Pereira[2]

1. Center of Environmental and Marine Studies
2. Centro de Investigação em Ciências Geo-Espaciais, Universidade do Porto

⋆ Corresponding author; tworp@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Wildfires, natural phenomena integral to ecosystem dynamics, land management, and global processes, are intensifying globally due to land use and climate change [1]. This escalation requires immediate action. The larger and more frequent wildfires threaten the UN's Goal 13 of Agenda 2030 by diminishing forests' capacity to sequester carbon. The UN Decade on Ecosystem Restoration (2021-2030) underscores the urgency of restoring degraded ecosystems in fire-prone regions to bolster resilience and carbon sequestration potential.
Remote Sensing (RS), including Unmanned Aerial Vehicles (UAVs) and satellites, is becoming increasingly important as an alternative to point-scale monitoring of ecosystems, enabling broader temporal and spatial coverage [2]. Our plan aims to enhance the use of RS for studying fire ecology and post-fire recovery of Pinus pinaster coastal woodlands in Portugal by progressing from field observations to UAV data.
The study aims to answer three scientific questions: Can remote sensing effectively monitor pine tree recruitment, survival, growth, and stress? Are RS datasets reliable for estimating carbon stocks in pine woodlands? Can RS accurately identify pine trees in different development stages?
The research plan is divided into three work packages: Develop and establish methods using RS to assess the impact of post-fire regeneration and rehabilitation on coastal Pinus pinaster populations; estimate and predict carbon stocks in Pinus Pinaster woodlands; and develop a tool to identify and assess the properties of Pinus pinaster trees.
The methodology will consist of building a geoinformatics database on Pinus Pinaster coastal woodlands integrating data collected in situ to validate data collected from RS technology.
The research will take into account the ICNF intervention plan for the coastal areas, which has been implemented since 2017 to achieve these objectives. Positive findings from this research plan will influence policymakers and forest managers to adopt better and more effective post-fire rehabilitation measures.

Keywords: *Remote Sensing, Multispectral imagery, LiDAR, Wildfires, Restoration, Carbon Sequestration*

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Acknowledgements. The authors gratefully acknowledge the financial support of the Portuguese Foundation for Science and Technology (FCT, I.P) to CESAM (UIDP/50017/2020 + UIDB/50017/2020 + LA/P/0094/2020) and the project ModelEco (PTDC/ASP-SIL/3504/2020). Bruna R. F. Oliveira is financed by FCT, I.P., FEDER and COMPETE 2020, through the stimulus for a scientific job (2021.00785.CEECIND). Tiago v.d. Worp da Silva is funded by FCT, I.P. (2023.01767.BDANA) in the form of a PhD grant in a non-academic environment.

Dynamic Decision Support System for Integrated Urban Environmental Comfort Management (DSS-IUECM)

Sina Ataee[†,⋆,1], Myriam Alexandra dos Santos Batalha Dias Nunes Lopes[1], Hélder Alexandre Relvas Paulo[1]

1. CESAM Department of Environment and Planning, University of Aveiro

⋆ Corresponding author; sinaataee@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. This research project investigates the intricate relationship between environmental comfort (EC) and urban spatial components. To achieve this, a novel Spatial Dynamic Decision Support System (DSS-IUECM) will be developed, focusing on multi-scale spatial components, and utilizing hybrid outdoor air and sound quality indexes. This initiative aims to contribute to Sustainable Development Goals (SDGs) 11 (Sustainable Cities and Communities) and 3 (Good Health and Well-being) (Metelkova et al., 2023; Shao et al., 2022).

The research begins with a comprehensive literature review to establish a comprehensive understanding of EC within urban spaces. This systematic literature review, which has already been completed, has explored the interconnectedness of thermal factors (air temperature, wind comfort, solar radiation, humidity), human perceptions (social engagement, economic activities, open area utilization), and spatial contexts (green spaces, urban morphology). Through system dynamics modeling, the project unveils the intricate feedback loops within the urban ecosystem and human experience(Bolund & Hunhammar, 1999; Fong et al., 2009; Soltani et al., 2022).

The findings highlight the necessity for an integrated urban planning approach that acknowledges the systemic nature of EC. This integrated approach holds the key to fostering livable and sustainable cities. Notably, the review identifies a gap in knowledge regarding the sensory dimensions of EC, specifically acoustic comfort and air quality. These areas are identified as potential avenues for future research.

The DSS-IUECM model will leverage spatial analysis techniques, spatial policy analysis through focus groups, and data from air and noise sensors. This comprehensive approach will yield valuable insights into the interplay between spatial functionalities and environmental comfort. Ultimately, this project empowers Planners and urban managers to make data-driven decisions that enhance quality of life and create future-proof interventions, focusing on Lisbon's urban area as a case study due to its dense urban fabric and existing sustainability initiatives.

Keywords: *Environmental Comfort, System Dynamics, Outdoor Urban Comfort, Sustainable Urban Planning*

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Acknowledgements. The authors would also like to acknowledge the support of CESAM (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020) and C2TN (UIDB/04349/2020). Thanks to FCT/MCTES for the contract granted to Helder Relvas (2021. 00185. CEECIND) and the contract of Sina Ataee (FCT GRANT 2023. 02767.BD).

Optimization of gasification of residual forest biomass and refuse-derived fuel, for the production of high-quality syngas

Jéssica Maria de Oliveira Moura[†,*,1], Luís António da Cruz Tarelho[1], Manuel Arlindo Amador de Matos[1]

1. CESAM

* Corresponding author; † Presenting author; Environmental sciences and engineering.

Abstract. The increasing global energy demand and the heavy reliance on fossil fuels have led to the brink of depletion of these resources, underscoring the need for new and renewable alternatives. Syngas is an excellent alternative fuel that could be used in vehicles, fuel cells, and in the production of chemicals (Gao et al., 2023). Biomass gasification produces a gas rich in H2 and CO, suitable for syngas production. Several studies have investigated the effect of process conditions on biomass gasification efficiency. The studies suggest that steam or steam-O2 mixture and high temperatures (800 to 950řC) are optimal for producing high-quality produced-gas (PG) rich in H2 and CO (Meng et al., 2019; Soria-Verdugo et al., 2019).
This project will study the steam and steam-O2 mixture gasification of two residual feedstocks to produce high-quality syngas for the synthesis of fuels. Residual forest biomass (RFB) and refused-derived fuel (RDF) will be used as feedstock due to their high availability, in Portugal, and great energetic potential, but poorly managed. However, these materials' composition (high ash and alkaline earth metals content) proves process challenges (defluidization and corrosion), that compromise their utilization and valorization in the upscale infrastructures (Fürsatz et al., 2021).
The gasification tests will be conducted in an electrically heated prototype-scale bubbling fluidized bed (BFB) reactor. The work will include the study of the application of low-cost catalytic material (such as ashes or char) to improve syngas quality (H2/CO range between 0.6 and 2 for Fisher-Tropsch production) and reduce tar formation (to 1 mg/Nm3, maximum acceptable for syngas) (Basu, 2010). Besides the state of art revision and infrastructure upgrading, preliminary tests were performed using different gasifying agents (air, O2-rich air, and air-steam), and eucalyptus residues. The findings proved that air-steam mixture is the most appropriate atmosphere to produce an H2-rich gas, suitable for fuel synthesis applications.

Keywords: *Residual forest biomass; Refused-derived fuel; Gasification; Syngas.*

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Acknowledgements. The authors gratefully acknowledge the financial support of the Recovery and Resilience Plan (PRR), in the scope of the Mobilising Agendas for Business Innovation Moving2Nutrality (M2N), under the investigation scholarship call 136/2023/BI/AgendasPRR.

Quantification of spatio-temporal reactive nitrogen emissions (NO2 and NH3) over the Iberian Peninsula with emission inversions coupled with a chemistry transport model.

Daniel Helm[†,*,1], Enrico Dammers[2], Carla Gama[1], Alexandra Monteiro[1]

1. CESAM, Department of Environment and Planning, University of Aveiro
2. Air Quality and Emissions Research, Netherlands Organisation for Applied Scientific Research (TNO), Utrecht

[*] Corresponding author; daniel.helm@ua.pt; [†] Presenting author; Environmental sciences and engineering.

Abstract. Anthropogenic emissions of reactive nitrogen have increased significantly over the last two centuries (Erisman et al., 2011). A large proportion of this reactive nitrogen is released into the atmosphere in the form of ammonia (NH3), generated from livestock farming activities and fertilizer use, and in the form of oxides of nitrogen (NOX) generated from the combustion of fossil fuels. The atmospheric deposition of reactive nitrogen can adversely impact ecosystems and biodiversity (Bobbink et al., 1998, European Nitrogen Assessment (ENA), n.d.). This is particularly relevant to the Iberian Peninsula where ecosystems that have a low threshold for eutrophication, and are therefore highly sensitive to nitrogen levels, are found (European Critical Loads, 2017).In-situ measurements of reactive nitrogen species in this region are sparse and those that are available are measurements of NHX & NOY wet deposition, or NO2 concentrations. This sparsity of data gives rise to a high degree of uncertainty in ascertaining the budget of nitrogen species in this region.This project, part of the FOstering Nitrogen Deposition Assessment over Portugal (FONDA) project, will attempt to address this issue by utilizing earth observation data to validate concentration distributions simulated by the LOTOS-EUROS chemistry transport model.Previous studies have developed approaches to estimate emissions of NO2 using TROPOMI and NH3 using IASI and CrIS satellite data (Fioletov et al., 2017, Beirle et al., 2019, Dammers et al., 2019, van der Graaf et al., 2022). This study will apply these approaches to the Iberian Peninsula.As a first-step, a steady-state emission inversion scheme will be applied to the Iberian Peninsula to derive spatial-temporal emission fields from satellite observations and evaluate these against inventory emissions and existing temporal distributions. The resulting emission fields will then be used within the LOTOS-EUROS model to simulate the concentration and deposition fields which will then evaluated with satellite data and in-situ data, where available. Following this, a non-steady-state inversion scheme will be applied through the use of a Local Transform Ensemble Kalman Filter (LETKF) to compare model parameters with satellite observations to optimize the a-priori spatial and temporal emission distributions.

Keywords: *atmospheric deposition, nitrogen, ammonia, remote sensing*

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Acknowledgements. European Commission (Grant agreement ID: 101079134) HORIZON-WIDERA 2023-2025

Circular Life Cycle Sustainability Assessment of Entotechnologies for Insect Production and Processing

Ana Fonseca[†,⋆,1], Paula Quinteiro[1], Ana C. Dias[1]

1. Centre for Environmental and Marine Studies (CESAM), Department of Environment and Planning, University of Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, Portugal

⋆ Corresponding author; anaritafonseca@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Insects are a promising tool to recover by-products and waste from the agri-food industry, avoiding organic matter decomposition in landfills, and contributing to the recovery of nutrients. Particularly, the black soldier fly (BSF) is being used to develop new value-added products such as protein for animal feed and frass as biofertilizer. The industrial rearing of insects is a booming sector, that can promote a circular economy by reviving organic matter using entotechnologies. However, the sustainability of the products from this new bio-industrial sector, considering and integrating environmental, social, socioeconomic, and circular indicators from a life-cycle perspective, remains poorly studied (Smetana, 2023). Under this context, this project aims to develop a Circular Life Cycle Sustainability Assessment (C-LCSA) methodology (UNEP, 2020), for jointly measuring the circularity and the 3 pillars of sustainability of the products obtained from insect bioconversion. The methodology will be applied to three case studies: 1) BSF products (protein, oil and frass); 2) BSF as a bioremediation service, quantifying the sustainability impacts of bioremediation of olive pomace used as feed for BSF, compared to traditional treatment routes; 3) frass application as a fertilizer substitute. In all case studies, the system boundaries will be considered from raw material acquisition up to product manufacturing; moreover, in the case study of frass application, this stage will also be accounted for. These case studies aim to quantify the total environmental, social, and socioeconomic impacts, as well as circularity indicators, and will help to identify hotspots and suggest improvements based on interlinkages and trade-offs along the defined value chains. The results will generate new knowledge to be shared with the scientific community and stakeholders, improving, supporting, and promoting innovative industrial closed-cycle productions.

Keywords: *Life Cycle Thinking, Frass, Insect, Fertilizer, Circular Economy, Sustainability*

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Acknowledgements. This study is funded by the PRR - Recovery and Resilience Plan and by the NextGenerationEU funds at Universidade de Aveiro, through the scope of the Agenda for Business Innovation InsectERA (Project no. 20 with the application C644917393-00000032). The authors would like to acknowledge the Portuguese Foundation for Science and Technology (FCT)/MCTES for the financial support to CESAM (UIDP/50017/2020+UIDB/50017/2020 + LA/P/0094/2020), through national funds. Paula Quinteiro and Ana Cláudia Dias also acknowledge the research contracts CEECIND/00143/ 2017 (doi:10.54499/CEE CIND/00143/2017/CP1459/CT0003) and CEECIND/02174/2017 (doi: 10.54499/CEECIND/02174/2017/CP1459/CT0019), respectively.

Research Summit 2024
Research Forum of the University of Aveiro
$16–19^{th}$ July 2024, Aveiro. Portugal

Environmental assets and liabilities of valorization of residual biomass and industrial sludge into biochar.

Carolina P. Morim[†,⋆,1], Mara Madaleno[2], Luís A. C. Tarelho[1], Flávio C. Silva[1]

1. Centre for Environmental and Marine Studies (CESAM), University of Aveiro, Department of Environment and Planning, Campus Universitário de Santiago, Aveiro,3810-193, Portugal
2. University of Aveiro, Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), Research Center GOVCOPP, Campus Universitário de Santiago, 3810-193, Aveiro, Portugal

⋆ Corresponding author; carolinapedrosamorim@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Climate challenges are urging efficient strategies to counteract the damage to natural resources, such as the depletion of soil quality. There is a need to restore soil health using sustainable methods that comply with the EU Circular Economy action plan. Pyrolysis of low-quality wastes for biochar production is a recognized valorization approach, presenting both environmental benefits and challenges. Biochar is a recalcitrant carbonaceous material whose application in soils leads to improvements, as well as having the potential to act as a carbon sink (Koide et al., 2011; Zheng et al., 2018). Despite the several benefits, biochar application may also induce environmental impacts in the surrounding compartments (Das et al., 2014; Xiang et al., 2021).
Current studies seldom consider environmental risks of biochar production and application. Hence, this proposal aims to develop fundamental and applied knowledge on valorization of residual forest biomass (RFB) and biological sludge from wastewater treatment of the pulp and paper industry (PPS) into biochar, and its soil application without threatening ecosystem services.
Therefore, pyrolysis assays will be performed at varying temperatures (500 600 řC) and residence time (5 10 min). The biochar produced will be used in soil incubation assays, where a factorial experimental design will be applied, varying the application rate (3%, 6%, and 10% (w/w)) and particle size (< 2 mm, > 2 mm, and unsorted). The assay will last 18 months, during which the leachate will be collected and analyzed. In the last 2 months, seeding of Lollium perenne will be done to assess plant productivity. The physicochemical and biochemical indicators and the carbon balance of the process will be analyzed to perform a techno-economic assessment.
This proposal pursues a study of optimal pyrolysis conditions, determines effective and safe soil application rates for biochar, and performs a techno-economic analysis, promoting sustainable waste management solutions.

Keywords: *Biochar; Soil quality; Carbon neutrality; Pyrolysis; Environmental Risk Assessment*

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(PCIF/GVB/0034/2019), in the scope of the Contest for Scientific Research and Technological Development Projects Fire Prevention and Combat 2019, exclusively financed through national funds

Assessing the impact on air quality of different urban morphologies using the WRF-CAMx modelling system

Bruno Augusto[†,⋆,1], Sandra Rafael[1], Margarida Coelho[2], Joana Ferreira[1]

1.
2. Department of Mechanical Engineering/Centre for Mechanical Technology and Automation LASI Intelligent Systems Associate Laboratory, University of Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Environmental sciences and engineering.

Abstract. With the rise of population living in cities, an increase in urbanization is expected with consequent changes to the morphology of urban areas, and thus, impacts in the urban environment. Air quality is one of these impacts, affecting ecosystem and human health (Liang et al., 2023). The objective of this study is to assess the ability ofurban morphologies to minimize air quality problems for future multi-core regions. This study is focused on Aveiro, Portugal, due to its multinuclear characteristics and open landscape, which could potentially benefit from different urban morphologies. Thus, three urban morphology scenarios were designed: two scenarios representing urban compaction (Focused City Scenario and Independent City Scenario); and one representing an extreme version of the current urban dispersion (Dispersed City Scenario). The impact of urban scenarios on emissions and air quality was compared against the current urban morphology. The modelling system including the Weather Research and Forecast (WRF) meteorological model, coupled with the chemistry model CAMx, adapted to consider a bigger differentiation of urban land use classes (high- and low-density urban areas, and industrial areas), was applied. Results show that for the study area, the compact urban morphology scenarios led to an increase of air pollutant concentrations (NOx and PM10) in industrial and urban hotspots, and the Disperse City scenario showed a higher variability of concentrations, with lower maxima, but with more hotspots, thus affecting more people. This study provides novel insights by applying a comprehensive methodology to assess the urban morphology's impact on air quality, and has the potential to provide urban planners and policy makers with the tools to prepare for more sustainable and healthier future urban areas.

Keywords: *Air Quality; Modelling; Urban morphology*

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Acknowledgements. The authors would like to thank CESAM by FCT/MCTES (UIDP/50017/2020 + UIDB/50017/2020 + LA/P/0094/2020); to UIDB/00481/2020 (https://doi.org/10.54499/UIDB/00481/2020), UIDP/00481/2020 (https://doi.org/10.54499/UIDP/00481/2020) and UIDB/ECI/04450/2020 - FCT - Foundation for Science and Technology; CENTRO-01-0145-FEDER-022083 - Regional Operational Program of Central Portugal (Centro2020), under the Partnership Agreement PORTUGAL 2020, financed by the European Regional Development Fund, and the co funding byalongside the FEDER, within the PT2020 Partnership Agreement and Compete 2020, who provided co-funding. Thanks are also due to FCT/MCTES for their financial support through a PhD grant to B. Augusto (https://doi.org/10.54499/2020.06293.BD) and for the contract granted to Joana Ferreira (http://doi.org/10.54499/2020.00622.CEECIND/CP1589/CT0020).

Establishing a high-resolution model to assess the impact of nature-based solutions on the built environment

Diogo Nascimento[†,⋆,1], Jorge Sousa[2], Myriam Lopes[1], Vera Rodrigues[1]

1. CESAM Centre for Environmental and Marine Studies, Department of Environment and Planning, University of Aveiro, Campus Universitario de Santiago, 3810-193 Aveiro, Portugal
2. VITO NV, Flemish Institute for Research and Technology, Boeretang 200, 2400 Mol, Belgium

⋆ Corresponding author; diogo.nascimento@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Cities are facing increasingly more complex environmental problems. Extreme weather events are becoming more severe and common. On the other hand, Europe's primary environmental health concern is air pollution, which significantly impacts urban populations. Approximately 96% of individuals in the European Union's urban centers were exposed to levels of fine particulate matter exceeding World Health Organization health guidelines (EEA, 2022).

In this context, Nature-based Solutions (NBS) are essential for enhancing air quality and mitigating the effects of extreme weather events in cities. Their effectiveness can be significantly improved if we have tools to assess their implementation and provide insight into making the best strategic planning (Guo et al., 2023; Rodrigues et al., 2018, 2024).
The literature lacks a comprehensive high-resolution model that can evaluate the urban atmosphere while considering complex urban structures, detailed surface properties, differentiated radiation heat exchange, and unsteady state simulations with local unstable atmospheric conditions (Mirzaei, 2021; Nascimento, 2022).
This work aims to enhance urban air quality and thermal patterns by developing code libraries to accurately model the interactions of NBS with the urban atmosphere. The developed code will be implemented into a Computational Fluid Dynamics model, OpenFOAM, which will be used to numerically model with high-resolution the local influence of NBS on microclimate and fine particle dispersion.
The final purpose of this work is to advance the scientific community's knowledge, provide a tool to model NBS behaviour in the urban atmosphere and support decision-makers in urban planning policies. This will help create cities that prioritize clean air and promote better health outcomes for residents.
This research is also in line with the United Nations' Sustainable Development Goals (SDG) by aiming to improve urban air quality, enhance the urban environment, and mitigate the effects of extreme weather events by optimizing urban thermal patterns, thereby addressing SDG 3 (Good Health and Well-being), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action).

Keywords: *Urban Atmosphere; CFD modelling; Fine Particulate Matter; Urban Microclimate;*

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Monitoring, Modelling, and Forecasting Air Quality in Cape Verde Using Low-Cost Sensors and Machine Learning

Anedito Zico Mendes de Carvalho da Costa[†,1], Myriam Lopes[⋆,2], José Aniceto[3]

1. PhD Program in Chemical Engineering
2. Department of Environment and Planning
3. Chemistry

⋆ Corresponding author; myl@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Monitoring air quality is of vital importance in urban and insular contexts, such as Cabo Verde, where environmental variations significantly impact public health and local ecosystems(Graça et al., 2023)(Freire et al., 2020). Recognizing this importance, low-cost sensors have been implemented in Cabo Verde for the continuous collection of data on atmospheric pollutants, this doctoral project focuses on analysing the collected data, using advanced statistical techniques to refine their quality, understand pollution patterns, and to develop precise predictive air quality models.

Using a rigorous methodological approach, this study applies sophisticated statistical methods to process and validate the collected data, reducing noise and inconsistencies and increasing the reliability of the information obtained(Nguyen et al., 2019). Statistical techniques such as time series analysis and regression models are applied to identify trends, seasonal patterns, and correlations between different air quality indicators. This in-depth analysis not only enhances understanding of current conditions but also facilitates the development of machine learning models that more accurately predict future air quality conditions

The expected results of the project include a significant improvement in the accuracy of air quality monitoring data in Cabo Verde, providing a robust database for further research and local authorities public policy. Moreover, the developed forecasting models will allow local authorities and the population to anticipate air pollution episodes, to alert the population, and to facilitate the adoption of more effective preventive and mitigation measures.

Keywords: *Air quality, Low-cost sensors, Machine learning, Cabo Verde*

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Tratamento anaeróbio como forma de valorização dos resíduos gerados pelo setor do Vinho Verde

Bruno Escobar†,⋆,1, Maria Helena Nadais1, Flávio Silva1

1. Centro de Estudos do Ambiente e do Mar, Departamento de Ambiente e Ordenamento

⋆ Corresponding author; bruno.p.escobar@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Atualmente, o setor vinícola se destaca pelo seu notável crescimento devido ao aumento do interesse e á globalização do mercado de vinhos. Em Portugal, as projeções indicam uma produção de 7,5 milhões de hectolitros de vinho, um aumento de 10% quando comparado à campanha realizada em 2022/2023 [1]. Esta expansão, implica também no significativo aumento na geração de resíduos sólidos e líquidos, os quais requerem tratamentos adequados antes do seu descarte, algo que representa um desafio para os produtores. Embora tenham sido propostas algumas formas de tratamento e valoração destes resíduos, muitos destes se baseiam em métodos complexos ou restritivos [2], podendo necessitar de grandes quantidades de ácidos ou solventes, além de uma infraestrutura dedicada para estes sistemas, algo dificilmente escalável para a realidade de pequenos e médios produtores, que é o caso para o setor do Vinho Verde. As restantes formas de valorização, apesar de práticas, não são ideais do ponto de vista de eficiência económica e ambiental, sendo a principal delas a queima dos resíduos [2]. Uma alternativa promissora é a digestão anaeróbia, um processo que pode ser adaptado a diferentes e específicas necessidades de cada produtor. Visando explorar o potencial desta temática, este estudo busca determinar se o tratamento por digestão anaeróbia é uma alternativa viável e eficiente para o tratamento de tais resíduos. Tal processo pode ser melhorado através da divisão do tratamento em duas fases [3], possibilitando condições controladas de pH, temperatura e microaeração, proporcionado um ambiente favorável para a decomposição da matéria vegetal [4,5]. Os produtos desse tratamento podem ter potencial agronômico os quais podem ser reaproveitados na viticultura, além de gerar energia que pode ser transformada em calor, fechando assim o ciclo da economia circular e contribuindo para a sustentabilidade do setor do Vinho Verde em Portugal.

Keywords: *Resíduos Vinho Verde, Digestão anaeróbia, Dois estágios, Micro aeração, Valorização*

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Biochar enhanced soil water storage and reduced runoff and erosion of vineyard soil

Behrouz Gholamahmadi[†,⋆,1], Carla Ferreira[2], Oscar Gonzalez Pelayo[3], Bruna Oliveira[3], Ana Catarina Bastos[3], Frank Verheijen[3]

1. Centre for Environmental and Marine Studies (CESAM), Department of Environment and Planning, University of Aveiro
2. Polytechnic Institute of Coimbra, Applied Research Institute
3. Centre for Environmental and Marine Studies (CESAM), University of Aveiro

⋆ Corresponding author; † Presenting author; Environmental sciences and engineering.

Abstract.
Land degradation in Portuguese vineyards is a significant challenge due to the region's hilly terrain and heavy rainfall events, causing soil erosion. To evaluate if biochar amendment can increase infiltration and reduce erosion, we conducted an 18-month box lysimeter experiment with soil from a vineyard during 28 rainfall events near Coimbra, Portugal. Three box lysimeters were installed with vineyard soil only (sandy loam) and another three were installed with biochar-amended soil (4% by weight). Each lysimeter box was equipped with one volumetric soil moisture-content probe (Decagon 5TE).
On average, biochar application enhanced the soil sponge function by 73%, significantly reduced both runoff ($p<0.05$) and runoff coefficient ($p<0.001$) by 44% and 45% respectively and reduced total soil loss (e.g. including fine-earth and coarse fragments) by 55%. Biochar effect size was statistically significant ($p<0.05$) to increasing stored water during 11 events by 135%, ranging from 60% to 303%, reducing runoff during 12 events by 58%, ranging from 35% to 83%, and reducing total soil loss during 10 events by 64% ranging from 46% to 77%.
Biochar application reduced soil bulk density by 7%, and reduced erosion of the fine-earth fraction and coarse soil particles, in part by reducing splash erosion. Moreover, the biochar-treated soil demonstrated enhanced moisture retention, maintaining elevated soil moisture levels during dry periods. These findings underscore the potential of biochar as a sustainable and environmentally friendly solution to address the land degradation challenges of vineyards in Portugal.

Keywords: *Biochar, Soil hydrology, Soil mechanism, Soil sponge function, Desertification.*

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Gholamahmadi, B. et al., (2024). Biochar enhanced soil water storage and reduced runoff and erosion of vineyard soil. To be submitted in Geoderma Journal.

Acknowledgements. We acknowledge the financial support of CESAM by the Portuguese Foundation for Science and Technology FCT/MCTES (UIDP/50017/2020+UIDB/50017/2020+ LA/P/0094/2020), through national funds. We further acknowledge the FCT for the funding of project SOILCOMBAT (https://doi.org/10.54499/PTDC/EAM-AMB/0474/2020) as well as of authors B. Gholamahmadi (https://doi.org/10.54499/2020.04610.BD), and F. Verheijen (https://doi.org/10.54499/CEECIND/02509/2018/CP1559/CT0004). A.C. Bastos was funded by national funds (OE), through FCT in the scope of the framework contract foreseen in art. 23ž DL57/2016 (numbers 4, 5, 6) of August 2929th August, amended by Law 57/2017 of July 1919th July. We wish to thank J.J. Keizer for connecting the Aveiro and Coimbra research groups, Luis Pato for donating soil, ESAC for research time on their lysimeters and ERASMUS+ students Gemma Nieuwenhout and Niek Schasfoort for fieldwork.

Particulate matter in an African megacity: exploring the links between composition, inhalation bioaccessibility and cytotoxicity

Marlene Soares[†,⋆,1], Célia Alves[1], Helena Oliveira [1]

1. University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; marlene98@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Particulate matter (PM) pollution is a threat to public health. PM10 and PM2.5 are classified as carcinogen by the International Agency for Research on Cancer [1]. As shown by satellite data, big cities in developing countries, like Luanda, are among the most polluted [2]. This Ph.D. research focuses on evaluating the PM exposure effects in Luanda, characterizing the PM composition, inhalation bioaccessibility and cytotoxicity using in vitro studies. PM is inhaled and can reach the alveoli and enter the bloodstream. Many particle-bound constituents, such as transition metals and aromatic organic compounds, boost inflammation of the respiratory system, leading to numerous illnesses [3]. Three cell lines will be used to assess in vitro toxicity, A549, RAW264.7 and BEAS-2B. Cell viability, ROS production, cell cycle alterations, phagocytosis capacity, and cytokine levels alterations after exposure will be assessed. The research will develop beyond traditional two-dimensional (2D) cell cultures by applying three-dimensional (3D) cell culturing techniques that simulate closely in vivo conditions. Additionally, simulated lung fluids will be used to extract the bioaccessible fraction of PM using physiologically based assays. Harmful substances attached to PM are expected to affect the three cell lines in different ways. The impact on cell viability, interruption of the cell cycle, and increased production of ROS will depend on the toxicity of PM-bound pollutants, concentration, and duration of exposure. Bioaccessibility will depend on PM chemical composition and physical characteristics that influence how PM substances can be absorbed into the body upon reaching the respiratory system. The findings will contribute to a better comprehension of PM pollution effects in Luanda, focusing on the risks to respiratory health. By establishing links between PM composition, bioaccessibility, and cytotoxicity, this study can provide information to mitigate the impact of PM pollution on respiratory health.

Keywords: *Luanda air quality, particulate matter, bioaccessibility, in vitro cytotoxicity, lung cell lines*

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Acknowledgements. An acknowledgment is given to the Portuguese Foundation for Science and Technology (FCT) for funding the PhD grant 2020.04826.BD. This work was supported by the project APAM - Air Pollution in an African Megacity: Source Apportionment and Health Implications (2022.04240.PTDC), financially supported by national funds (OE), through FCT/MCTES (DOI: 10.54499/2022.04240.PTDC). The financial support to CESAM by FCT/MCTES (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020), through national funds, is acknowledged. With cooperation from the University of Aveiro (CESAM - Centre for Environmental and Marine Studies and DAO (Department of Environment and Planning) and Agostinho Neto University in Luanda.

Life cycle sustainability assessment of diets for animal feeding

Sara Silva[†,⋆,1], Paula Quinteiro[1]

1. Centre for Environmental and Marine Studies (CESAM), Department of Environment and Planning

⋆ Corresponding author; † Presenting author; Environmental sciences and engineering.

Abstract. The increasing demand for livestock products worldwide has pressured the agri-food sector to search for sustainable and innovative feed options [1,2]. Insects, due to their abundant presence on the planet, are recognized as a viable alternative source of feedstock [3]. Specifically, research has focused on the protein and oil derived from the Black Soldier Fly (BSF) as a substitute for conventional feedstock in animal feed production [3,4]. This shift towards using insects as a nutritional resource aims to promote sustainability, circularity, and locally sourced animal feed production, thereby facilitating the creation of new feed product lines. The extension of the circular economy will contribute to significantly accelerating progress towards achieving climate neutrality and the Sustainable Development Goals (SDGs) by 2030 (SDG12- Responsible Consumption and Production, SDG13- Climate Action).The mobilizing agenda InsectERA (Recovery and Resilience Plan), aims to create a new bio-industrial sector in Portugal using insects as a tool for the bioconversion of by-products into value-added products. In this scope, this project aims to ensure the environmental, social, and socioeconomic sustainability of the new diets for animal feed, covering the full supply chain, from the valorisation of olive pomace, using BSF as bio converters of protein and oil to the production of high-quality diets. For this purpose, a Life Cycle Sustainability Assessment (LCSA) constitutes the appropriate methodology for jointly handling indicators related to the three dimensions of the sustainability concept. However, a consistent LCSA methodology with robust and comprehensive guidelines ensures results reproducibility and a state of comprehensive environmental, social, and socioeconomic indicators over the animal compound feed supply chain. Thus, the goal of this research proposal is to develop an LCSA methodology to assess the sustainability of several BSF-based diets and compare them with those currently on the market, giving insights into decision-making, policy recommendations, and user acceptance.

Keywords: *Life cycle thinking; sustainability assessment; agri-food by products; insect-based diets; circular economy*

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Acknowledgements. The authors would like to acknowledge the Portuguese Foundation for Science and Technology (FCT)/MCTES for the financial support to CESAM (UIDP/50017/2020+UIDB/50017/2020 + LA/P/0094/2020), through national funds. Paula Quinteiro also the research contract CEECIND/00143/ 2017, doi:10.54499/CEE CIND/00143/2017/CP1459/CT0003. This study was funded by the PRR - Recovery and Resilience Plan and by the NextGenerationEU funds at Universidade de Aveiro, through the scope of the Agenda for Business Innovation InsectERA (Project no. 20 with the application C644917393-00000032).

Air pollution in an African megacity: source apportionment and health implications

Alan Victor da Silva[†,⋆,1], Célia dos Anjos Alves[1], Manuel Joaquim Sabença Feliciano[2]

1. Department of Environment and Planning, CESAM Centre for Environmental and Marine Studies, University of Aveiro, 3810-193 AVEIRO, Portugal
2. Higher Agricultural School, CIMO Mountain Research Center, Polytechnic University of Bragança, 5300-253 BRAGANÇA, Portugal

⋆ Corresponding author; alanvisi@gmail.com; † Presenting author; Environmental sciences and engineering.

Abstract. Air pollution is a critical concern in many megacities worldwide due to it is a significant threat to public health and the environment. The concern maybe event worst in regions with a lack of air quality monitoring, such as African countries (Simwela et al., 2018). According to UNEP data from 2019, in Angola, every individual was exposed to levels of fine particles 5.6 times higher than WHO guidelines, resulting in 18 deaths per 100,000 people attributable to fine particle pollution, and contributing to 6% of neonatal disorders (United Nations Environment Programme, n.d.). Therefore, this PhD research aims to investigate the sources of air pollution in Luanda, evaluate its health implications and propose source-oriented cost-effective control strategies. To achieve this, the following tasks will be conducted: (i) a passive monitoring of air quality for assessment of the spatial distribution of air pollution; (ii) a long-term monitoring campaign for temporal analysis of gaseous and particulate pollutants, and for evaluating a low-cost device against reference methods, as a cheaper solution for a monitoring network; (iii) chemical and toxicological analyses of particulate matter; and (iv) air quality evaluation and source apportionment by the Positive Matrix Factorization model, HYSPLIT and The Redistributed Concentration Field method. Additionally, a health risk assessment and modeling of exposure doses will be carried out to determine the potential impact on human health (Alves et al., 2021). Findings of this research are expected to contribute valuable insights on the specific sources of air pollution in the African megacity, enabling the development and implementation of effective air pollution policies and strategies to improve public health. The research's comprehensive methodology, which combines cutting-edge analytical techniques, health risk assessment and communication tactics, will provide long-term solutions to air pollution problems in the Angolan megacity and could raise the standard of living of its citizens.

Keywords: *Luanda, Gaseous pollutants, Particulate matter, Low-cost sensors, Health impacts, Policy making.*

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Acknowledgements. This work was supported by the Portuguese Foundation for Science and Technology (FCT) through the PhD fellowships 2023.02059.BD. The research was performed in the frame of the project APAM, financially supported by national funds (OE), through FCT/MCTES (DOI: 10.54499/2022.04240.PTDC). The financial support to CESAM by FCT/MCTES (UIDP/50017/2020 + UIDB/50017/2020 + LA/P/0094/2020), through national funds, is also acknowledged.

Chemical profile of PM10 from urban road dust resuspension in Bragança, Portugal

Yago Cipoli[†,⋆,1], Manuel Feliciano[1], Célia Alves[1]

1.

⋆ Corresponding author; yagocipoli@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. Air pollution in cities plays an important deleterious impact on morbidity and mortality of their population [1]. Among the most targeted pollutants, particulate matter with aerodynamic diameter below 10 m (PM10) has been widely related to serious health outcomes. Traffic-related emissions are often pointed out as the main source of PM and responsible for most of the exceedances of PM10 in European cities. Despite the significant reductions of tailpipe emissions worldwide [2], cities in Europe have not experienced the expected drop in PM10 concentrations, a fact that is attributed to non-exhaust emissions (e.g., tyre wear, brake wear and road dust resuspension) [3]. The lack of emission factors and chemical profiles can compromise the application of emission inventories, air quality models and the accurate assessment of health risks. With the aim of characterising the PM10 fraction, a mobile resuspension chamber with a gravimetric sampler (Echo Tecora, Italy) was used to collect road dust from eleven roads in Bragança. Monitoring was conducted only on sunny days and dry roads. At each sampling site, at least 3 replicate samples were collected (covering an area of 2 m Œ 3 m) on the right side of one of the lanes. The PM10 samples were analysed for organic and elemental carbon (OC and EC) by a thermo-optical technique and elemental composition by ICP-MS and ICP-OES. Dust loadings of 0.34 ś 0.28 mg PM10 m-2 were obtained for urban roads. A higher mean value was achieved inside the tunnel in the city centre (1.03 mg PM10 m-2). The emission factors ranged from 2.16 to 10.2 mg km-1 veh-1 and from 3.25 to 6.53 mg km-1 veh-1 for the periurban and urban areas, respectively. The most abundant elements in their oxidesed form were Ca (7%), Al (6.5%), Fe (5%), Mg (3.6%) and S (2.45%). Irrespective of the sample, high enrichment factors (EF) were estimated for Cu and Zn. In addition, other traffic-related elements, such as P, S, Cr, Sn and Pb, also presented significant enrichments (EF >10). Moreover, a periurban road without strong influence of traffic exhibited extremely high enrichments for Co (50), S (406) and P (698), suggesting the use of pesticides on surrounding areas. Total carbon (TC) represented a PM10 mass fractions of 8-30%, while metal oxides accounted for 8-73%. The results obtained for Bragança denote low concentrations of PM10-bound elements when compared with other studies carried out in Portugal, such as Porto, Aveiro, and Lisbon.

Keywords: *Road Dust Ressuspension; Emission Factors; Elements; Chemical Profiles; Enrichment Factor.*

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Schoolchildren exposure to particulate matter in different seasons: comparison of two do-simetry models (MPPD vs ExDoM2)

Isabella Charres[†,⋆,1], Manuel Feliciano[2], Celia Alves[1]

1. Centre for Environmental and Marine Studies (CESAM), Department of Environment, University of Aveiro, 3810-193 Avei-ro, Portugal
2. Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, 5300-253, Bragança, Portugal c Laboratório Associado para a Sustentabilidade e Tecnologia em Regiões de Montanha (SusTEC), Instituto Politécnico de Bragança, 5300-253, Bragança, Portugal

⋆ Corresponding author; isabellacharres@ua.pt; † Presenting author; Environmental sciences and engineering.

Abstract. The school environment has a relevant importance in the health, learning and psychosocial development of pupils, since at school age, children spend a considerable part of their time in educational environments [1]. Studies conducted in Portuguese schools have investigated potential sources of particulate matter (PM) in classrooms [2], the relationship between allergy symptoms and indoor air quality [1] and dose assessment of PM [3], but only a few aimed to calculate PM deposition among children and how size segregated PM is de-posited in regions of the respiratory system. As deposition fractions (DF) and doses (DD) may vary from sea-son to season and there are very few studies on the DD of PM while children attend classes, this study investigated the hourly and seasonal variations in the deposition of total and regional fractions and doses of PM1, PM2.5 and PM10 in the childrens respiratory system using two dosimetry models. The exposure to PM of children aged 312 years in a school near an industrial complex in Portugal was estimated. PM10, PM2.5, and PM1 were measured over two seasons in classrooms representing different school year groups. Particle deposition in the respiratory tract, as well as the DD of PM was calculated using MPPD and ExDoM2, assuming an 8-hour exposure scenario to represent the school day. Differences in PM concentrations were observed in response to room occupancy periods and season. The highest average PM2.5 concentration was recorded in winter when the classroom was not occupied (23.7 ś 20.5 g m-3), while the highest average PM10 was observed in spring during school hours (61.7 ś 24.2 g m-3). With MPPD, a 3-year-old child has a lower mean DD per hour com-pared to children aged 8 and 9 years for the three PM sizes evaluated in both seasons, while with ExDoM2, the lowest values were observed in children aged 10 years. The highest deposition of PM10 and PM2.5 was in the upper region while the lowest was in the tracheobronchial region. Furthermore, the variations observed be-tween the models are the result of the difference of the lung physiological values used as input parameters. In general, good agreement was obtained between both models, although some differences, especially for region-al deposition, could be observed.

Keywords: *Indoor air quality; Schoolchildren; PM; Dose; Dosimetry models.*

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Acknowledgements. The authors sincerely thank FCT/MCTES for funding CESAM (UIDP/50017/2020 + UIDB/50017/2020 + LA/P/0094/2020) from through national funds, and co-funding by FEDER, within the PT2020 Partnership Agreement and Compete 2020, SusTEC (LA/P/0007/2020) and CIMO (UIDB/00690/2020). The authors acknowledge the financial support of

FCT for the scholarship I. Charres (SFRH/BD/2022.12142). The authors would like to extend their gratitude to staff, teachers, and pupils for their help with this study. This work was performed within the STEP project - Schools Tackling Estarrejas Air Pollution funded by the LabEx-DRIIHM-OHM programme (CNRS INEE, France).

Food science and technology and nutricion

Valorisation of Lycium spp through the production of high-value food products

Mariana Monteiro[†,1], Dulcineia F. Wessel[2], Artur M. S. Silva[1], Susana M. Cardoso[1]

1. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. CERNAS-IPV Research centre, Polytechnic University of Viseu, Campus Politécnico, Repeses, 3504-510 Viseu, Portugal

⋆ Corresponding author; † Presenting author; Food science and technology and nutricion.

Abstract. Lycium barbarum L. and Lycium chinense Mill. are two species commonly referred as goji. Gogi berries and leaves are being used as functional ingredients in foods and beverage products, due to their valuable nutrient and phytochemical content, including polysaccharides, phenolic compounds, carotenoids, vitamins, and minerals. Research has demonstrated the biological properties of these compounds, such as antioxidant, immunomodulating, hypoglycemic, hypolipidemic, anti-aging, neuroprotective, and cardioprotective effects [1,2,3].
Goji cultivation is widespread globally, with Portuguese producers emphasizing organic cultivation and the sale of fresh fruit to differentiate their products from the predominantly conventionally cultivated and dried fruits sold in the Chinese market. This highlights the need for innovative applications in goji-derived products [4].
This work is outlined to settle the profile of valuable nutrients and phytochemicals of L. barbarum L. and L. chinense Mill. cultivated under organic regime in Portugal by Sanaberry company, and to valorize plant products of low commercial value, namely small calibre berries, leaves and pruning wastes, as new ingredients for functional foods. Such applications will be supported by scientific knowledge regarding the gains on the phytochemical values, as well as on the bioavailability and bio-efficacy of innovative food ingredients.
To establish the nutritional and phytochemical profiles, the berries, leaves and pruning biowaste from the two plant species were submitted to extractions with solvents of distinct polarities. Moreover, moisture, yield of extraction, total sugars, sugar profile, carotenoid profile, total phenolic content and antioxidant activity were analysed through extracts.
L. barbarum L. and L. chinense Mill. berries will be used as ingredient in new formulations for sorbets. The nutritional and phytochemical value of the sorbets will be assessed. Additionally, the content of target compounds, oxidative stability, melting point, pH, texture, colour, and sensory analysis of the new formulated foods will be evaluated through standard methods. Furthermore, the leaves are being explored for their potential to serve as health-promoting infusions whereas pruning wastes are intended to be screened for their potential to be used as food ingredients.

Keywords: *Goji berries, phytochemicals, functional foods, food formulation, sorbet*

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Acknowledgements. Funding: LAQV-REQUIMTE (UIDP/50006/2020, http://doi.org/10.54499/UIDP/50006/2020) received financial support from PT national funds, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior (FCT/MCTES). Acknowledgements: Thanks are due to the University of Aveiro, and to FCT/ MCTES for the financial support to LAQV-, through national funds, and the co-funding by the FEDER, within the PT2020 Partnership Agreement and Compete 2020. Susana M.Cardoso thanks FCT/MCTES for the labour contract under the Scientific Employment Stimulus Institutional Call. Mariana Monteiro thanks FCT for funding through PhD grant Ref. 2021.08740.BD.

Development of functional ingredients based on mushroom -glucans: Elucidation of hypocholesterolemic mechanisms.

Maria Inês Arranca[†,⋆,1], Filipe Coreta Gomes[2], Manuel A. Coimbra[3], Elisabete Coelho[4]

1. LAQV-REQUIMTE, Chemistry Department, University of Aveiro, 3810-193 Aveiro, Portugal
2. LAQV-REQUIMTE, Chemistry Department, University of Aveiro, 3810-193, Aveiro, Portugal
3. LAQV-REQUIMTE Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
4. LAQV-REQUIMTE - Department of Chemistry, University of Aveiro

⋆ Corresponding author; inesarranca@ua.pt; † Presenting author; Food science and technology and nutricion.

Abstract. Cardiovascular diseases are responsible for high mortality and morbidity indexes with consequences for health, society, and economy(Shapiro & Fazio, 2016), mostly caused by deregulation on cholesterol blood levels. These highlight the importance of prevention strategies to regulate cholesterol levels namely using functional food ingredients.
-glucans from oat and barley are accepted by EFSA with the health claim "maintenance of normal blood cholesterol levels"contributing for the prevention of cardiovascular diseases when consumed 3g per day(EFSA, 2009). There are other sources of -glucans prevalent in the human diet, like mushrooms, that demonstrated hypocholesterolemic potential(Silva et al., 2021). However, the mechanism and structure-function relationship for the large structural diversity of -glucans from mushrooms(Karácsonyi & Kuniak, 1994; Li et al., 2014) isnt elucidated. In this work, evaluation of the effect of -glucans with different chemical structures on cholesterol bioaccessibility will be performed using a simplified in vitro intestinal model.
The polysaccharide extraction and characterization of ethanolic, aqueous and alkaline extracts of cultivated Ganoderma lucidum resulted in a low yield of soluble (6-7%) and high yield of insoluble (54%) polysaccharides. The extracts and residue are rich in sugars (37-100%), the composition of polysaccharides showed that glucose is the most abundant sugar in all samples (68-95%). The purest fraction (100% carbohydrates; 94% glucose) was extracted with 1M KOH and precipitated under dialysis. Even it yielded only 0.56% of initial mushroom, was a homopolymer of (13)-glucose. The insoluble residue of 4M KOH yielded 54% of initial mushroom, its composed by 91% carbohydrates. This residue is also constituted by a linear (13)-glucan, however, its insolubility could be explained due to the presence of (14)-linked GlcNAc (5%), resulting in chitin-glucan complex. To solubilize fractions, enzymatic treatment with zymoliase allowed to recover 4.5-6.2% of (13)-linked polysaccharides (1.7-2.4%) and oligosaccharides (2.7-4.5%). The solubilized fractions will be tested for hypocholesterolemic potential.

Keywords: *Mushroom, -glucans, Hypocholesterolemic effect, Functional ingredients, Structure-function relationship.*

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Acknowledgements. The authors thanks to the project Safe2Taste (MTS/BRB/0056/2020 DOI 10.54499/MTS/BRB/0056/2020). Maria Inês Arranca thanks to the project Safe2Taste for her grant ref. MTS/BRB/0056/2020. Elisabete Coelho thanks Portuguese national funds (OE), through FCT, I.P., in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of the article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19 (CDL-CTTRI-88-ARH/2018 - REF. 049-88-ARH/2018). Filipe Coreta-Gomes acknowledge the research contract funding due to LAQV-REQUIMTE (UIDB/50006/2020 DOI 10.54499/UIDB/50006/2020) project.
Funding: This work was financially supported by Safe2Taste (MTS/BRB/0056/2020), funded by FCT/MCTES through national funds and, where applicable, co-financed by the FEDER, within the PT2020 Partnership Agreement and Compete 2020. The authors also acknowledge the funding through LAQV/REQUIMTE (LA/P/0008/2020 DOI 10.54499/LA/P/0008/2020, UIDP/50006/2020 DOI 10.54499/UIDP/50006/2020, and UIDB/50006/2020 DOI 10.54499/UIDB/50006/2020).

Development of innovative and sustainable low-alcoholic grape-based beverage: strategies to select potential ethanol replacers

Sónia G. Ribeiro[†,⋆,1], Ben Montpetit[2], Sílvia M. Rocha[1]

1. LAQV-REQUIMTE Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. University of California, Davis, One Shields Avenue, Davis, CA 95616, United States of America

⋆ Corresponding author; srgr@ua.pt; † Presenting author; Food science and technology and nutricion.

Abstract. Currently, it has been verified that the international market, especially the young adults, has a great desire for the consumption of drinks with low ethanol content (< 5%). However, market offers do not meet demand, especially regarding the quality of grape-based products available and the level of sustainability of the industrial strategies. According to international code 18/73 of oenological practices, wine is the beverage resulting exclusively from the partial or complete alcoholic fermentation of fresh grapes, whether crushed or not, or of grape must and its alcohol content cannot be less than 8.5% vol. (OIV, 2024). Thus, the production of total or partial dealcoholized wine has major drawbacks, with the major ones being the high energy consumption for wine dealcoholisation steps. Also, the loss or modification of compounds of interest for sensorial characteristics of the product, may also occur, which may explain the reduced quality of products on the market. Furthermore, total or partially dealcoholized wines do not respond to the aforementioned market trends. Thus, this study aims to develop an innovative and sustainable grape-based fermented beverage, with an ethanol content < 5%. A holistic strategy was developed, and the first step comprises the selection of potential ethanol replacers, based on the use of AI supported by the understanding of the effects of the ethanol on the physical-chemical properties of wine, as well as on the human perception and behaviour.

Keywords: *Ethanol, Grape-based fermented beverage, Wine, Physical-chemical properties*

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Acknowledgements. This work received financial support from PT national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) through the project Laboratório Associado para a Química Verde - Tecnologias e Processos Limpos [10.54499/LA/P/0008/2020, 10.54499/UIDP/50006/2020 & 10.54499/UIDB/50006/2020] financed by national funds through the FCT/MCTES (PID-DAC). Sónia G. Ribeiro thanks FCT (Fundação para a Ciência e Tecnologia) and ESF (European Social Fund) through POCH (Programa Operacional Capital Humano) for her PhD grant [UI/BD/154542/2022].

Geosciences

An automated method for estimating ocean wave heights from video images

Tochukwu Ngene[†,⋆,1], Tiago Abreu [1], Paulo A. Silva [1], Paulo Baptista [1]

1. CESAM

⋆ Corresponding author; † Presenting author; Geosciences.

Abstract. Ocean waves have the potential to be a major source of sustainable energy. However, harnessing this energy effectively faces significant challenges, including limited data availability and the high costs associated with deploying monitoring infrastructure in coastal areas. This study proposes a cost-effective solution using remote sensing technology.
In this study, a methodology for estimating ocean wave heights using image data collected from an Unmanned Aerial Vehicle (UAV) was developed, with Figueira da Foz serving as the case study. The proposed approach automates the extraction and estimation of wave characteristics through computer vision techniques (Ngene et al., 2024). The estimated wave heights were validated against measurements from an Acoustic Doppler Current Profiler (ADCP) deployed in the study area concurrent with the UAV survey.Analyzing individual wave measurements across different devices can lead to errors, primarily due to inconsistencies in measurement scaling unless the devices are synchronized. Wave statistics, such as significant wave heights (Hs), provide a more comprehensive representation of the overall sea state and are preferred for ocean wave parameterization (Mitchell, 1983). Consequently, the Hs of the four largest features in each frame were computed. The average estimated Hs was 0.64m, closely matching the ADCP-measured Hs of 0.63m. This close agreement demonstrates the methods potential for accurate wave predictions, which are essential for potential energy generation applications in areas such as port harbors. Future research will aim to extend this methodology to diverse environmental conditions in various nearshore zones to ensure its robustness and reliability.

Keywords: *Optical Images, Photogrammetry, Ocean Wave Parametrization, Image Segmentation*

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Acknowledgements. Thanks to FCT/MCTES for the financial support to CESAM, (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020), through national funds. Content produced within the scope of the Agenda NEXUS - Pacto de Inovação Transição Verde e Digital para Transportes, Logística e Mobilidade, financed by the Portuguese Recovery and Resilience Plan (PRR), with no. C645112083-00000059 (investment project no. 53).

Gerontology and geriatrics

Validity and Reliability of the OARS Multidimensional Functional Assessment Questionnaire in Angolan Elderly People Cognitive and functional domains Section 01

Rita Barbara[†,1], Mario Lopes[1]

1. Universidade de Aveiro

⋆ Corresponding author; † Presenting author; Gerontology and geriatrics.

Abstract. Introduction:The aging population poses unique challenges to healthcare systems worldwide. Understanding the functional and cognitive aspects of elderly individuals is crucial for providing tailored care and support.Objective: The objective of this research was the translation and cross-cultural adaptation of the OARS Multidimensional Functional Assessment Questionnaire for older adults people in Angola, focusing on the cognitive and functional domains. Methods: The instrument underwent a complete linguistic translation process, following the guidelines of Beaton et al. (2000), A sample composed of 102 elderly people living in Luanda. A committee of experts evaluated the validity of the instrument, reaching a consensus on its suitability for assessing the domains of cognition and functionality. Results: The internal consistency of each domain was assessed separately using Cronbach's alpha coefficient. For the physical activity domain, strong internal consistency was obtained, with a Cronbach's alpha coefficient of 0.80 (95% CI: 0.72 - 0.85). However, for the mental health domain, internal consistency was moderate, with a Cronbach's alpha coefficient of 0.59 (95% CI: 0.45 - 0.70). Conclusion: These results indicate a reliable assessment of physical activity and a moderate assessment of mental health in this specific context.

Keywords: *Validation, Elderly, Functionality, Cognitive*

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Navigating change: perspectives on peer education and institutional practices in lifelong learning

Giuliana Casanova [†,⋆,1], Joyce Weil [2], Margarida Cerqueira [3]

1. Center for Health Technology and Services Research (CINTESIS@RISE), Departement of Education and Psychology, University of Aveiro, Aveiro Portugal, Institute of Biomedical Sciences Abel Salazar, University of Porto, Porto, Portugal
2. Department of Health Sciences, Towson University, Maryland, USA
3. Center for Health Technology and Services Research (CINTESIS@RISE), School of Health Sciences, University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; gcasanova@ua.pt; † Presenting author; Gerontology and geriatrics.

Abstract. ABSTRACT
The concept of productive aging, as outlined by Butler and Gleason (1985) highlights individuals' ability to maintain independence while contributing to their families or communities through various activities, whether paid or unpaid. These activities can be described as volunteering, caregiving, and full or part-time work, among others (O'Reilly & Caro, 1995). More recent researchers have focused on the impact of engaging in productive activities on the well-being of older adults and the impact this engagement can have on society and social capital (Morrow-Howell & Wang, 2013; Gonzales et al., 2015; Schulte et al., 2018). This research project centers on the experiences of older adults as peer educators in institutions of lifelong learning in the United States and Portugal and how their involvement in this productive activity has impacted their aging process and the institutions they work for.
Through interviews with 17 participants, a notable theme emerged: the profound impact of the COVID-19 pandemic on their roles and experiences. The research examines the effects of Covid-19 on classes, students, and institutions. Key themes include integrating new technology, shifts in student attendance and enrollment, and insights into the resilience demonstrated by educators and students despite educational disruptions. We also conducted interviews with 10 administrators from lifelong learning institutions and universities of the third age in both the United States and Portugal. It provides insights into prevailing practices regarding the recruitment and retention of older adult educators. Preliminary findings reveal a lack of formal retention programs and reliance on personal commitment among educators. Recruitment strategies primarily rely on word-of-mouth without official marketing efforts.
This research contributes to the understanding of how the Covid-19 pandemic has reshaped the landscape of lifelong learning institutions and the experiences of older adult peer educators within them. Moreover, it illuminates the current state of initiatives aimed at educating the public about opportunities for involvement in peer-education programs and strategic recruitment efforts to enhance the participation of older adults in productive activities. These findings highlight potential areas for policy improvement and the implementation of best practices to enhance the later years of older adultt's lives.

Keywords: *Covid-19, lifelong learning, adult education, engagement, older adults*

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Acknowledgements. This work was supported by the national funds through FCT- Fundação para a Ciência e a Tecnologia, I.P., within CINTESIS AgeingC Cluster (UI/BD/151450/2021) and DOI identifier https://doi.org/10.54499/UI/BD/151450/2021

Gerotranscendence and Well-Being in Institutionalized Older Adults

Taiane Abreu[†,1], Lia Araujo[1], Laetitia Teixeira [1], Oscar Ribeiro[1]

1.

⋆ Corresponding author; † Presenting author; Gerontology and geriatrics.

Abstract. Gerotranscendence is an adaptative theory of aging that postulates a mindset shift in late life about time perception, connection with the universe, ego-integrity, and increased need for solitude. Gerotranscendence has been associated to higher levels of life satisfaction, well-being, and lower levels of depression; how gerotranscendence could be developed and explored, however, remains unclear. The aim of this project is to explore how the gerotranscendence theory can be used as a guiding framework for an intervention program for institutionalized older adults. The review on gerotrasncendence interventionsprovided knowledge about how and if this theory can serve and guide psychosocial group interventions. Findings showed that gerotranscendence can be developed through weekly thematic encounters. The validation of gerotranscendence scales for the Portuguese population is currently undergoing, as well as an additional review of gerotranscendence interventions with staff members and focus groups with older adults to understand their perceptions of gerotranscendence. More recently, the application of the feasibility study was finalized, and currently the application of the gerotranscendence intervention programs on nursing homes and the randomized trial is on curse.

Keywords: *gerotranscendence, interventions, scoping review, transcendence, older adults.*

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Acknowledgements. The author(s) disclosed receipt ofthe following nancial support forthe research, authorship, and/or publication of this article: Thisreview is supported by the National Funds through FCTFundacaopara a Ciencia e a Tecnologia, I.P., within a PhD scholarship(reference UI/BD/151489/2021)

From theory to table: a doctoral journey in dementia mealtime support

Lígia Passos[†,⋆,1], João Tavares[2], Melissa Batchelor[3], Daniela Figueiredo[2]

1. Center for Health Technology and Services Research (CINTESIS@RISE), Departement of Education and Psychology, University of Aveiro, Aveiro Portugal, Institute of Biomedical Sciences Abel Salazar, University of Porto, Porto, Portugal
2. Center for Health Technology and Services Research (CINTESIS@RISE), School of Health Sciences, University of Aveiro, Aveiro, Portugal
3. The George Washington University, School of Nursing. Washington DC, USA

⋆ Corresponding author; ligiamaria@ua.pt; † Presenting author; Gerontology and geriatrics.

Abstract. Mealtime connects individuals, families, societies, and cultures through food to celebrate, socialize and express emotions. People with dementia may face challenges during mealtimes, leading to malnutrition, dehydration, social isolation, and decline in physical and mental well-being. Training programs for staff assisting in mealtime care are inadequately documented and exhibit inconsistent efficacy1.

The research project within the Doctoral Program in Gerontology and Geriatrics aimed to develop, implement, and evaluate an educational intervention to improve mealtime support for institutionalized people with dementia.

A scoping review initiated the research, summarizing existing literature on mealtime interventions for people with dementia living in residential care settings. Thirty-three interventions were grouped into four categories: environmental, mealtime assistance, staff training, and multicomponent. Most studies showed positive outcomes, including improved food intake and reduced agitation and aggression among residents. Furthermore, interventions improved care staff's knowledge and attitudes toward mealtime support needs.

Seventeen direct care workers were interviewed to explore their perceptions, concerns, and challenges related to mealtime support for residents with dementia, and their educational needs to improve performance. Interviews showed a limited understanding of dementia and mealtime issues with many facing daily challenges in caring for people with dementia, especially during mealtimes. Participants expressed a genuine desire to enhance their knowledge and skills to better meet the needs of residents.

These two studies, along with models and specialized training on mealtime support needs2,3 guided the interventiont's development, which was pilot tested in a nursing home involving 16 direct care workers and 9 residents with dementia. Feasibility rates were excellent, and the majority of the direct care workers expressed high satisfaction and recognizing its educational and practical benefits. A significant decrease in a burnout dimension, along with an increase in job satisfaction and knowledge test scores were found.

Finally, the intervention's effects were tested in a cluster-randomized controlled trial involving 51 direct care workers and 35 residents with dementia from 4 nursing homes. Preliminary results showed a significant improvement in the direct care workers experimental group, mainly in levels of knowledge and skills to feed residents, in addition to reducing burnout and increasing job satisfaction. Residents from experimental group also benefited from the intervention, having a better mealtime experience. Control groups outcomes remained similar throughout the study.

This research rigorously addressed dementia care challenges, culminating in a promising intervention for mealtime support. It emphasizes targeted training's significance and broader implementation potential for dementia care improvement.

Keywords: *mealtime support needs, feeding difficulties, dementia, intervention, long-term care; nursing homes*

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Industrial engineering and management

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Portugal's Remarkable Renewable Energy Journey: The Impact of Feed-in Tariffs

Nuno José Gomes Rodrigues da Costa[†,1], João Carlos Oliveira Matias[2]

1.
2. DEGEIT

⋆ Corresponding author; † Presenting author; Industrial engineering and management.

Abstract. Portugal's Remarkable Renewable Energy Journey: The Impact of Feed-in Tariffs
Portugal has witnessed a meteoric rise in renewable energy production, often attributed to the implementation of feed-in tariffs. This paper delves into the effectiveness of the feed-in tariffs as a driver for renewable energy deployment. By analyzing data on renewable energy production capacity and electricity generation mix from 2000 (pre feed-in tariffs) to 2023, a strong correlation emerges between feed-in tariffs implementation and a significant increase in renewable energy production capacity, particularly in wind and solar energy. These findings contribute significantly to the ongoing debate, providing compelling evidence that feed-in tariffs can incentivize renewable energy investment and accelerate capacity expansion, especially in the early stages of development.
However, recognizing the limitations of feed-in tariffs is crucial. Long-term concerns include the sustainability of fixed tariffs as renewable energy technologies mature and production costs decrease. Additionally, feed-in tariffs can introduce administrative complexities and potentially distort market competition. Acknowledging these limitations, Portugal has embarked on a strategic transition towards market-based mechanisms for allocating capacity for new renewable energy projects.

Keywords: *Renewable energy, Feed-in tariffs*

Development of a Simulation Model for a Sustainable Residual Biomass Supply Chain Using AnyLogistix: A Methodological Approach.

Chidozie Bernardine Chigozie[†,1], Ana Luísa Ramos[⋆,1], José Vasconcelos Ferreira[1], Luís Pinto Ferreira[2]

1. GOVCOPP, DEGEIT Universidade de Aveiro, 3810-193 Aveiro, Portugal
2. Associate Laboratory for Energy, Transports and Aerospace (LAETA-INEGI), Rua Dr. Roberto Frias 400, 4200-465 Porto, Portugal.

⋆ Corresponding author; aramos@ua.pt; † Presenting author; Industrial engineering and management.

Abstract. In the quest for environmentally sustainable energy sources, residual biomass has become known as a promising renewable resource. However, achieving sustainability in residual biomass entails complex operations requiring detailed methodical approach to optimize supply chain through simulation models. It still remains a harlequin task. This research aims to shorten this notable gap by presenting a comprehensive methodological framework for designing a simulation model tailored to sustainable supply chains handling agroforestry residual biomass. Utilizing anyLogistix, a multi-method simulation software, we employ hybrid research approach which incorporates process mapping, data-driven analysis, and system dynamics to create an in-depth model of the biomass supply chain network. Key elements such as storage facilities, conversion processes, transportation logistics, and biomass sourcing are modeled and interconnected with an aim to obtain key metrics for the supply chain improvement. The methodology is exemplified and validated through a case study implementation. The result obtained from the simulation experiment establishes a significant relationship between the economic, social, and environmental metrics analyzed and the efficiency of the supply chain. By applying this methodological framework, stakeholders can gain valuable insights into supply chain dynamics, facilitating informed decision-making to enhance the sustainability and efficiency of biomass utilization for energy production. Future work may involve expanding the model to accommodate more variables and realistic scenarios.

Keywords: *AnyLogistix, Residual biomass, Methodology, Simulation, Supply chain, Sustainability.*

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Employee well-being, job satisfaction, and firm performance

ZAHRA AMIRI[†,1], Prof. Dr.João Carlos O. Matias[⋆,1]

1. DEGEI

⋆ Corresponding author; † Presenting author; Industrial engineering and management.

Abstract. In the contemporary and dynamic business environment, companies must navigate complex challenges to manage their operations, create competitive advantages, and maintain sustainability, particularly in the post-COVID-19 era. Developing and implementing strategies that enhance sustainability and optimize performance is critical. Central to this is the active engagement of employees, which involves prioritizing their well-being and ensuring job satisfaction. A supportive and engaging workplace environment enables employees to maximize their potential, contributing positively through heightened engagement and favorable emotions. Conversely, employee dissatisfaction results in higher turnover rates, diminished productivity, and stifled innovation, all of which undermine a company's profitability. Moreover, disengaged employees may exacerbate environmental issues through increased energy consumption and waste generation.

This research aims to address the question: Can employees' well-being influence their job satisfaction, thereby yielding tangible benefits for Triple Bottom Line (TBL) performance? To investigate this, we conducted a comprehensive review of current literature on well-being, job satisfaction, work performance, and sustainability using scientific databases. The findings indicate a robust positive correlation between employee well-being and job satisfaction, alongside with a significant negative correlation with employee turnover. Ultimately, companies that prioritize employee well-being experience higher levels of job satisfaction, leading to enhanced TBL performance.

Keywords: *Employee well-being, job satisfaction, and firm performance*

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Planning and Control of Production Processes in Smart City Kitchens

Hugo Mostardinha[†,1], Ana Moura[2], Pedro Gonçalves[3], Fernão Abreu[4]

1. DEGEIT
2. GOVCOPP
3. ESTGA
4. WishandCook

⋆ Corresponding author; † Presenting author; Industrial engineering and management.

Abstract. Integrated into the smart cities philosophy, we will present an energy optimization plan for a new concept, which will be smart kitchens. These fully autonomous kitchens will benefit cities and integrate with communities by providing personalized meal services tailored to the customer's preferences, schedules, and comprehensive management of resources, consumption, and environmental impact.The management and optimization of the operation of processes required throughout the kitchen, from cooking to supply, ingredient placement, washing, waste management, among others, including the suggestion of systems for using natural energy resources and waste reuse.This work will study a energy optimization that will include real-time information and optimization of over all system. Moreover, the system will also help the company make decisions about the hardware to use, according to the clients demands.To achieve these goals, the WishandCook company's prototype will be used as a live testing laboratory and the following strategy will be followed:Mass sensorization of the system (IoT);Data collection (consumption, times, demand);Schematization of the processes involved in production and mapping of alternatives;Study of alternative and/or renewable energy sources;Estimation of product demand;Production process optimization;Identification of bottlenecks and system congestion;Inclusion of interactive optimization to save energy and avoid waste.The intended results will be a system, implemented in a real prototype, which will monitor and optimize the entire process in real time, leading to precise knowledge of costs and waste, as well as energy and resource savings, resulting in economic profitability and the sustainability of natural resources.

Keywords: *Industry 5.0; Optimization; alternative energy; Solar energy; Wind power; Power system operation and analysis; Smart meters; Load forecasting; Smart meters;*

Acknowledgements. WishandCook and FCT

Human energy reinforcement in Industry 5.0: The design of an agile Toolkit "Human Energy Hot Spot".

Ifeoma Onyemelukwe[†,1], Jose Antonio Vasconcelos Ferreira[⋆,1], Ana Luísa Ramos[1], Inês Cristina Direito[2]

1. GOVCOPP
2. Center for Mechanical Technology and Automation (TEMA),

⋆ Corresponding author; † Presenting author; Industrial engineering and management.

Abstract. Amid recent global events such as social unrest, geopolitical instability, and economic uncertainty, the human energy crisis has intensified, leading to depleted surge capacity and widespread mental and heart health issues due to escalating anxiety and stress levels. In light of the European Union's human-centric approach to Industry 5.0 and the significance of workforce population size in society, the industrial sector can play a pivotal role in addressing this pressing issue. Being a novel concept, adoption and implementation could prove challenging for many organizations, but having the right tools makes it easier to navigate. This study endeavours to design the "Human Energy Hot Spot, an agile toolkit aimed to help identify and manage human energy within the industry, thereby fostering a more resilient and productive workforce, which are also members of society. This toolkit encompasses a variety of strategies, techniques, frameworks, and resource recommendations for industry use to influence employee experience and mitigate the human energy crisis, one industry at a time. This study utilizes a blend of Design Science Research (DSR) and Human-Centered Design (HCD) qualitative methodologies, incorporating expert interviews and questionnaires to develop a toolkit with strategies for mitigating current and impending stress triggers. While DSR methodology focuses on creating innovative artifacts to address real-world problems, HCD places the needs and experiences of users at the center of the design process. This complementary blend enables comprehensive problem identification and solution-seeking techniques firmly grounded in both theory and practical applications. A prototype is developed for user testing and iterative refinement based on industry feedback, ensuring the toolkit meets the needs of stakeholders and effectively addresses human energy reinforcement goals. The result of this endeavor is an agile toolkit, "Human Energy Hot Spot,"designed to be easily adaptable for use in diverse industry settings. Serving as a valuable resource for employees and managers alike, the toolkit supports identifying and addressing factors contributing to human energy depletion, ultimately enhancing productivity and fostering resilience amidst the challenges faced in today's world. This study supports the European Unions goal for industry to influence society through a human-centric approach to Industry 5.0, prioritizing placing the worker at the core of industrial operations.

Keywords: *Human energy, Industry 5.0, toolkit, Human-centricity, human energy crisis*

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SME internationalization: best practices and the emerging concept of foreign champion

Nuno Calheiros-Lobo[†,⋆,1], Jose Vasconcelos Ferreira[1], Manuel Au-Yong-Oliveira[2]

1. Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP), DEGEIT Department, University of Aveiro, Campus Universitario de Santiago, 3810-193 Aveiro, Portugal
2. GOVCOPP, INESC TEC

⋆ Corresponding author; ncl@ua.pt; † Presenting author; Industrial engineering and management.

Abstract.
Small and medium-sized enterprises (SMEs) internationalization is a specific challenge (Brieger et al., 2022). This particular study makes an original contribution to SME internationalization success (Buzavaite & Korsakiene, 2019), in so far as a new human-resource role is introduced. In this field of study, certain questions remain unanswered and uncertainty still exists in this process, which may be very expensive as it involves cross-border travel and transportation. The body of literature (see also Calheiros-Lobo et al., 2023) focuses more on antecedents than on implementation factors. Twelve stakeholders and practitioners discussed their views, experiences and best practices regarding success in SME Internationalization. Of note is that the purposive sample the authors had access to is considered to be an optimal mix of theory and practice (bringing together academics and practitioners).
The research questions are:
R1: What best practices regarding SME Internationalization should firms follow?
R2: Regarding the uncertainty which still exists in the SME Internationalization process, what may one add to theory and practice for more effective results?
R3: What new human-resource roles should one create to ensure success in SME internationalization?
The authors considered the following objectives:
O1: With the empirical research, the authors seek to identify the best practices deemed the most crucial.
O2: To identify where problems arise and how to solve them.
O3: To propose new variables involving human interaction to diminish uncertainty.
The authors hence seek with this study, in the age of Artificial Intelligence, to add to the literature regarding human intervention, while maintaining costs at a minimum, in an Era of unprecedented change and resource shortage. The authors introduce a new specialization - someone to champion the foreign entry process. This individual will have to reunite certain competences and specific skills beyond being culturally aware and knowledgeable of foreign languages. This new role will have to involve an intuitively adept person to establish bridges of communication and an ability to close deals in multicultural environments. The age old principal-agent problem is also one of the motivation albeit this new role - at the level of the CFO (Chief Financial Officer), CMO (Chief Marketing Officer) and COO (Chief Operations Officer) - brings new emphasis to cross-border relations in an increasingly globalized world. The authors foresee that this role will grow in importance as international relations become more complicated in an ever more belligerent world. webQDA software was used in primary data analysis and greatly enriched the authors' research.

Keywords: *SME Internationalization, Semi-structured interviews, Qualitative Research, Grounded Theory*

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Acknowledgements. The authors express their gratitude to all participants who contributed with their time and expertise to this research.

Otimização de Processos: Balanceamento e Afetação de Recursos em Linhas de Produção Modulares em Tempo Real

Leonor Gonçalves[†,⋆,1], Ana Moura[2], Ana Raquel Xambre[3]

1. Universidade de Aveiro
2. GOVCOPP
3. CIDMA

⋆ Corresponding author; † Presenting author; Industrial engineering and management.

Abstract. Atualmente, as empresas operam num contexto de mudança de requisitos de mercado, com prazos mais curtos, maiores custos e maior complexidade no desenvolvimento de produtos, pelo que, as linhas de produção devem ser planeadas adequadamente e melhoradas após a sua implementação no chão de fábrica (Brás & Moura, 2021). O desenho e gestão de linhas de montagem em ambiente produtivo, quer sejam manuais ou semi-automatizadas, requer elevados níveis de investimento, o que significa que todas as atividades de melhoria nestas áreas são extremamente importantes (Katiraee et al., 2023). Tendo por objetivo a melhoria da eficiência das linhas de produção, dois importantes aspetos que devem ser considerados são: (i) o balanceamento de linhas, e (ii) a afetação de recursos. A otimização destes aspetos traduz-se muitas vezes numa redução de desperdícios e num correto dimensionamento da capacidade produtiva, afetando positivamente a produtividade do sistema de produção. Um outro aspeto a considerar como forma de potenciar a eficiência das operações, auxiliando assim as empresas que atuam em ambientes altamente dinâmicos, são os sistemas de produção modulares, que, devido ao seu maior nível de flexibilidade e adaptabilidade, podem tornar-se uma forte alternativa à comum produção em linha de montagem (Shaik et al., 2015).É cada vez mais urgente as empresas analisarem os seus processos e obterem informações em tempo real para que possam reagir de forma eficiente e eficaz aos problemas encontrados. Posto isto, surge a necessidade de desenvolver sistemas de produção mais flexíveis, que permitam ajustes imediatos nas operações. O principal foco da presente proposta de projeto é otimizar, em tempo real, o balanceamento de linhas de montagem e afetação de recursos aos postos de trabalho, sendo as abordagens utilizadas transversais a todo o tipo de linhas, mas com particular interesse em ambientes de produção com linhas modulares. Pretende-se ainda desenvolver e implementar soluções tempo real, o que é essencial para minimizar ineficiências e aumentar a eficiência operacional das operações.

Keywords: *Otimização, Balanceamento de Linhas, Afetação de Recursos, Linhas Modulares*

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Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

A Conceptual Framework for developing Sustainable Business Models for Residual Agroforestry Biomass Valorization

Prabalta Rijal[†,⋆,1], Joao Matias[1], Helena Carvalho[2], Susana Garrido[3]

1.
2. NOVA School of Science and Technology
3. University of Coimbra

⋆ Corresponding author; † Presenting author; Industrial engineering and management.

Abstract. The urgent need for sustainable energy sources, coupled with the rising incidence of forest fires, has ignited interest in utilizing residual agroforestry biomass. The abundance of residual biomass, including agricultural and forestry residues, presents an opportunity for energy, biofuel, and bioplastic production. By doing so, we can potentially address land use disputes and food scarcity issues. However, the economic value of woody residues remains low, necessitating cost-effective valorization processes throughout the supply chain. To address this challenge, this study aims to formulate a sustainable business model for the valorization of residual plant biomass. The business models will incorporate environmental and societal considerations alongside financial aspects. Key findings from previous studies, including systematic literature reviews and supply chain mapping analyses, have helped to identify several critical factors for successful residual agroforestry biomass valorization, these includethe role of supportive governmental policies that encourage biomass valorization, job creation and rural development, overcoming market pressure, addressing financial constraints and stake holder empowerment.
Sustainable business models hold promise for unlocking the potential of residual agroforestry biomass, contributing to both environmental conservation and socio-economic development. Therefore, by examining various valorization options, challenges, and supply chain dynamics, this study constructs a conceptual framework that contextualizes the factors influencing residual agroforestry biomass valorization. This framework addresses the interests of key stakeholders, integrates sustainability principles, and provides insights to guide the formulation of sustainable business models. The abstract proposes a conceptual framework for the development of sustainable business models in this rapidly growing field and suggests two distinct business models based on the conceptual framework.

Keywords: *A Conceptual Framework for developing Sustainable Business Models for Residual Agroforestry Biomass Valorization*

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Human factor in the fourth industrial revolution: a framework to foster operator 4.0 working engagement

Juliana Salvadorinho[†,⋆,1], Carlos Ferreira[2], Leonor Teixeira[3]

1. Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), Institute of Electronics and Informatics Engineering of Aveiro (IEETA), University of Aveiro, 3010-193 Aveiro, Portugal
2. Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), Institute of Electronics and Informatics Engineering of Aveiro (IEETA), Intelligent Systems Associate Laboratory (LASI), University of Aveiro, 3010-193 Aveiro, Portugal
3. Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), Institute of Electronics and Informatics Engineering of Aveiro (IEETA), Intelligent Systems Associate Laboratory (LASI), University of Aveiro, 3010-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Industrial engineering and management.

Abstract. Since Industry 4.0's emergence in 2011, evolving now for Industry 5.0, companies have prioritized enhancing their technological infrastructure. However, this extensive and still unstandardized improvement has overlooked the human factor's significance. This has fueled the Great Resignation, driven not only by digitalization but also generational shifts (Serenko, 2022), notably among Generation Z. Acknowledging the pivotal role of human resources in driving innovation becomes increasingly crucial as digitalization advances. With a globalizing workforce, retaining talent and organizational knowledge is paramount. Organizations can bolster employee commitment and retention by nurturing engagement, which entails the ability to invest emotionally in job tasks (Salvadorinho & Teixeira, 2023). Three key factors have been identified to elevate employee engagement levels: cultivating a learning organization (Salvadorinho et al., 2023), encouraging a protean career mindset (Salvadorinho, Ferreira, et al., 2024), and fostering employees voice behaviour (Salvadorinho, Pintor, et al., 2024).
This thesis is expected to make significant contributions in two main areas. Firstly, from a practical standpoint, it proposes a framework comprising methods and a proof of concept (technological tool) designed to evaluate and promote workforce engagement. This framework aims to assist decision-making regarding the future of workers within an Industry 4.0 environment, determining whether they remain with the organization or choose to leave. Secondly, from a theoretical perspective, the thesis seeks to address the gap in literature concerning the positioning of the human factor in the context of Industry 4.0 by presenting a robust methodology. Additionally, it aims to raise awareness among organizational management about key strategies that foster engagement and increase work commitment, countering phenomena such as the Great Resignation. Furthermore, the thesis endeavours to contextualize Generation Z within motivational theories and propose a leadership style tailored to managing this generation, constructed with consideration of existing models.

Keywords: *Industry 4.0; Workforce Engagement; Industry 5.0; Protean Career Attitude; Meaningful work; Generations*

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Acknowledgements. The present study was developed in the scope of an individual research grant funded by Foundation for Science and Technology with the number 2021.07419.BD and in the scope of the Augmented Humanity project [POCI-01-0247-FEDER-046103], financed by Portugal 2020, under the Competitiveness and Internationalization Operational Program, the Lisbon Regional Operational Program, and by the European Regional Development Fund

A self-scheduling model as a sustainable decision support system tool for home energy management

ghanavati@ua.pt[†,⋆,1], João C. O. Matias[1], Gerardo Osorio[2]

1. University of Aveiro, Aveiro, Portugal
2. Portucalense University Infante D. Henrique, Porto, Portugal

⋆ Corresponding author; ghanavati@ua.pt; † Presenting author; Industrial engineering and management.

Abstract. The most recent activities and developments in the era of Sustainable Energy Management have been articulated in the literature (Ostovar et al., 2023). The main target of the new research activity conducted in this domain is related to the self-scheduling approach for Home Energy Management Systems (HEMS). Self-scheduling within the HEMS addresses energy usage optimizations at the household level (Tostado-Véliz et al., 2022). By strategically planning the operation of appliances and devices, households can minimize electricity costs, manage load demand effectively, and promote resources (Ghanavati et al., 2024). Through self-scheduling, users can align energy consumption with renewable energy generation patterns, such as solar power, thereby reducing reliance on non-renewable sources and contributing to environmental sustainability. Additionally, self-scheduling considers the user's comfort levels and convenience by ensuring that essential appliances operate when needed while minimizing disruptions to daily routines (Javadi et al., 2021). Moreover, it plays a crucial role in maintaining grid stability by balancing supply and demand, reducing peak loads, and enhancing the resilience of the electrical infrastructure. Indeed, self-scheduling in HEMS offers a comprehensive approach to energy management, encompassing cost savings, load management, resource efficiency, user comfort, and grid stability, making it indispensable for modern households.
The main activities conducted in this domain focus on the self-scheduling of home appliances and provide a timeline for optimal charging of Electric Vehicles (EVs) at home (Wu et al., 2022). The model utilizes a computer-based self-scheduling algorithm to minimize the cost of electricity while the preferences of the end-users have been considered in the model. Different electricity tariffs have been simulated in this study to assess the electricity costs of residential end-users in Portugal. The cost reduction strategy is expected to change consumer behavior while consumer preferences are maintained. In addition, the other home appliances will be organized in such a way as to respect the preferences of the end-users in terms of plugging time and utilization of the controllable home appliances. The model is represented as a standard Mixed-Integer Linear Programming (MILP) optimization problem. The developed model is tested and verified for cost reduction strategy at the residential level while EV charging at home is considered. A typical load profile is selected to test the HEMS capability. The cost reduction potential for the given smart home for different electricity tariffs has been elaborated.

Keywords: *Decision Support System; Electric Vehicles; Energy Management System; Optimal Scheduling; Sustainable and Renewable Development.*

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Studying of relationship between the financial, energy, and environmental performance indicators by concept of exergy

Maryam Hajishams[†,*,1], Shahed. Rasekh[2], Margarita Robaina[1], J.C.O. Matias[1]

1. 1DEGEITDepartment of Economics, Management, Industrial Engineering, and Tourism, University of Aveiro, 3810-193 Aveiro, Portugal
2GOVCOPPResearch Unit on Governance, Competitiveness and Public Policies, University of Aveiro, 3810-193 Aveiro, Portugal
2. 3Dpt. Materials and Ceramic Eng., CICECO-Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal

* Corresponding author; maryam.hajishams@ua.pt; † Presenting author; Industrial engineering and management.

Abstract. Recognizing the significance of evaluating companies from both internal and external stakeholders viewpoints, relevant indicators in financial, energy, and environmental domains have been identified and delineated in the previous step of this work. These indicators play a crucial role in accurately assessing companies' performances across these categories (Kenton, 2023). To achieve this, a semi-systematic literature review (SLR) was conducted to select relevant manuscripts spanning from 2002 to 2023, with particular emphasis on the past five years.

Following the establishment of indicators, the relationship between these indicators should be established, which consequently will be used for analysis the companies using exergy concept. Therefore, at this step interviews and the distribution of questionnaires among selected companies in Portugal and Spain is undertaking. The selection of companies followed a specific protocol prepared for this purpose. Following this protocol 17 companies were selected from diverse industrial sector to have example of different form of companies functionality and goals. The sectors that selected were Clothing, Energy and Petrochemicals, Hypermarkets, Banking, Automobile manufacturing, Pulp and Paper, Flag carriers, Department stores, Telecommunications, and Civil and Engineering construction.

Moreover, up to this point, for financial aspect, interesting relationship were found but still incomplete. The establishing the connections between the indicators for each category as well as inter-categories will pave the path for establishing a corelated table of indicators. Once this table is formed, using exergy concept the analysis of a company will be performed to find the functionality of the company.

Keywords: *Financial performance indicators, Energy performance indicators, Environmental performance indicators, Exergy.*

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Acknowledgements. The authors wish to thank the Universidad de Aveiro for financial support. This work was also developed within the scope of the PhD project of Maryam Hajishams (grant 2021.05055.BD funded by FCT). This work was supported by the research unit on Governance, Competitiveness and Public Policy (UIDB/04058/2020), funded by national funds through FCTFundaco para a Ciência e a Tecnologia. Shahed Rasekh acknowledges the support of the Research Employment Contract FCTCEECIND/02608/2017.

Proposal of a Framework for the implementation of Quality 4.0 in Small and Medium Enterprises

Diana Solange Almeida Oliveira[†,⋆,1], Maria João Machado Pires da Rosa[2], Helena Maria Pereira Pinto Dourado e Alvelos[3]

1. Department of Economics, Management, Industrial Engineering and Tourism
2. Centre on Research into Higher Education Policies and Department of Economics, Management, Industrial Engineering and Tourism
3. Center for Research Development in Mathematics and Applications and Department of Economics, Management, Industrial Engineering and Tourism

⋆ Corresponding author; † Presenting author; Industrial engineering and management.

Abstract. In this era of digital transformation, Quality 4.0 emerges as a fundamental step in quality management practices (Chiarini, 2020). Although the concept of Quality 4.0 has been increasingly discussed, accompanied by a growing number of empirical studies in the field, most of these studies explore theoretical aspects, or address the presence of a favourable environment for Quality 4.0, as well as the barriers to its implementation. Therefore, it can be said that there remains a gap in practical investigations on Quality 4.0 implementation in the industrial environment.

To address this gap, a systematic literature review was conducted to explore the developments in Quality 4.0, followed by a case study within a ceramics company in Portugal, aiming to comprehensively understand its developments in this domain. Building upon the findings of these studies, the design of a questionnaire, intended as a diagnostic tool for assessing the implementation of Quality 4.0 in Portuguese companies, have been undertaken. The questionnaire comprises twenty-three closed questions categorized into four main sections: i) the company's context about Industry 4.0; ii) quality management under an Industry 4.0 approach; iii) Quality 4.0 professionals and iv) motivations, critical success factors, and challenges for implementing Quality 4.0.

The questionnaire was made available via an online platform, was pre-tested to ensure its content validity, and then sent to more than 1200 Portuguese companies.

It is believed that the results of the questionnaire application will provide comprehensive information on the status of Quality 4.0 implementation in Portugal. This effort is aimed at acquiring a differentiated understanding of the quality management tools, methodologies, and practices prevalent in these organizations. Additionally, the questionnaire will allow to identify the skills and competencies essential for professionals navigating the Quality 4.0 paradigm.

Finally, it is expected that the data collected will offer valuable insights into the motivating factors driving the adoption of Quality 4.0, as well as the main challenges companies face when implementing it. By examining these factors, a framework will be developed to help industries implement Quality 4.0. The framework aims to offer practical recommendations for overcoming obstacles and enhancing the effectiveness of Quality 4.0 initiatives.

Keywords: *Quality 4.0; Industry 4.0; Questionnaire; Portuguese companies*

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Generation of automated warehouse simulation models and optimisation of material flow analysis

Rúben Bessa[†,⋆,1], Ana L. Ramos[1], José V. Ferreira[1], Luís P. Ferreira[2]

1. GOVCOPP, DEGEIT, Universidade de Aveiro, Aveiro, Portugal
2. LAETA-INEGI

[⋆] Corresponding author; rubenbessa@ua.pt; [†] Presenting author; Industrial engineering and management.

Abstract. In its early days, the warehouse began as a place far removed from factory operations, functionally limited and small [1]. Today, in a supply chain, warehouse management plays a vital role [2], as it seeks to achieve a balance in the amount of stock needed to produce continuously [3]. Continuous production also implies the need for constant communication between the different players, which can suffer some barriers and/or delays, whether internal or external [4], resulting in costs, loss of effectiveness and inefficiency for the organisation as a whole [5]. Considering the potential problems in managing warehouse operations, I4.0 has emerged as a differentiating concept between companies [6]. Applying its pillars to warehouse operations leads to the concept of W4.0 [7].
Simulation is a powerful tool for W4.0, as it makes it possible to develop computer models that replicate real contexts, making it possible to assess system performance [8]. The warehousing area and its operations have a significant impact on company finances and can account for up to 30 per cent of total logistics costs [9]. This is a significant cost since warehousing operations do not add value to the product [10]. Simulation makes it possible to analyse and conjecture the entire flow of current and future operations, making it possible to develop layouts suited to the particularities of each company. In addition to the layout, the main operations benefit from the implementation of I4.0.
In the context of simulation, there are different forms of modelling. System dynamics (SD) makes it possible to understand the dynamic behaviour of a complex system and predict the variables that influence it [11]. Discrete Event Simulation (DES) uses the means of representing discrete events at a given time to model the system [12]. The Agent-Based Model (ABM) models a system by representing autonomous entities, with each entity having its own behaviour [13].

There is the possibility of combining different techniques and models to improve the analysis of complex systems, such as Hybrid Simulation (HS) [14]. Basile & Coppola [15] developed a HS using Petri nets for a warehouse.
This study optimises material flows that supply automated warehouses in a real context, and developing a set of libraries in the simulation software to speed up the development of simulation models. The aim is to analyse different material flow strategies that feed automated warehouses in order to reduce supply times and identify the most critical variables.

Keywords: *Simulation; Industry 4.0; Warehouse 4.0; Warehouse optimisation; Warehouse operations; Decision-making*

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Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Sustainable development of Marine renewable energies supply chain management in Portugal

Seyedasghar Bayatghiasi[⋆,1], João Carlos de Oliveira [1], Mohamadreza Kamali[2], Fátima L. Alves[3]

1. Departament f Economics, Management, Industrial Engineering and Tourism, University of Aveiro, Portugal
2. CESAM -KU Leuven, Department of Chemical Engineering, Process and Environmental Technology Lab, Jan Pieter de Nayerlaan 5, 2860 Sint-Katelijne-Waver, Belgium
3. CESAM - Centre for Environmental and Marine Studies, Department of Environment and Planning, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portuga/ Oricid: 0000-0002-7304-6953

⋆ Corresponding author; † Presenting author; Industrial engineering and management.

Abstract. Commercialization of marine renewable energies (MREs) is able to play a prominent role for the sustainable development of the societies due to its abundant and environment-friendly characteristics. Availability of extensive marine areas in Portugal allows using these types of energy to meet the current and future needs of the clean and renewable sources of energy. In line with the goals 7, 12 and 13 of the 2030 Agenda for Sustainable Development, it is aimed Sustainable Supply Chain(SSC) of MREs in Portugal, considering all the sustainability criteria in order to fill the gap between current and future energy needs and supply, which may reduce the need to the energy imports. The results of this study will aim all the involved parties to promote the generation and application of this types of renewable energies in Portugal.
In this academic year, finding indicators influencing SSC of marine renewable technologies, prioritizing different Indicators relevant in with Sustainability criteria, and a sociometric study for analyzing past current and future of MREs was conducted.
In order to develop SSC of MREs, first we identified the important indicators influencing sustainable supply chain of marine renewable technologies, using evidence from different steps of supply chain in MREs. Waves, tidal range, tidal currents, ocean currents, ocean thermal energy conversion and salinity gradients are the main branches of MREs technologies are mixed with Technical, Economic, Social, and Environmental criteria based on Sustainability.After that with A Fuzzy Delphi Approach we prioritized and detected different Indicators relevant in with 4 Criteria of Sustainability in 4 Sections of Supply Chain (Sourcing, Delivery and Distribution, Consumption and Recycling).Moreover, we analyzed and critically discussed current practices, challenges, and future directions in MRE supply chains by selecting and screening the papers which published in marine renewable energy and finding the connection between these topics. A historical perspective of sustainable supply chain adoption in MREs was provided, followed by the criteria of publishing categories, contributing countries and publishing years in research and development. Current trends and challenges were discussed, and the need for collaboration, standardization, and innovation to advance the sustainable implementation of MREs were highlighted.Then we need to analyze the effects of the technical criteria involved in Sustainable Supply Chain of MREs, and SSC criteria can lead to select the most sustainable MREs, then promote SSC in MREs in Portugal by selecting the most appropriate sites for development of MREs in Portugal using sustainability criteria.

Keywords: *Marine Renewable Energy, Sustainability, Supply chain*

Acknowledgements. This work was financially supported by the Research Unit on Governance, Competitiveness and Public Policies (UIDB/04058/2020) + (UIDP/04058/2020), funded by national funds through FCT

The contribution of the aviation industry to sustainability: A case study at Mirpuri Foundation

Yazan Odeh Faleh Al Khalayleh[†,1], João Carlos de Oliveira Matias [⋆,1], Carina Maria Oliveira Pimentel[2]

1. University of Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, Portugal
2. Universidade do Minho, Campus de Azurém, 4800 058, Guimarães, Portugal

⋆ Corresponding author; jmatias@ua.pt; † Presenting author; Industrial engineering and management.

Abstract. Sustainable development is a term adopted to promote economic growth, environmental protection, and social inclusion for all people worldwide. One of the most intriguing aspects of this approach is the sustainable industrialization, a topic that will be explored in detail during this study, more specifically, in the aviation industry. Since the adoption of the SDGs in 2015, there were a lot of indications showing that the performance needs to be improved in all sectors. The advent and spread of COVID-19 in early 2020 changed the world, including the progress already achieved. Additionally, after lifting most of the restricting measures by the majority of the countries and starting to recover from the pandemic, another global constraint happened. In February 2022, Russia decided to invade Ukraine and to start a war and this decision came with serious impacts on a lot of countries e.g., closure of airspace. Therefore, its also essential to analyze the related consequences, especially since its still an ongoing conflict. Accordingly, this research will be conducted in a certain aviation organization in Portugal as a case study and will take advantage of mixed methods that collects both quantitative and qualitative data within the same study. Firstly, self-administered questionnaires in combination with face-to-face interviews will be conducted to gather all the necessary data, then it will be analyzed using the Statistical Package for the Social Sciences (SPSS) and content and thematic analysis when applicable. The research objectives intend to analyze the relationship between the sustainability framework in aviation and SDGs, the sustainable measures adopted in three different periods: before pandemic, during COVID-19 and during Russian-Ukrainian War. The study will also investigate the types of measures to adopt in the future to ensure the fulfillment of the SDGs by 2030. The researchs practical implications will aid in perceiving the current situation and forthcoming trends regarding the sustainable development in the aviation sector in Portugal, understanding the type of relation between the SDGs and aviation, conveying a clearer picture about the various measures implemented during normal circumstances, pandemics and zone wars, evaluating the measures needed to implement to improve sustainability and to get back on track from the point of view of the aviation field, whereas the theoretical implications will strengthen the research in sustainability, constitute a basis for subsequent studies to be conducted in other countries of interest and other sectors and provide the opportunity to further improve the results reached.

Keywords: *Sustainable Development, Aviation, Portugal, COVID-19, Russian-Ukrainian War, Future Impact, Sustainability*

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Metalworking Project Management: A Review of Artificial Intelligence Applications

José Silva[†,⋆,1], João Matias[1], Paulo Ávila[2], Luíz Faria[2]

1. Department of Economics, Management, Industrial Engineering and Tourism, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. Department of Mechanical Engineering, Instituto Superior de Engenharia do Porto, R. Dr. António Bernardino de Almeida, 431, 4249-015 Porto, Portugal

⋆ Corresponding author; jose.sil@ua.pt; † Presenting author; Industrial engineering and management.

Abstract. Fierce competition between companies, especially in the metalworking industry, has driven the continuous search for strategies to reduce production costs, minimise material waste, and improve product quality. These efforts aim to shorten delivery times, enhance customer satisfaction, and boost competitiveness. However, these industries continue to grapple with persistent delivery delays, stemming from complex factors such as supply chain disruptions, project management shortcomings, and technical or operational challenges.

Various approaches and methodologies have been employed to tackle these issues (Silva et al., 2022). Agile management methodologies, including Scrum, Prince2 Agile, and Lean Project Management, are being implemented in metalworking to enhance production flexibility and adaptability (Weflen et al., 2022). Conversely, established analytical solutions like the Gantt/Waterfall Method, PMBOK Guide, Spiral Model, Prince2, and Critical Path Method (CPM) or Program Evaluation and Review Technique (PERT) have traditionally provided a clear and structured approach to project management (Vila Grau & Capuz Rizo, 2022).

In addition to traditional project management, AI offers the potential for data-driven insights and improved decision-making (DHaese et al., 2021). A comprehensive review of the literature highlights a significant preference for Machine Learning (ML), particularly Artificial Neural Networks (ANNs) (Mishra et al., 2022). In civil construction, AI has proven its worth by enabling more accurate delay prediction, streamlining operations, and ensuring optimal resource allocation (Taboada et al., 2023).

Despite advances in AI research in project management, a critical gap exists in its application to the metalworking industry. This study aims to fill this gap by exploring the application of AI to address project management challenges specifically in metalworking. This investigation integrates AI techniques to predict project delays and optimise resource allocation

This research integrates AI techniques to predict project delays and optimise resource allocation and aims to demonstrate the potential benefits of AI in improving project management practices in this sector.

Keywords: *Project Management; Schedule; Planning; Forecast; Artificial Intelligence; General or Strong AI; Narrow or Weak AI; Machine Learning; Deep Learning; Metalworking.*

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Acknowledgements. The authors are grateful for the financial support of the Foundation for Science and Technology (FCT) under the EU/FEDER PTDC/EME-APL/29713/2017 (CENTRO-01-0145-FEDER-029713) projects through the CENTRO 2020 and COMPETE 2020 programs, and UID/EMS/00481/2019-FCT under CENTRO-01-0145-FEDER-022083. MG Silva also recognizes the financial support of FCT through the doctorate. grant SFRH/BD/143775/2021.

Accelerating towards the circular economy: the consumer role.

Rui Carreira†,1, José Vasconcelos Ferreira2

1. Universidade de Aveiro Campus Universitário de Santiago 3810-193 Aveiro
2. josev@ua.pt

⋆ Corresponding author; † Presenting author; Industrial engineering and management.

Abstract. The transition from the linear economy to the circular economy (CE) is already an unavoidable reality, which has been integrated with different origins and triggers. Legal imperatives, the industry's own imposition, or what is thought to be the most sustainable and long-lasting, a customer demand (Alarcón et al., 2020).
In this research, we intend to assess whether CE is a customer demand and whether it corresponds to one of the quality parameters identified by the consumer (Luthra et al., 2022).
In the first phase of this research, a state of the art was carried out to assess what has been published on CE. From the systematic literature review, it was possible to conclude that most authors believe that the consumer is not the factor that triggers the transition from the linear economy to CE (Carreira et al., 2023).
In the second phase of the research, companies were surveyed to find out how Portuguese SMEs have implemented CE and whether the customer values such practices. In order to carry out this task, it was decided to conduct interviews with Portuguese SMEs from different sectors of activity and to carry out a qualitative analysis of the results obtained from these interviews. A sample of 34 companies was selected and interviews were carried out with their managers. In addition to the interviews, the circularity practices of each company were observed in situ. Subsequently, the aim was to understand what triggered the companies to start these practices and what the consumer's behaviour was in demanding these practices. After analysing the results, it was possible to conclude that most customers do not value the products and services that offer circularity.
In a third phase, the aim is to survey consumers and understand what they have to say on the subject. The aim is to survey a sample of more than 300 respondents to understand their perception of CE practices in the products and services they buy, and whether these practices influence their decision-making behaviour.
In the final stage, after understanding the consumer's perception of CE and the aspects they value most, the aim is to propose a solution that will help speed up the process of implementing CE in Portugal.

Keywords: *Circular economy; Consumer; Customer requirements; Quality; Portuguese SME*

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Guidelines for sustainable manufacturing in the metal-mechanics industry: a design-centric approach

Marta C. Morais Cláudio[†,⋆,1], João Carlos O. Matias[2]

1. Universidade de Aveiro, Campus Universitário de Santiago 3810-193 Aveiro Portugal
2. Universidade de Aveiro, Campus Universitário de Santiago 3810-193 Aveiro Portugal

⋆ Corresponding author; martaclaudio@ua.pt; † Presenting author; Industrial engineering and management.

Abstract. In contemporary society, there is a growing acknowledgment of the critical need for an innovative economic model that effectively integrates environmental and social considerations into production and consumption practices. Stakeholders are increasingly demanding transparency from industries, pushing them to disclose the environmental and social impacts of their operations. Within this context, sustainable manufacturing emerges as a vital imperative, aiming to mitigate environmental degradation, minimize resource consumption, and uphold social responsibility and economic viability. A recent literature review focusing on sustainable manufacturing within the industrial domain revealed a significant gap: a lack of attention to the complete value chain, including suppliers, logistics, and the crucial design phase of products, such as the selection of eco-friendly raw materials and process design. This research aims to explore the impacts of design for manufacturing strategies on manufacturing efficiency and environmentally friendly processes, with an emphasis on waste reduction and recyclability. A systematic literature review will be conducted to identify case studies of sustainable design practices, as well as patterns, challenges, and successful strategies. The overarching objective is to extract key lessons and principles that can be applied to future design strategies and develop comprehensive guidelines for integrating sustainable design into manufacturing processes. These guidelines will offer practical recommendations tailored for designers and manufacturers, facilitating the adoption of environmentally responsible practices across the manufacturing landscape and contributing to the scientific knowledge in sustainable manufacturing.

Keywords: *Sustainable Manufacturing, Green Manufacturing, Eco-efficiency, Sustainable Industry, Design to Manufacturing, Product Life Cycle.*

Hybrid simulation dynamic modelling to improve the performance of hospital waste supply chains

André Ferreira[†,⋆,1], Ana Luísa Ramos[2], José Vasconcelos Ferreira[1], Luís Pinto Ferreira[3]

1. GOVCOPP, DEGEIT University of Aveiro, 3810-193 Aveiro, Portugal
2. GOVCOPP, DEGEIT University of Aveiro, 3810-193 Aveiro Portugal
3. Associate Laboratory for Energy, Transports and Aerospace (LAETA-INEGI)

⋆ Corresponding author; and.moura@ua.pt; † Presenting author; Industrial engineering and management.

Abstract. Hospitals, nursing homes and various pathology laboratories have contributed to the increase in hospital waste, such as syringes, scalpels, bloody cottons and chemical products, leading the World Health Organization to consider this type of waste as non-hazardous municipal solid waste (Chauhan & Singh, 2021). The management of medical waste is one of the most complex and demanding tasks that managers face as the population grows and the demand for medical services increases (Windfeld & Brooks, 2015).

Modeling and simulation are widely used in areas such as manufacturing and supply chains in order to support better and more informed decision-making (Mustafee et al., 2022). Simulation plays a fundamental role in the decision-making process of many companies, allowing for the analysis of various scenarios to ascertain which is the best. Hybrid simulation allows simulation models to be built with greater precision.

With the constant competitiveness of companies worldwide, all organizations need a good ability to respond to customer demand at the lowest possible cost, maximizing profit. Hybrid simulation, known as a combination of two or more simulation methods, namely system dynamics, discrete event simulation and agent-based simulation, has grown almost exponentially over the last two decades (Brailsford et al., 2018). However, there are studies that use the definition of hybrid simulation when they make use of a mathematical model and one of the aforementioned techniques.

Therefore, improving the performance of a supply chain can be a very demanding task, but an important one because of the economic potential it can generate for a company. This project will be carried out at the SUCH company, and its main objective will be to develop a hybrid simulation model to analyze and improve the supply chain of the hospital waste company. The aim is to improve response capacity and support decision-making in supply chains and logistics in order to manage a hospital waste supply chain by carrying out various scenarios combining two or more simulation methods to increase the efficiency of the results and to find out which is best for each decision, minimizing the negative impacts that the process has on both society and the environment.

Keywords: *Hybrid Simulation, Supply Chain, Industry 4.0, Sustainability, Hospital Waste*

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Language sciences

The textual genre package leaflet for human pharmaceuticals: information for users

Raquel Oliveira Fernandes [†,⋆,1], Katrin Herget[1]

1. Languages, Literatures and Cultures Research Centre, Department of Languages and Cultures, University of Aveiro, Campus Universitário de Santiago, 3810-193 AVEIRO, Portugal

⋆ Corresponding author; a16244@ua.pt; † Presenting author; Language sciences.

Abstract. The area of health covers a wide range of specialisations, using various textual genres to disseminate information, each with specific linguistic characteristics and purposes. Maciel (2010) points out that specialised language is not limited to interaction between specialists but is accessible to different audiences and levels of formality. In the pharmaceutical context, information leaflets must comply with the product's characteristics and be written in a way that is accessible to a non-professional audience, as emphasised by Montalt and Davies (2014). Rocha (2021) classifies package leaflets as predominantly injunctive texts, intended to guide the recipient through the instructions for the medicine.

As part of this study, we aim to explore the growing interest in specialised language in the health sector, with a focus on describing the mechanisms of enunciative responsibility and the linguistic configuration of the discursive types frequently found in drug information leaflets. The methodology involved the selection and analysis of a specific set of information leaflets, allowing us to investigate how pharmaceutical companies use specialised language to communicate effectively with a non-specialised audience and achieve their communication objectives in this specific context.

Analysing the microstructure of the leaflets reveals that interactive and informative discursive segments alternate in the various sections of the leaflets. Direct information about the medicine coexists with interactive approaches using question-answer schemes. The informative function predominates, coexisting with an injunctive discourse marked by uncertainty and obligation. The preferential production of these linguistic structures can affect the communication objectives and interfere with the understanding of the recommendations, increasing the user's doubts.

Keywords: *genre, information leaflet, discourse, discursive types*

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Overcoming barriers: popularisation of public health discourse in portuguese and chinese communities

Huanqi Sun[†,1], katrin Herget[⋆,1], João Paulo Silvestre[1]

1. Department of Languages and Cultures, Languages, Literatures and Cultures Research Centre, Department of Languages and Cultures, University of Aveiro, Campus Universitário de Santiago, 3810-193 AVEIRO, Portugal

⋆ Corresponding author; † Presenting author; Language sciences.

Abstract. In a world increasingly reliant on digital information, the accessibility and comprehension of scientific discourse have become crucial. The vast amount of information available online has transformed how laypeople engage with public health topics. This democratization of knowledge empowers individuals to play a more active role in their health, but it also introduces challenges related to information quality, reliability, and the risk of spreading misinformation. One of the main challenges is translating complex scientific concepts into language that laypeople can understand without sacrificing accuracy. This requires balancing simplification with scientific integrity. Common techniques in discourse popularisation include the use of analogies, metaphors, and reformulation (Gonçalves et al., 2017). Moreover, leveraging multimedia elements such as infographics, videos, and interactive content can further aid comprehension and engagement. According to Brand (2008), the vertical structure of medical discourse in Language for Specific Purposes (LSP) primarily differentiates between internal communication and external discourse. External discourse, which is patient-oriented, encompasses doctor-patient interactions and communication with a broader audience. The goal of discourse popularisation is to ensure that scientific information becomes accessible to a wider audience. Consequently, it's essential to adjust the language used depending on the level of popularisation required (López, 2012). This paper examines strategies for popularising scientific discourse in the field of public health in both Portuguese and Chinese, identifying effective approaches to enhance scientific literacy in these linguistic communities. The analysis is based on a comparable corpus of electronic and print popular science texts on dietary health in Portuguese and Chinese, with texts dated from January 2019 onwards. The corpus analysis is conducted using the corpus manager and text analysis tool, Sketch Engine (Kilgariff et al., 2014).

Keywords: *Public health, Discourse, Popularisation, Comparable corpora, Strategies*

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Acknowledgements. Firstly, I would like to thank my supervisors for their invaluable help during data collection, analysis and thesis writing. Second, I would like to thank the editors and reviewers, whose careful review and constructive feedback helped me to improve the quality of this thesis.

Marine science, technology and management

Unraveling Suaeda albescens halophyte as a functional food with add value and healthy lipids

Marisa Pinho[†,⋆,1], Javier Cremades[2], Ana Lillebø[3], Rosário Domingues[4]

1. Centre for Environmental and Marine Studies - CESAM, Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. Coastal Biology Research Group (BioCost), Facultad de Ciencias and CICA,
3. ECOMARE, CESAM, Department of Biology
4. Mass Spectrometry Center, LAQV-REQUIMTE, Department of Chemistry

⋆ Corresponding author; marisapinho@ua.pt; † Presenting author; Marine science, technology and management.

Abstract. Halophytes are increasingly being consumed because they are recognized as plants with good nutritional value, containing essential fatty acids (FA) and bioactive compounds like antioxidants, making them a promising healthy and functional food (Aschemann-Witzel et al., 2021; Grigore, 2021). Despite their potential, their detailed lipid composition and functional value remain scarcely known. This work aims to unravel halophytes as a valuable source of n-3 and n-6 lipids and to identify the bioactive properties of their lipid extracts. New halophytes species less explored will be studied, such as Suaeda, as new candidates for novel food products. Recently, results gathered in the lipidomics analyses of Suaeda albescens allowed to identify 20 FAs, with seed exhibiting as well as 166 lipid species, from five classes. The results show that seeds had a higher amount of FA 18:2 n-6, while the plants had a higher content of FA 18:3 n-3. Triacylglycerols were the most abundant class in seeds while membrane lipids, as glycolipids and phospholipids are more abundant in the plants. The extracts exhibited varying levels of bioactive properties, with the seed showing lower antioxidant activity compared to the plant. Both the seed and plant showed significant capacity to inhibit the COX-2 enzyme, with the seed inhibiting half the amylase activity. However, none of the extracts showed the potential to inhibit the glucosidase enzyme. This study was the first to identify and compare the plant and seed lipidomes of S. albescens, showcasing S. albescens as a source of healthy lipids and as an alternative for a sustainable nutritional and functional food.

Keywords: *Lipidomics; Halophytes; Lipids; Mass Spectrometry*

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Acknowledgements. Marisa Pinho was funded by national funds through the FCT, under the PhD granted via CESAM (UI/BD/153346/2022). The authors acknowledge to FCT/MCTES the financial support to CESAM (UIDP/50017/2020+UIDB/50017/2020 + LA/P/0094/2020), LAQV/REQUIMTE (UIDB/50006/2020), iBiMED (UIDB/04501/2020) and to RNEM, Portuguese Mass Spectrometry Network, (LISBOA-01-0145-FEDER-402-022125), through national founds and, where applicable, co-financed by the FEDER, within the PT2020 Partnership. The authors are thankful to the COST Action EpiLipidNET, CA19105- Pan-European Network in Lipidomics and EpiLipidomics.

Application of antimicrobial photodynamic inactivation technology as an alternative to prevent bacterial infections on aquaculture systems

Cátia Vieira[†,⋆,1], M. Amparo F. Faustino[2], Jesus L. Romalde[3], Adelaide Almeida[1]

1. CESAM, Department of Biology, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
3. Department of Microbiology and Parasitology, CRETUS CIBUS, Faculty of Biology, University of Santiago de Compostela, 15782 Santiago de Compostela, Spain

⋆ Corresponding author; catiavieira@ua.pt; † Presenting author; Marine science, technology and management.

Abstract. Vibrio anguillarum is a pathogenic bacterium for farmed fish that causes high mortality rates and severe financial losses in the aquaculture industry (Hickey & Lee, 2018). This bacterium is often found in Artemia nauplii (brine shrimp), a common fish live feed, making it a primary vector for V. anguillarum transmission to farmed fish (Grisez et al., 1996). This study aimed to assess the potential of antimicrobial Photodynamic Inactivation (PDI) in preventing V. anguillarum infections in aquaculture. To this purpose, we evaluated the efficiency of PDI treatments in the: photoinactivation of V. anguillarum on seawater; prevention of infections on Psetta maxima pre-challenged with V. anguillarum; decontamination of Artemia franciscana nauplii contaminated with V. anguillarum. These evaluations were performed using a widely studied photosensitizer, TMPyP (5.0 ţM), in combination with potassium iodide (KI, 10-100 mM), a well-known adjuvant of PDI, under white light irradiation (100 mW.cm-2). Our findings suggest that PDI mediated by TMPyP + KI was efficient to reduce V. anguillarum concentration in seawater to the detection limit of the method (8 log CFU.mL-1) in less than 10 min of PDI treatment, at the tested concentrations. Additionally, preliminary toxicity assays enabled the selection of a non-toxic concentration of treatment, TMPyP (5.0 ţM) + KI (10 mM), for the in vivo studies on P. maxima and brine shrimp. This concentration significantly decreased the V. anguillarum concentration in A. franciscana nauplii by over 3 log CFU.mL-1 after 30 min of irradiation. Furthermore, in the P. maxima experiments, the application of this treatment for only 5 min prevented severe symptoms in fish but had no preventive effect on fish mortality. These findings suggest that PDI is an effective approach to prevent V. anguillarum infections in aquaculture by disinfecting the waters and fish live feed. However, it cannot prevent fish mortality once the infection process is initiated.

Keywords: *Vibrio anguillarum, Artemia franciscana, Psetta maxima, photossensitizers*

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A Systematic Review of Deep-Sea Ecosystem Services Valuation Studies

Laura M. Trovão[†,⋆,1], Bruna Vieira[1], Stephen Hynes[2], Ana Hilário[1], Helena Vieira[3]

1. Centre for Environmental and Marine Studies, Department of Biology, University of Aveiro Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. Socio-economic Marine Research Unit, Whitaker Institute, University of Galway
3. Centre for Environmental and Marine Studies, Department of Environmental and Planning, University of Aveiro Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Marine science, technology and management.

Abstract. Climate change and anthropogenic pressures are negatively affecting marine habitats at a global scale (Steffen et al. 2007), causing biodiversity loss and negative impacts on ecosystem functioning (Gissi et al. 2021; Mora et al. 2013). The REDRESS and DEEP REST projects aim to provide solutions to restore degraded deep-sea habitats to recover biodiversity and associated ecosystem services, applying ecologically and economically cost-effective protocols and offering innovative solutions for the engagement of governance, policy, financial and economic sectors. Under these projects, the socio-economic impacts of deep-sea ecosystems restoration will be assessed using a natural capital accounting approach to examine the potential welfare and economic impact on society from changes in biodiversity, ecosystem extent, condition, ecosystem service and natural capital value over time and across different case studies (DEEPREST, 2022; REDRESS, 2024). As a starting point, we performed a systematic review, using a diverse array of scientific search engines such as Scopus, WoS or Open Alex, to identify all studies published in the last 10 years relative to cost and benefit analysis of marine ecosystem restoration as well as studies related to payment models for deep sea (or related) marine ecosystem services. This preliminary research allows us to quantify and isolate the studies related to the deep-sea to better understand the existing gap associated to this vast expanse of the marine realm. We are currently developing a database compiling all relevant studies and their data to provide estimates of ecosystem service benefit values accruing to deep-sea restoration activities. These results will be shared in this conference. On a later stage, a novel Cost-Benefit Analysis protocol will be developed to evaluate the socio-economic effects of any restoring deep-sea ecosystems, making it available to any relevant stakeholder, including industry and policy decision-makers.

Keywords: *Anthropogenic pressures; Ecosystem services; cost-benefit analysis; marine ecosystem restoration; economic impacts.*

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Acknowledgements. REDRESS: Co-funded by the European Union and UK Research and Innovation (Project number:

101135492).This research was funded through the 2020-2021 Biodiversa and Water JPI joint call for research projects, under the BiodivRestore ERA-NET Cofund (GA Nř101003777), with the EU and the following funding organisations : Agence Nationale de la Recherche (ANR-21-BIRE-0003), France, Ministry of Agriculture, Nature and Food Quality (LNV), Netherlands, Research Foundation Flanders (FWO), Belgium, German Federal Ministry of Research (BMBF) through VDI/VDE-IT, Germany, Environmental Protection Agency (EPA), Ireland, Fundação para a Ciência e a Tecnologia (FCT), Portugal, Fundo Regional para a Ciência e Tecnologia (FRCT), Portugal-Azores and State Research Agency (AEI), Spain. Three other entities also contribute to the project : University Center in Svalbard (UNIS), Norway, Centre National de la Recherche Scientifique (CNRS), France, University of Bergen (UiB), Norway.

Use of isotopic fingerprints as traceability and species discrimination tools: seahorses as a case study

Ana Elisa Cabral[†,1], Ricardo Calado[1], Jorge Palma[2], Fernando Ricardo[1], Eduardo Ferreira da Silva[3], Carla Patinha[3], Miquel Planas [4]

1. ECOMARE, CESAM, Departamento de Biologia, Universidade de Aveiro
2. CCMAR - Centro de Ciências do Mar, Universidade do Algarve
3. GEOBIOTEC, Departamento de Geociências, Universidade de Aveiro
4. Departamento de Ecologia e Recursos Marinhos, Instituto de Investigaciones Marinas (IIM-CSIC)

⋆ Corresponding author; anacabral@ua.pt; † Presenting author; Marine science, technology and management.

Abstract. Seahorses are extensively traded, being supplied to Traditional Chinese Medicine, curios and the ornamental trade (Kuo and Vincent, 2018). Traceability tools may contribute to fill gaps along supply chains, securing information on geographic origin and the identification of traded specimens (Cohen et al., 2013; Cabral et al., 2021). Differences in stable isotope fingerprints (13C and 15N) determined from the dorsal fins of specimens cultured in Instituto de Investigacións Mariñas (IIM, Spain) and Centro de Ciencias do Mar (CCMAR, Portugal) were assessed, as well as between Hippocampus guttulatus, from IIM and CCMAR, and between wild and cultured H. guttulatus. No significant differences were observed in 13C and 15N of H. kuda and H. reidi from IIM, as was the case for H. hippocampus and H. guttulatus from CCMAR. However, significant differences were noted in the isotopic profiles of H. guttulatus from IIM, when compared to the other two species, likely attributed to phylogenetic dissimilarities (Keppeler and Winemiller, 2020) and variations in seawater temperature (Valladares and Planas, 2020), given the tropical nature of H. kuda and H. reidi in contrast to the temperate H. guttulatus. Moreover, significant differences were observed in the isotopic profiles of H. guttulatus from the two research centers and between wild and cultured specimens (ANOSIM, p-value <0.001 and p-value = 0.06, respectively), with 15N emerging as the significantly contributing variable. Isotopic profiles of dorsal fins appear to be a promising, non-lethal approach for tracing the geographic origin of live cultured seahorses and to discriminate between wild and cultured specimens. However, additional studies are needed to validate the reliability of this method for other seahorse species and specimens sourced from the wild. This tool may also be of interest for the certification of production centers.

Keywords: *Hippocampus spp., stable isotopes, fin clipping, geographic origin*

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Acknowledgements. The authors acknowledge the support of project CITAQUA, Desenvolvimento do Projeto de Reforco do Polo de Aveiro (H4), framed within Measure 10 of Investment TC-C10-i01 - Hub Azul - Rede de Infraestruturas para a

Economia Azul, financed by the Recovery and Resilience Plan (RRP) and supported by Fundo Azul of the Portuguese Government. This work was also supported by national funds through Fundacão para a Ciencia e Tecnologia (FCT) under a PhD grant to Ana Cabral (UI/BD/153063/2022). Additionally, this study received Portuguese national funds from FCT through projects UIDB/04326/2020, UIDP/04326/2020 and LA/P/ 0101/2020 and was financed by the scientific project HIPPONUTRE Cultivo do cavalo marinho de focinho comprido, Hippocampus guttulatus: Optimizacão zootecnica e avaliacão de requisitos nutricionais (Ref. proj. 16-02-01-FMP-54), financed by the Programa Operacional MAR2020. Seahorses from IIM-CSIC were cultured under project Hippoeco through Spanish national funds (Ref.CGL2015-68110-R, Ministerio de Ciencia, Innovación y Universidades) and co-funding by FEDER. Acknowledgements are also due to FCT/MEC for the financial support to CESAM (UIDP/50017/2020+UIDB/50017/2020) and to GEOBIOTEC (UIDP/04035/2020) through national funds and co-funding by FEDER, within the PT2020 Partnership Agreement and Compete 2020. We also acknowledge the project Impacto e Consolidação em I&DT da Unidade de Investigação Química Orgânica, Produtos Naturais e Agroalimentares em áreas Agroalimentares e afins ICT_2009_02_005_2034 for financing the ICP-MS.

Newly extruded embryos of the pink spiny lobster (Palinurus mauritanicus): Insights into fatty acid profiles

Simão Maia[†,⋆,1], Ricardo Calado[1], M. Rosário Domingues[2], Marisa Pinho[3], Joana Figueira[4], Sérgio M. Leandro[4], Sam Dupont [5], Felisa Rey[2]

1. Centre for Environmental and Marine Studies, Department of Biology, University of Aveiro Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. Centre for Environmental and Marine Studies and Mass Spectrometry Centre LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
3. Centre for Environmental and Marine Studies, Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
4. MARE Marine and Environmental Sciences Centre, Politécnico de Leiria, ESTM, 2520-630 Peniche, Portugal
5. Department of Biological and Environmental Sciences, University of Gothenburg, Kristineberg 566-45178 Fiskebäckskil, Sweden

⋆ Corresponding author; smaia@ua.pt; † Presenting author; Marine science, technology and management.

Abstract. The pink spiny lobster, Palinurus mauritanicus, holds high commercial value (Mamadou et al., 2021), spurring interest in sustainable farming technologies to reduce reliance on wild populations (Nankervis & Jones, 2022). However, our understanding of spiny lobster reproductive biology remains limited (Goñi & Latrouille, 2005; Yeap et al., 2022). Embryonic development of decapod crustaceans is lecithotrophic (Rosa et al., 2007). Uneven nutritional reserve distribution during oogenesis can cause within-brood variability, resulting in varying yolk reserves and unequal ability to withstand suboptimal feeding of newly hatched larvae (Rosa et al., 2007). The present study tested whether the fatty acid (FA) profile of P. mauritanicus newly extruded embryos are influenced by their position in the brooding chamber. The bilateral nature of P. mauritanicus ovaries was the rationale supporting the sampling of embryos attached to 16 different regions of six females brooding chamber. Palinurus mauritanicus embryos showed a similar FA profile regardless of their position in the brooding chamber. A total of 29 FA were identified, with embryos showing high levels of 18:1 n-9 (13.81 +/- 1.70 -16.19 +/- 3.24 ug mg-1 DW), 16:0 (10.25 +/- 1.70 - 11.70 +/- 2.96 ug mg-1 DW), 20:5 n-3 (3.75 +/- 1.49 - 11.27 +/- 1.30 ug mg-1) and 22:6 n-3 (3.73 +/- 1.56 - 13.30 +/- 2.79 ug mg-1 DW). Monounsaturated FA were the most abundant FA class, representing more than 30 ug mg-1 DW in embryos from the different regions of the brooding chamber, followed by polyunsaturated FA and saturated FA. These findings suggest that maternal investment of P. mauritanicus promotes homogeneous lipid catabolism during embryogenesis. Furthermore, such information provides insights into P. mauritanicus reproductive biology, and contributes with important data for development of suitable maturation diets for spiny lobster broodstock.

Keywords: *Crustaceans, Achelata, Embryogenesis, Maternal investment, Early-stage embryos, EPA, DHA*

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Acknowledgements. We acknowledge financial support to CESAM by FCT/MCTES (UIDP/50017/2020+UIDB/50017/2020+LA/P/0094/2020) and LAQV-REQUIMTE (UIDP/50006/2020 + UIDB/50006/2020), through national funds. Simão Maia acknowledges FCT by financially supporting his PhD grant (REF: 2020. 05286.BD; https://doi.org/10.54499/2020.05286.BD). Felisa Rey acknowledges FCT/MCTES for individual funding in the scope of the Individual Call to Scientific Employment Stimulus (CEECIND/00580/2017, https://doi.org/10.54499/CEECIND/00580/2017/CP1459/CT0005).

Megabenthos associated to cold-water coral reefs and mounds across the deep Atlantic Ocean

Teresa Cardoso Ferreira[†,⋆,1], Ana Hilário[1], Covadonga Orejas[2], Claudia Wienberg[3]

1. Centre for Environmental and Marine Studies, Department of Biology, University of Aveiro Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. Gijón Oceanographic Centre, Spanish Institute of Oceanography, Avenida Príncipe de Asturias 70 bis, 33212 Gijón (Asturias), Spain
3. MARUM Center for Marine Environmental Sciences, University of Bremen, Leobener Strasse, 28359 Bremen, Germany

⋆ Corresponding author; tcferreira@ua.pt; † Presenting author; Marine science, technology and management.

Abstract. Cold-water corals play an important structuring and functional role in the deep sea (Buhl-Mortensen et al., 2015). Desmophyllum pertusum and Madrepora oculata can build prominent and complex deep-seafloor structures ranging from present-day reefs to mounds built over geological timescales, which constitute habitats for rich megabenthic communities (Roberts et al., 2006). These habitats occur widely along the continental margins of the Atlantic Ocean where variable environmental conditions and differences in megabenthic communities have been documented (BuhlMortensen et al., 2017; Hebbeln et al., 2014, 2020). However, Atlantic-wide comparisons are lacking despite being essential to obtain accurate knowledge of species distribution and understanding the role of environmental drivers. Accordingly, this work aims to characterize megabenthic communities associated with cold-water coral mounds and reefs across three different regions in the Atlantic. Seabed imagery and environmental data from cold-water coral mounds in the Porcupine Seabight (NE Atlantic), the Gulf of Mexico (NW Atlantic) and off Angola (SE Atlantic) will be used to describe megabenthos composition including structuring coral species, investigate the relation between environmental parameters and species occurrence, and lastly build species distribution models. Preliminary observations of ROV imagery comprising comprehensive searches of different observable morphospecies (> 5 cm) already allowed to identify potential differences between regions. For instance, larger numbers of poriferan, cnidarian and fish morphospecies were observed off Angola, contrasting with a potential absence of crinoids and holothurians which were in turn present in the Porcupine Seabight. Ongoing and upcoming work will allow to fully assess megabenthos presence/absence and species density across regions, as well as to explore the functional diversity, environmental setting variation and evidence of anthropogenic impacts. Overall results are expected to improve the knowledge of different mounds and reefs delivering for the first time an Atlantic-wide comparison, contributing to inform management and conservation of Vulnerable Marine Ecosystems urging protection and currently threatened by climate change and fishing.

Keywords: *Deep-sea ecology, Species distribution, Ecosystem engineers, Vulnerable marine ecosystems, Biodiversity*

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Acknowledgements. We acknowledge financial support of Fundação para Ciência e Tecnologia (FCT) through the PhD grant awarded to Teresa C. Ferreira (PRT/BD/154427/2022) financed by protocol with AIR Centre.

Marketing and strategy

Is sustainability relevant to explain tourists intentions toward the use of Virtual Reality? - a conceptual model development

Filipa Jorge[†,⋆,1], Manuel Au-Yong-Oliveira[2], Mário Sérgio Teixeira[3], Maximino Bessa[4]

1. Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP), University de Aveiro
2. DEGEIT, University of Aveiro, Campus Universitario de Santiago, 3810-193 Aveiro, Portugal
3.
4. University of Trás-os-Montes and Alto Douro (UTAD), Quinta de Prados 5000-801, Vila Real, Portugal
5. Centre for Transdisciplinary Development Studies (CETRAD)
6. INESC TEC, Porto, Portugal

⋆ Corresponding author; † Presenting author; Marketing and strategy.

Abstract. In recent years, particularly since COVID-19, digital tourism has been described as a form of sustainable tourism since visiting tourist destinations or attractions can be considered a sustainable form of travel because it allows better management of the carrying capacity of destinations suffering from over tourism. This approach also contributes to reducing the emission of polluting gases, and it can be included as a source of income for the economic sustainability of organisations in the tourism industry. One of the technologies used to enable tourists to experience digital tourism activities is Virtual Reality (VR). According to the literature, this technology may be used as a promotional tool, as a complement to the tourist experience, or as a way of providing tourists with a memorable tourist experience (Leung et al., 2022). Several studies suggest that tourists are receptive to the use of VR and identify the main characteristics that may be developed to increase the probability that this technology be used by tourists (Itani & Hollebeek, 2021; Vishwakarma et al., 2020). However, few studies explore the importance of sustainability concerns as antecedents of the intention to use VR for tourism purposes. Additionally, few empirical studies focus on the willingness to pay for the use of this technology.
This study aims to justify the conceptual model proposing that tourists perceptions about sustainability are determinants of their intention and willingness to use VR for tourism purposes. To achieve this objective, a quantitative approach is proposed, suggesting the use of a questionnaire as a data collection instrument. The proposed questionnaire should be completed by individuals who have travelled at least once in the previous year. As the proposed study does not include VR experience, the questionnaire can be administered in person or remotely via forms platforms. Data should be analysed using structural equation modelling, allowing us to understand the significance of the hypotheses presented in the conceptual model, and to analyse the indirect effects of the determinants on the two dependent variables, the intention to use VR and the willingness to pay for the use of this technology.The results of the conceptual model empirical test could be valuable for management and marketing professionals in the tourism industry, enabling them to understand whether tourists who are more sensitive to sustainability issues are the ones who should be targeted for the use of VR for digital tourism activities.

Keywords: *Virtual Reality, tourism, sustainability*

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The Role of Positive Supply Chain Management in Global Market Leadership

Abolghasem Safarzadeh Amiri[1], Manuel Au-Yong-Oliveira [2], Sh. Rasekh[3]

1. DEGEITDepartment of Economics, Management, Industrial Engineering, and Tourism
2. 2GOVCOPPResearch Unit on Governance, Competitiveness and Public Policies
3. Dpt. Materials and Ceramic Eng., CICECO-Aveiro Institute of Materials

⋆ Corresponding author; † Presenting author; Marketing and strategy.

Abstract. Abstract
Background: The advancement of markets has brought significant disruptions in various industries, necessitating renewed business strategies to thrive in the globalized era.
This analysis examines the several sections of the organization for executive purposes to schedule, implement, and monitor the company's activity (Melnik and Ermolaif, 2020).
Its purpose is to examine the importance of Supply Chain Management (SCM), which entails consistently acquiring knowledge and evolving in response to markets (Khan et al, 2021).
Objectives: Our objectives are to evaluate the impact of Supply Chain Management (SCM) strategies on organizational behavior in the global market and to investigate the potential of technological innovations within SCM to enhance agility, competitiveness, and adaptability.
Research Gap: Many papers have analyzed SCM strategies separately, there is a need to consolidate these strategies and discuss their pros and cons comprehensively within one article.
Methodology: This would be a systematic review of existing literature that explores the relationship between SCM, and business strategies adopted by the global market, with a specific focus on how they contribute to the success and growth of organizations in the markets globally. The powerful bibliometric analyses software, VOS viewer, is used for an analysis of related scientific journals and papers, focusing on last 5 years sources from 2019 to 2024.
In conclusion: Developing sales discounts and offers through considered price optimization of goods/ services is critical (Liu et al, 2024), for which SCM is pivotal in cost reduction, optimizing material/ product management, as well as refining processes (Vaiit & Iorait, 2023).

Keywords: *SCM, IT solution, Global Trading, Market Leadership*

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Materials science and engineering

Investigating the electromechanical properties of ZnO nanoparticles-embedded bacterial nanocellulose films

Fernando G. Sá[†,*,1], Anna Laromaine[2], Paula M. Vilarinho[3], Paula Ferreira[1]

1. CICECO Aveiro Institute of Materials, Department of Materials Ceramic Engineering, University of Aveiro, Aveiro, 3810-193, Portugal
2. ICMAB-CSIC - Institut Ciència de Materials de Barcelona, Campus UAB, 08193 Bellaterra, Spain fernandosa@ua.pt
3. CICECO

* Corresponding author; fernandosa@ua.pt; † Presenting author; Materials science and engineering.

Abstract. In contemporary society, we constantly face technological advancement, compelling industries to achieve a delicate balance between miniaturization and the enhanced sustainability of electronic devices. The pursuit for sustainability extends beyond the needs for recyclability or disposability of electronic equipment; it also encompasses the importance of making these systems energetically self-sufficient. This can be accomplished by integrating energy harvesting techniques with biopolymers, leading to the development of nanosensors or nanogenerators. Cellulose, Earth's most abundant polymer, presents itself as a promising candidate for bioelectronics applications. Bacterial nanocellulose (BC) provides an environmentally superior alternative compared to its wood-based counterpart, being synthesized by a greener route with bacteria while presenting higher crystallinity. BC is an ideal substrate for incorporating active materials, such as conductive or piezoelectric nanostructures. Piezoelectricity, the conversion of mechanical energy into electrical energy, is exhibited by materials like zinc oxide (ZnO), a vastly studied sustainable semiconductor oxide with easy synthesis processes and notable biocompatibility.
This work focuses on understanding the electromechanical behaviour of BC and further studying the impact of ZnO in these properties. The BC ZnO composites were made through an in-situ growth methodology using a microwave-assisted hydrothermal synthesis. After multiple washing cycles and drying, the films underwent comprehensive characterization such as X-ray diffraction (XRD), Raman spectroscopy, scanning electron microscopy (SEM), ultraviolet-visible (UV-Vis) spectroscopy, and Fourier-transform infrared spectroscopy (FTIR). The ensuing electric characterization was performed with a shaker equipment and the examination of mechanical and piezoelectric properties at the nanoscale was done through atomic force microscopy (AFM) and piezoresponse force microscopy (PFM). The effect of poling on the electromechanical properties of these films was also investigated.

Keywords: *Electromechanical properties, bacterial cellulose, zinc oxide, composite, nanosensor*

Acknowledgements. This work was developed under the scope of the CICECO-Aveiro. Projects: FCT (UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020); FS also thanks FCT for the PhD grant SFRH/BD/150787/2020 and COST CA20126.

Alternative sintering techniques for barium strontium titanate (BST) dielectric ceramics

Camila Ribeiro[†,⋆,1], Oleksandr Tkach[1], Elisabete Costa[1], Paula Vilarinho[1]

1. Department of Materials and Ceramic Engineering, CICECO - Aveiro Institute of Materials, 3810-193 Aveiro, Portugal

⋆ Corresponding author; camila@ua.pt; † Presenting author; Materials science and engineering.

Abstract. The growing demand for advanced ceramics that enable electronic devices for a sustainable and digital society has intensified the search for improved performance of dielectric materials such as (BaxSr1-x)TiO3 (BST) ceramics. BST is a vital dielectric material in tunable devices for modern wireless communication technologies, owing to its high dielectric tunability and low dielectric loss. The conventional processing of BST ceramics requires a high sintering temperature above 1300 žC, leading to increased grain size. It is well known that optimizing and tailoring the electrical properties significantly depends on the microstructural characteristics of these materials. To address these challenges, this doctoral research investigates several alternative sintering techniques aimed at reducing the required sintering temperatures while enhancing material performance and controlling microstructure development. The techniques under exploration include the Cold Sintering Process (CSP), Flash Sintering (FS), and Spark Plasma Sintering (SPS), among others. The study will thoroughly evaluate the impacts of these methods on the structure, microstructure, and electrical properties of BST electroceramics. Ultimately, the goal is to develop innovative, sustainable processing routes for high-performance, lead-free materials, thus paving the way for their broader application in advanced technologies.

Keywords: *Alternative sintering process, BST, Dielectrics*

Acknowledgements. This work was developed within the scope of the project CICECO - Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MEC (PIDDAC). Camila Ribeiro acknowledges FCT for the Ph.D. grant (2020.09855.BD) support. Alexander Tkach acknowledges FCT for financial support under independent researcher grant 2021.02284.CEECIND/CP1659/CT0018 (DOI 10.544 99/2021.02284.CEECIND/CP1659/CT0018).

Bend-testing evaluation of transparent thin films of niobium molybdenum oxide for electrochromic applications

Alice Marciel[†,⋆,1], Jorge Monteiro[2], Joel Borges[3], Filipe Vaz[3], Rui Silva[4], Manuel Graça[2]

1. I3N and CICECO
2. I3N
3. CF-UM-UP
4. CICECO

⋆ Corresponding author; alicemarciel@ua.pt; † Presenting author; Materials science and engineering.

Abstract. The fabrication of electrochromic devices on flexible substrates entails the deposition of multiple layers of functional thin films. These films must retain their mechanical integrity throughout both operation and their expected lifespan. In this study, we investigated the mechanical integrity of a commercial indium tin oxide (ITO)-coated polyethylene terephthalate (PET) substrate, and transparent niobium molybdenum oxide (NbxMoyOz) thin films grown on the above mentioned substrate by reactive magnetron sputtering. Bend-testing was conducted using a custom-built system with collapsing radius geometry, equipped with in-situ electrical measurement capabilities. The bending radius varied from 20 mm to 8 mm over 20,000 cycles. The damage progression in both ITO and niobium molybdenum oxide thin films was analyzed using a scanning electron microscope (SEM).
A transition from stable to unstable crack propagation was observed at a critical bending radius of 13 mm for the ITO-coated PET sample. For the ITO-NbxMoyOz composite film, this critical bending radius decreased to 10 mm. Post-critical bending radius, the electrical resistance of the samples showed an exponential increase in the ITO-coated PET sample, while the ITO-NbxMoyOz composite exhibited a slower rate of increase. This suggests that the NbxMoyOz layer mitigates the rapid mechanical degradation of the ITO base electrode.

Keywords: *Niobium molybdenum oxide, Flexible substrate, Bend-testing, Electrochromic*

Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MCTES (PIDDAC) and with the support of the i3N, UIDB/50025/2020, UIDP/50025/2020 and LA/P/0037/2020 projects, as well as the following projects LISBOA-01-0247-FEDER-039985/POCI-01-0247-FEDER-039985.

Stability of the cubic phase in CsSnCl3 perovskite maintained under different humidity and luminosity conditions

William Renan Basso Bassoli[†,⋆,1], Deise Shafer[2], Cristiani Campos Pla Cid[2]

1. Thin Films and Surfaces Laboratory - Materials Engineering Department
2. Thin Films and Surfaces Laboratory - Physics Department

⋆ Corresponding author; willbassoli@gmail.com; † Presenting author; Materials science and engineering.

Abstract. Perovskite is the name of a group of materials that share the same crystal structure, with a basic chemical formula of ABX3, where A and B are cations of different sizes and X is a halide. The approximate structure resembles a face-centered cube; however, the difference between the A and B cations can distort this structure. The perovskite CsSnCl3 has various potential applications, including its potential use in photocatalysis tests, LEDs, solar cells, photodetectors, and photovoltaics, due to its bandgap values ranging from 2.8 to 3.8 eV. However, its low structural and chemical stability has limited its use. Ziyan Wu et al. [1] observed that this type of material undergoes physicochemical changes within a few days under moisture and light conditions, leading to the loss of its photocatalytic activity and thus limiting its intended applications. Based on the study conducted by Tianchen Xia et al. [2], it was possible to produce CsSnCl3 nanoparticles and extend the stability of the perovskite for a period exceeding 3 months, employing a preparation methodology that uses water as a reactive medium without the need for a glovebox. DSC analysis indicates that only the cubic phase is formed in CsSnCl3 systems above 110řC, a phase that presents bandgap values applicable for use in solar cells. However, through a route developed by us, it was shown that at this temperature, the synthesis process involves the coexistence of cubic and monoclinic phases (30% by weight and 70% by weight, respectively). Furthermore, the cubic phase evolves into the monoclinic phase during the system's degradation, occurring when subjected to variations in humidity and luminosity. Therefore, this study considered different synthesis temperatures ranging from 100řC to 200řC to optimize the initial formation of the cubic phase. Apart from controlling the structural phases by the Rietveld refinement technique regarding the larger fraction of each phase concerning the synthesis temperature, the nanoparticles were characterized for their morphology by transmission electron microscopy, showing an average particle size variation from 60 to 100 nm in a spherical shape. Bandgap values were obtained through UV-Vis spectroscopy and ranged between 2.8 and 3.8 eV, which is desirable for photocatalysis. The results obtained offer a new option regarding the stability of inorganic perovskites under ambient conditions of light and humidity.

Keywords: *Perovskite; CsSnCl3 nanoparticles; Structural stability*

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Acknowledgements. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001 and CAPES PRINT - PROGRAMA INSTITUCIONAL DE INTERNACIONALIZAÇÃO - UFSC.

Electrical Impedance Spectroscopy Analyses of Chitosan-based Films

Dayana L. Guzmán Sierra[†,⋆,1], Paula M. Vilarinho[1], Claudia Nunes[1], Paula Ferreira[1]

1. University of Aveiro

⋆ Corresponding author; Dlguzmans@ua.pt; † Presenting author; Materials science and engineering.

Abstract. Chitosan, a biopolymer obtained via chitin deacetylation, has garnered significant research interest across diverse fields owing to its unique properties, including biocompatibility, biodegradability, antimicrobial activity, and minimal cytotoxicity [1]. Dielectric properties, encompassing a material's electrical response under an applied electric field, are crucial for applications in electronics, energy storage devices, sensors, and biomedical engineering. The elucidation of the dielectric properties of chitosan holds the potential to provide valuable insights into its suitability for these aforementioned applications and pave the way for the design of novel materials with superior performance characteristics [2,3]. In this study, we employ Electrical Impedance Spectroscopy (EIS) and Fourier Transform Infrared Spectroscopy (FTIR) to investigate the influence of the chitosan films neutralization and of the incorporation of organic (chitin nanofibers) and inorganic (barium titanate nanoparticles) fillers within the matrix. Our findings unveil significant correlations between the targeted manipulation of specific functional groups and the observed dielectric response, encompassing both the capacitive and resistive components of the material. This investigation aims to contribute to a deeper understanding of polysaccharide-derived bionanocomposites, particularly within the context of their potential applications in future flexible electronics.

Keywords: *Chitosan, Impedance spectroscopy, Flexible biodegradable electronics*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MEC (PIDDAC). Also, this work was funded by national funds, through FCT, IP, in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of article 23, of the Decree-Law 57/2016, changed by Law 57/2017. FCT is acknowledged by the PhD fellowship ref. UI/BD/151142/2021.

Bioplastic coatings for paper based on agrifood byproducts

Mariana Vallejo[†,1], José Martinho Oliveira[1], Paula Ferreira[1], Idalina Gonçalves[1]

1. CICECO

⋆ Corresponding author; † Presenting author; Materials science and engineering.

Abstract. Non-biodegradable plastics that carry a negative ecological footprint have been widely used for paper coating industry. With a crescent search for more sustainable options, starch-based bioplastics have gained significant attention because of their natural ability to create a thermoplastic matrix applicable as biodegradable bioplastic coatings for paper. Nonetheless, there is still a necessity for improvement of its gas barrier, water tolerance, and mechanical performance. Agrifood byproducts have demonstrated the potential for mitigating these shortcomings [1]. In this work, the influence of powdered onion peels (OP) and of garlic peel (GP) on chromatic, mechanical, and water barrier properties of thermoplastic starch-based bioplastics for paper coating was studied. Under a circular economy approach, starch recovered from potato washing slurries was used.
OP and GP conferred an orange and brownish color to the bioplastics, respectively, while providing a natural brightness. OP increased the starch-based bioplastics Youngs modulus (YM) in ca. 150%, while GP decreased their YM in ca. 66%. Regarding the water barrier properties, OP and GP increased the surface hydrophobicity in ca. 50% and in ca. 30%, respectively. Additionally, thermoplastic starch/OP- and starch/GP-based bioplastics were both successfully applied onto the paper surface, showing adherence without compromising the mechanical and barrier properties of the coated materials.
Overall, this work highlights that starch-rich potato processing slurries, onion peels, and garlic peels can be successfully valorized to develop thermoplastic, flexible, and water tolerant bioplastic coatings paper, thus opening an opportunity to develop active and eco-friendly bioplastics for the paper coating industry.

Keywords: *Bioplastics; onion peel; garlic peel; starch; paper coatings*

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Acknowledgements. This work received FCT/MCTES funding through CICECO (UIDB/50011/2020; UIDP/50011/2020; LA/P/0006/2020) projects. FCT is acknowledged for the research contracts under the frame of the individual Call to Scientific Employment Stimulus (IG, https://doi.org/10.54499/CEECIND/00430/2017/CP1459/CT0032) and PhD scholarship 2022.13787.BD.

Tuning refrigeration in strain-engineered functional oxides: experimental perspectives

Venkata Ramana Eskilla[†,⋆,1]

1. Department of Physics, University of Aveiro, Portugal

⋆ Corresponding author; ramana.venkata@ua.pt; † Presenting author; Materials science and engineering.

Abstract. To reduce greenhouse gas emissions caused by the current vapor-compression based cooling technology, it is necessary to design low-noise and environmentally friendly refrigerants. Electric field-induced cooling can be viewed in this light as a promising, fast and affordable on-chip cooling method that can be scaled down to smaller dimensions. Nanostructures with switchable polarization, and near phase transitions, can exhibit large entropy changes that can be tuned by tailoring material properties (Wang et al., 2020). Compared to bulk crystals, artificially engineered ferroelectric heterostructures such as epitaxial thin films, possess inherent advantages for easy integration in microelectronics with higher efficiency energy-recovery strategies. In the current work, we developed and investigated caloric effects of two different oxide materials (Ramana et al., 2021; Ramana et al., 2022) (binary and perovskite) with varied dimensions. Detailed structure/microstructure and physical properties were evaluated. In-depth x-ray diffraction studies confirmed oriented growth of oxide ferroelectrics with varied lattice strains. In addition, binary oxide materials with different doping concentrations exhibited negative and positive caloric properties due to compositional changes. We observed adiabatic temperature changes >10 K and 6 K respectively for perovskite and binary oxide nanostructures. The results suggest that the growth of high-quality nanostructures with tuned lattice strain and dimensions are great candidates for future echo-friendly refrigerants that operate at moderate external stimuli for energy-efficient solid-state cooling.

Keywords: *Nanomaterials, Sustainability, Ferroelectric, Thin films*

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Acknowledgements. Portuguese foundation for science and technology (FCT) for the financial support by national funds (OE) in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of the article 23 of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19. The authors also acknowledge financial I3N, UIDB/50025/ 2020 & UIDP/50025/2020 funded by FCT/MEC. Part of this work was developed within the scope of the project FCT, I.P., Expl/CTM/CTM/0054/2021.

Shape-tailored silicon nitride green structures using digital light processing technology

J. R. S. Pereira[†,⋆,1], Cristina Fernandes[2], Sónia G. Patrício[1], José M. Oliveira[3]

1. CICECO Aveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193, Aveiro, Portugal
2. PALBIT, S.A., 3854-908 Branca, Aveiro, Portugal
3.

⋆ Corresponding author; † Presenting author; Materials science and engineering.

Abstract. Silicon nitride (Si3N4) is a non-oxide ceramic material showcasing outstanding chemical stability as well as thermal and mechanical (e.g. toughness, strength and hardness) properties, thus making it highly suitable to be applied in a plethora of industrial challenging environments as gas turbine engines, automotive turbochargers, bearings, thermocouple tube sleeves and cutting tools, among others[1]. Despite highly promising for different end-use industries, conventional shaping techniques[2] have hindered the Si3N4 market growth towards emerging opportunities and new products. From an industrial perspective, additive manufacturing (AM) technologies have represented a significant promise for the fabrication of disruptive silicon nitride structures with on-demand functionality[3], overcoming time-consuming and costly conventional processes.
In this work, highly loaded Si3N4 suspensions with suitable rheological properties and crosslinking kinetics were developed to be further applied in Lithography-based Ceramics Manufacturing (LCM). Based on this advanced digital light processing technology, we were able to fabricate complex green Si3N4-based structures encompassing a vast array of hollow geometries with highly accurate recreation of the CAD design. Therefore, high shape- and size-fidelity of Si3N4-based structures could be engineered to drive specific technological function. Currently, debinding and sintering conditions (temperature, dwell time and heating/cooling rate) are being optimized to achieve highly dense structures, aimed at offering alternative solutions to the hardmetal industry.

Keywords: *Silicon nitride ceramics; digital light processing; complex geometries*

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Development of laser textured surfaces for anti-icing aeronautical applications

Carlos Matos[†,⋆,1], Bernardo Espirito Santo[2], Martim Correia[2], Rúben Abreu[2], Georgina Miranda[1]

1. CICECO, Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Materials and Ceramic Engineering (DEMaC), University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Materials science and engineering.

Abstract. Ice accumulation on aircraft wings presents a critical safety concern, impacting performance and reliability, as it can influence aircrafts aerodynamics, increase drag and weight [1], [2]. The existing anti-icing methods mainly relying on electrical heating or surface chemical treatments, present some limitations regarding efficiency, weight, and environmental impact [3]. This study explores the use of surface laser modification as a novel approach to reduce or even mitigate ice formation on aircraft wings. This procedure would be considered a passive anti-icing method, presenting as biggest advantage the lack of energy requirements nor a need for periodic treatment [3]. By precisely altering the surface topography through laser irradiation, it is possible to reduce the surface wettability, either by preventing ice formation on the wings surface or by facilitating ice removal during flight operations by jointly using low power active systems [1], [3], [4]. A hydrophobic surface typically gathers properties such as low surface energy, that can be achievable through micro roughness modulation [4]. During this research study, several designs, including bio-inspired designs and several combinations of different laser parameters, namely laser power, scan speed and scanning strategies were investigated towards the modification of aluminium alloy surfaces. An aluminium alloy was selected for this study, since this material is commonly used on aircrafts due to their light weight and high strength [4]. The results demonstrated that the surface wettability was greatly reduced on the laser modified surfaces, offering a promising solution for improving aircraft safety and efficiency.

Keywords: *Anti-icing; Laser surface modification; Wettability; Hydrophobicity; Aluminium alloy.*

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Homogeneity study for glass fibre reinforced polyamide 6 composites produced by Thermoplastic Resin Transfer Moulding

F. P. Martins[†,⋆,1], P. S. Lima[2], J.M. Oliveira[1]

1. 1EMaRT GroupEmerging: Materials, Research, Technology, School of Design, Management and Production Technologies Northern Aveiro, University of Aveiro, Oliveira de Azeméis, Portugal. 2CICECO AveiroInstitute of Materials, University of Aveiro, Aveiro, Portugal
2. 1EMaRT GroupEmerging: Materials, Research, Technology, School of Design, Management and Production Technologies Northern Aveiro, University of Aveiro, Oliveira de Azeméis, Portugal. 3TEMACentre for Mechanical Technology and Automation, University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; ftomas@ua.pt; † Presenting author; Materials science and engineering.

Abstract. The increase of Global Greenhouse Gases (GHG) emissions can affect the worldt's biodiversity and natural resources. Aware of this problem, the automotive industry has been promoting new solutions to reduce GHG emissions. Polymer-based materials have been increasingly used in road vehicles mainly due to their low density. To use these materials in structural applications they need to be reinforced. Structural composites are currently made from thermosetting polymers, which leads to end-of-life problems.1
Thermoplastic-Resin Transfer Moulding (T-RTM) is a liquid moulding technology with the potential to produce lightweight thermoplastic composites. These materials can be reinforced with continuous fibres and have a higher recyclability potential. This technology consists on the injection of a thermoplastic monomer and its subsequent polymerization inside a mould. To produce a polyamide 6 matrix, an exotherm reaction occurs through anionic ring-opening polymerization of -caprolactam.2
T-RTM is not suitable at an industrial stage. Besides the common problems of liquid moulding technologies, as the presence of voids, the instability of the resin in the presence of moisture, oxygen and thermal gradients can cause heterogeneities in the manufactured parts. If polymerization occurs outside the mould, such as in the injection system, it can lead to clogging issues and therefore high repair costs.3 To improve the homogeneity of the parts, a new dynamic mixing and vibrational systems were developed based on a reciprocal movement and vibration of the resin inside the mould. The effect of each system on the production of the parts was evaluated through physical, thermal and mechanical analyses.
AP-Nylonő -caprolactam monomer (CL), Brüggolenő C1 catalyst (C1) and Brüggolenő C20P activator (C20P) were used in an 85:10:5 wt% ratio. For each part, two layers (30 vol.%) of Saertex X-E-573g/m2-1270mm glass fibres fabric were used.
The results indicate that the new systems can have a positive influence on the composites homogeneity.

Keywords: *T-RTM; thermoplastic matrix; dynamic mixing system*

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This work was also supported within the scope of TEMA - Center for Mechanical Technology and Automation, by the projects UIDB/00481/2020 and UIDP/00481/2020 - Fundação para a Ciência e a Tecnologia , DOI 10.54499/UIDB/00481/2020 (https://doi.org/10.54499/UIDB/00481/2020) and DOI 10.54499/UIDP/00481/2020 (https://doi.org/10.54499/UIDP/00481/2020); and CENTRO-01-0145-FEDER-022083 - Centro Portugal Regional Operational Programme (Centro2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional

Development Fund.

The effect of cork treatments on Polyamide 6/cork residues composites via in-situ polymerization

L. Santos†,⋆,1, S. P. M. Silva2, P. S. Lima1, J. Monteiro2, J. M Oliveira1

1. EMaRT GroupEmerging: Materials, Research, Technology, School of Design, Management and Production Technologies Northern Aveiro, University of Aveiro, Oliveira de Azeméis, Portugal
2. CICECO AveiroInstitute of Materials, University of Aveiro, University of Aveiro, Aveiro, Portugal
3. TEMACentre for Mechanical Technology and Automation, Mechanical Engineering Department, University of Aveiro, Aveiro, Portugal
4. Simoldes Plásticos S.A., Oliveira de Azeméis, Portugal
5. 1) EMaRT GroupEmerging: Materials, Research, Technology, School of Design, Management and Production Technologies Northern Aveiro, University of Aveiro, Oliveira de Azeméis, Portugal. 2) CICECO AveiroInstitute of Materials, University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; laura.santos@ua.pt; † Presenting author; Materials science and engineering.

Abstract. Cork industry produces around 50,000 tons/year of cork residues, which are almost entirely incinerated or landfilled. Derived from the cork oak tree, cork is a natural, renewable and recycling material. It has a particular alveolar-like structure that gives its unique characteristics. The use of cork waste has been investigated for the development of cork products with added value. Cork-polymer composites (CPC) are an example of this type of product, in which cork residues are added as a filler to a polymer matrix. However, the production of thermoplastic-based CPC should not be processed in conventional thermoplastic processing technologies, due to the use of high pressure that breaks downs cork alveolar-like structure and deteriorates the characteristics of cork [1 - 2].

Thermoplastic Resin Transfer Moulding (T-RTM) technology has been studied for the development of continuous fiber-reinforced composites. This technology requires low pressure due to the use of low-viscosity precursors, and polymerization takes place inside the mold, known as in-situ polymerization [3].

The main aim of this work is the study of thermoplastic-based CPC obtained from T-RTM technology (170 řC, 3 bar). Polyamide 6 (PA6) was used as the thermoplastic matrix, by mixing its precursors, AP-NYLONő Caprolactam (monomer), BRUGGOLENő C10 (catalyst) and BRUGGOLENő C20P (activator). MF5 cork granules (Amorim Cork Composites) were used as the filler. In order to improve the properties and dispersion of the cork in PA6, cork surface was chemically treated, such as alkaline and acetylation treatments. The addition of lignin as compatibilizing agent was also studied. The materials obtained were characterized by mechanical, morphological and thermal analyses.

The results obtained revealed that the treatment of cork surface promotes improved interaction with the polymeric matrix. As future work, continuous glass and flax fibres will be included in the CPC to improve its mechanical properties.

Keywords: *Cork-polymer composites, Thermoplastic Resin Transfer Moulding, cork treatments*

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Acknowledgements. This research was funded by the Portuguese Foundation for Science and Technology (Portugal) through the PhD grant 2023.02569 BDANA.
This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020

(DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC).
This article was also supported within the scope of TEMA - Center for Mechanical Technology and Automation, by the projects UIDB/00481/2020 and UIDP/00481/2020 - Fundação para a Ciência e a Tecnologia , DOI 10.54499/UIDB/00481/2020 (https://doi.org/10.54499/UIDB/00481/2020) and DOI 10.54499/UIDP/00481/2020 (https://doi.org/10.54499/UIDP/00481/2020); and CENTRO-01-0145-FEDER-022083 - Centro Portugal Regional Operational Programme (Centro2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund.

Bioinspired nanoparticle-reinforced bioplastics for food packaging

Sara Magalhães da Silva[1], Martinho Oliveira[⋆,2], Filipa Dinis[3], Liliana R. Sousa[†,4]

1. EMaRT Group - Emerging: Materials, Research, Technology, University of Aveiro, 3720-511 Oliveira de Azeméis, Portugal
2. Department of Materials and Ceramic Engineering
3. CICECO - Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
4. School of Design, Management and Production Technologies
5. CICECO Aveiro Institute of Materials, Department of Materials and Ceramic Engineering
6. United Resins- Produção de Resinas S.A.
7. EMaRT Group - Emerging Materials, Research, Technology

⋆ Corresponding author; † Presenting author; Materials science and engineering.

Abstract. Despite global initiatives to reduce consumption and carbon emissions, the use of plastics for food packaging has been increasing and still dependent on fossil resources, which increased pollution and greenhouse gas emissions [1]. Plastic industry must decarbonize to reach zero-carbon emissions by 2050, so the use of natural feedstocks with comparable performance and processability to fossil plastics can be a viable strategy for meeting current environmental demands. Herein, starch-based blends are being developed due to starchs availability, low cost, non-toxicity, and biocompatibility [2]. Starch reveals some drawbacks that are mostly related to water permeability and lower mechanical performance compromises their processability by injection molding. Rice is the world's most consumed cereal, so its processing generates tons of rice husk (RH). Cellulose is the major organic component (33%), where approximately 20%wt corresponds to the inorganic content, being 94% silica [3]. It possesses high thermal and mechanical stability, non-toxic and a high level of wettability. Silica nanoparticles (SiNPs) can be extracted and synthesized from RH ashes and have already proven to act as reinforcing agent in thermoplastic composites. At the end of the PhD project, it is expected to produce packaging solutions with starch-based blends as the polymeric matrix, the SiNPs as a reinforcement and the use of essential oils as compatibilizing agents.Currently, the work is focused on the preparation and characterization of starch-based blends using aliphatic polyesters, like polybutylene succinate (PBS). To improve the compatibility and performance of the developed blends, it will be evaluated the effect of pine resin as a compatibilizing agent. Therefore, the main objective of this study was to evaluate the effect of pine resin derivatives (5, 10, 20, or 30 wt%) on the structural, thermal, and mechanical properties of starch-based/PBS blends formulations prepared by an extrusion process.Such strategy will contribute to creating a sustainable alternative for rigid packaging adapted for injection moulding processes.

Keywords: *Rigid Packaging; Biocomposites; Agro-food Waste; Silica Nanoparticles; Starch-based Blends.*

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Acknowledgements. Liliana Sousa thanks FCT for the PhD grant 2023.02457.BDANA. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC).

Recovery of mill scale waste: Innovative approach to produce high value ceramic materials

Inês Vieira[†,⋆,1], Inês Silveirinha Vilarinho[1], Leire Buruberri[2], Jorge Carneiro[2], Maria Paula Seabra[1]

1. CICECO Aveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
2. GRESTEL - Produtos Cerâmicos S.A, Zona Industrial de VagosLote 78, 3840-385 Vagos, Portugal

⋆ Corresponding author; inesvieira00@ua.pt; † Presenting author; Materials science and engineering.

Abstract. Population growth, increasing purchasing power in developing countries and prevalent linear economy model lead to the scarcity of materials, the colossal expenditure of natural resources and the production of considerable quantities of waste/by-products which, in most cases, are disposed of in landfills. Hence, its imperative to explore sustainable alternatives to the materials utilized, notably within the ceramic sector, characterized by extensive consumption of high-cost virgin raw materials, including iron-based pigments. Mill scale is a waste produced in the steel rolling (SR) and wire drawing (WD) processes with an high iron content (> 68 wt.%), usually landfilled. To reduce its environmental impact and promote the closing of the cycle, this work aims to develop stoneware pastes using these two wastes as chromophore agents, replacing commercial pigments. The influence of the level of incorporation (3, 5 and 10 wt.%) and different pre-treatments (sieving at 250, 150 and 63 microns and grinding followed by sieving at 63 microns) on the properties of the prepared samples was evaluated. Pastes changed their colour, from beige to darker hues, varying between grey and reddish tones. More homogeneous and intense colours were obtained for smaller particle sizes and higher content of incorporation. Industrial tests were performed, based on the results obtained at a laboratory scale and the opinion of the company's design department. Two formulations were selected, and more than 30 plates were shaped and glazed. These were submitted to the tests normally carried out by the company on new products and their technical conformity was ensured, with thermal shock resistance enhanced, comparing with the standard. Levels of leached Fe, Pb, and Cd were analysed, and the immobilization of these compounds was confirmed. This discovery shows that mill scale can be used as a secondary raw material in stoneware pastes, acting as a chromophore agent, without compromising its properties, making it possible to obtain more sustainable products and, at the same time, reduce the amount of waste deposited in landfill.

Keywords: *Industrial waste; Circular economy; Stoneware; Industrial symbiosis; Sustainability.*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MCTES (PIDDAC).

Agrifood byproducts for the development of sustainable bioplastic packaging materials by blown extrusion

Paulo Brites[†,⋆,1], Cláudia Nunes[1], Nicolas Joly[2], Patrick Martin[2], Amparo López-Rubio[3], José Martinho Oliveira[4], Paula Ferreira[1], Idalina Gonçalves[1]

1. CICECO - Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
2. Unité Transformations Agroressources, ULR7519, Université dArtois-UniLaSalle, F-62408 Béthune, France
3. Food Safety and Preservation Department, IATA-CSIC, Avda. Agustín Escardino 7, 46980, Paterna, Valencia, Spain
4. CICECO Aveiro Institute of Materials, School of Design, Management and Production Technologies Northern Aveiro, University of Aveiro, Estrada do Cercal, 511, Santiago de Riba-Ul, 3720-509, Oliveira de Azeméis, Portugal

⋆ Corresponding author; paulodavid@ua.pt; † Presenting author; Materials science and engineering.

Abstract. Blown extrusion is the most widely used processing technique for flexible plastic production, so the use of this processing technique with biopolymers is highly desirable for the large-scale production of bioplastics. Thermoplastic starch (TPS)-based materials have garnered attention for their renewable and biodegradable properties. However, their widespread adoption is hindered by challenges such as low melt tenacity, limited thermal stability, brittleness, and sensitivity to water.Along the course of this PhD work, the suitability of using starch-rich rice and potato by-products for bioplastics processable by blown extrusion has been explored. Rejected colored rice (CR), a by-product from the rice-industry obtained during color sorting, allowed to develop flexible bioplastics with hydrophobic surfaces and processable by blown extrusion. On the other hand, rice dust (RD), a by-product from the rice flour industry, although showing a good film forming ability, gave rise to flexible and hydrophilic bioplastics. To overcome this limitation, RD has been esterified with palmitic acid and then compounded with a RD-based formulation. In the near future, it is expected the development of materials based on RC and RD suitable to produce bioplastic packaging through blown extrusion. Overall, this PhD thesis will contribute to advanced knowledges and addressing real-world challenges in various industrial fields such as agriculture, food science, material science, and environmental sustainability.

Keywords: *Polysaccharides; Bio-based films; Flexibility; Hydrophobicity; Circular economy*

Acknowledgements. This work was developed within the scope of the projects CICECO-Aveiro Institute of Materials, (UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020) and LAQV-REQUIMTE (UIDB/50006/2020; UIDP/50006/2020) and financed by national funds through the FCT/MCTES (PIDDAC). FCT is also thanked for Individual Call to Scientific Employment Stimulus (IG, https://doi.org/10.54499/CEECIND/00430/2017/CP1459/CT0032), and PhD grant (PB, UI/BD/151143/2021) Acknowledgement is also due to Qualiriso, Lda for providing RD and CR. The Accreditation of IATA-CSIC as Center of Excellence Severo Ochoa CEX2021-001189-S funded by MCIN/AEI/ 10.13039/501100011033 is also fully acknowledged.

Cvd + hipims deposited hybrid coatings for machining stainless steels

João Ferreira[†,1], Filipe Oliveira[1], Ana Girão[1], Daniel Figueiredo[1], Cristina Fernandes[1], Bruno Guimarães[1], Francisco Marques[1]

1.

⋆ Corresponding author; † Presenting author; Materials science and engineering.

Abstract. In the current era of energy transition, the manufacturing of new electric vehicles changed, as lighter and stronger materials such as high strength special steels are needed. Thus, harder, and stronger tools to machine those steels are also required [1,2].The main objective of this work is to investigate the application of one (AlCrN) or two (AlCrN + ZrN) final coating layers deposited by high power impulse magnetron sputtering (HIPIMS), onto carbide substrates previously coated by chemical vapor deposition (CVD) (TiCN-Al2O3-TiN). Another objective is to assess whether the textured alumina layer exhibits advantages over the non-textured counterpart concerning the tool life.Identification of the different crystalline phases and texture assessment was carried out by X-ray Diffraction (XRD). Scanning Electron Microscopy with Energy Dispersive Spectroscopy (SEM-EDS) enabled morphological characterization and mapping of the elemental distribution within the multilayered coatings [3].
Flank wear operations were also carried out to test the tools with an additional coating layer of AlCrN and AlCrN + ZrN deposited by HIPIMS on top of the final TiN layer. The machining performance in flank wear showed that the tool life of the textured insert is longer than that of the non-textured insert.
The latter is most probably due to the combination between the high increase in the hardness of the texturized alumina layer and its microstructure. The influence of the thickness of each layer and total thickness of the multilayered coating on the machining performance of high strength special steels was evaluated. The thickness layer of the texturized Al2O3 layer did not show any brittle failure and increased thickness demonstrated a relevant positive impact. Finishing the multilayered tools with a coating layer of AlCrN and AlCrN + ZrN also proved its benefits in the flank wear of high strength special steels. This work foresees new tools with short term universal application and superior productivity conditions.

Keywords: *Cutting tools, coatings, CVD, PVD, HIPIMS, AlCrN, roughness machining of stainless steels*

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TPMS-based metal-ceramic interpenetrating phase composites using additive manufacturing to materialize designs that enhance energy absorption

Simão Santos[†,*,1], Carlos Matos[1], Isabel Duarte[2], Susana Olhero[1], Georgina Miranda[1]

1. CICECO Aveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193, Aveiro, Portugal
2. TEMA Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal

* Corresponding author; simaocordeirosantos@ua.pt; † Presenting author; Materials science and engineering.

Abstract. Interpenetrating Phase Composites (IPCs) are advanced engineering composites with at least two continuous and topologically interconnected phases throughout the microstructure. Due to their continuous morphology, each phase can directly contribute to the final properties of the composite, allowing a combination of dissimilar properties (Guo et al., 2023). Metal-ceramic IPCs present promising potential owing to the combination of ceramic phase properties such as high hardness, wear resistance, and stability at high temperatures, with metal phase properties such as fracture toughness and thermal conductivity. These collective traits make metal-ceramic IPCs well-suited for demanding applications such as cyclic fatigue situations, braking systems, high-temperature conditions, and lightweight armour (Kota et al., 2022). Furthermore, the spatial arrangement of each phase within the IPC significantly affects its behaviour. IPCs featuring randomly distributed phases induce uncertainties and diminish control over the composite properties (Al-Ketan et al., 2017). Conversely, architected IPCs with a periodic phase distribution offer precise control over the desired properties by adjusting various parameters that define the 3D topology (Al-Ketan et al., 2017). This work studied the effect of phase distribution on the mechanical properties of architected aluminium-alumina IPCs. Alumina Triply Periodic Minimal Surface (TPMS) structures were fabricated using Digital Light Processing AM technology and aluminium was infiltrated into the macro porosity of the alumina structures using Investment Casting. A comprehensive characterization was conducted, encompassing alumina TPMS structure's printability, shrinkage and mass loss, specimen morphology, chemical and crystalline characterization, density assessment, and mechanical testing. In summary, the incorporation of aluminium into the brittle alumina TPMS structures resulted in notable alterations to the compressive behaviour of the samples, exhibiting energy absorption characteristics. Also, this integration contributed to an average improvement in the compressive offset stress of roughly 6% compared to the original aluminium alloy. Diamond and Gyroid IPCs exhibited comparable mechanical properties and demonstrated the highest mechanical performance.

Keywords: *Interpenetrating phase composites (IPCs); Triply Periodic Minimal Surface (TPMS); Additive Manufacturing; Investment casting; Energy absorption*

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Screen-printable bio-based sensor for fish packaging

Hélder Baptista[†,⋆,1], Matthijs Dekker[2], Paula Ferreira[1], Cláudia Nunes[1]

1. CICECO - Aveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
2. Food Quality and Design Group, Wageningen University and Research, P.O. Box 17, 6700 AA Wageningen, The Netherlands

⋆ Corresponding author; hbaptista@ua.pt; † Presenting author; Materials science and engineering.

Abstract. Food waste is a growing issue, addressed over the past decade through extensive research around intelligent food packaging. The capability to monitor the food product, providing real-time information about its freshness allows for enhanced food quality and/or safety (Salgado et al., 2021). During spoilage, fish releases total volatile basic nitrogen (TVB-N) compounds, which induces an alkaline environment. As anthocyanins change color under different pH, they can act as colorimetric indicators of fish freshness (Sun et al., 2021). While most research focus on embedding anthocyanins within the packaging matrix, achieved mostly via high-cost and low scalable techniques, this work explores screen-printing to print a bio-based sensor onto packaging. This technique is affordable, adaptable and allows printing of the most intricate designs over plenty of surfaces (Hematian et al., 2023).
A screen-printable anthocyanins-based ink was explored as a colorimetric sensor for the spoilage detection of packaged fish. Extraction of anthocyanins from red cabbage was done for 20-60 minutes using ultrasonication and different concentrations of ethanol (60-90%) to evaluate their yield and antioxidant activity. An extraction yield of up to 84 mg/100 g of fresh weight (FW) and a high ABTS+ inhibition (49%) were obtained, corresponding to the extract of 80% ethanol for 50 minutes. The extract was then freeze-dried to obtain a powder which was integrated, at 20% w/v, in solutions of water soluble chitosan (WSC) and starch (S) and printed on paper and plastic. Different ratios (WSC:S) were explored in terms of viscosity and recovery rate to obtain the most uniform and saturated prints. The best formulation was found to be the WSC:S of 10:4. Moreover, the color change of the sensors was simulated by exposing them to ammonium hydroxide, which rapidly evaporates, inducing a basic environment. The color changed from violet to green, indicating the suitability of the sensor to detect TVB-N. The sensor also appeared to be reusable, since after 12 hours its color changed back to the original violet. As air exposition induced visible color loss, the sensors color stability (E*) was further evaluated for 28 days, under no humidity and N2 atmospheres. The color of the sensors remained stable, barely presenting any E*. Finally, the sensor was validated inside a closed environment at 4řC for 4 days with fish, and the change of color showed its aptness to indicate fish freshness.

Keywords: *Anthocyanins; antioxidant activity; TVB-N; sensor; color stability*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MEC (PIDDAC). Also, this work was funded by national funds, through FCT, IP, in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of the article 23, of the Decree-Law 57/2016, changed by Law 57/2017. FCT is acknowledged by the PhD fellowship funded with the 2022.11211.BD grant. We also thank the COST action CA19124.

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Fabrication and characterization of ceramics-based thermoelectric module for renewable energy applications

Parisa Amirkhizi[†,1], Andrei Kovalevsky[1], Shahed Rasekh [1]

1. Department of Materials Engineering and Ceramics (DEMaC), CICECO-University of Aveiro

* Corresponding author; † Presenting author; Materials science and engineering.

Abstract.
Nowadays, as we use more and more energy, the costs of fossil fuels constantly rise along with increasing greenhouse gas emissions. Thus, the search for alternative sustainable energy generation is essential. One promising option is thermoelectric (TE) power generation, which directly converts waste heat into electricity [1,2]. For these applications, not only TE materials with high performances are required, but good ceramics-metal joining processes are also necessary to produce TE modules with high power output.

The aim of this study is to fabricate high-performing materials, both n-type and p-type, using a cost-effective and easily scalable method, to be integrated as legs into a TE module. To achieve this goal, Ca0.93Sr0.07Co4O9 and Ca0.95Ce0.05MnO3, as p- and n-type materials, respectively, were prepared using attrition milled precursors [3,4]. These materials have shown promising TE properties, making them suitable candidates for applications in waste heat recovery and sustainable energy generation. The p-type material was compacted using hot uniaxial pressing at 900řC and 50MPa for 1 hour, while the n-type material was uniaxially pressed and sintered at 1310řC for 1 hour. The relevant TE properties were measured, including Seebeck coefficient, electrical resistivity, and thermal conductivity, as well as dilatometry for both compounds. Afterwards, these prepared legs were assembled into a TE module prototype, involving silver paste as a precursor for electrical interconnections. Finally, the module was characterized using a home-made system, cooling the cold side to around 18řC with a flowing water circuit, while heating the hot side to temperatures between 200 and 900řC.

The obtained results indicate that these TE modules have significant potential to effectively convert heat into electricity. This research contributes to the ongoing efforts in developing advanced materials for energy conversion and highlights the promise of calcium cobaltite and calcium manganite-based TE modules in addressing the global energy sustainability challenges.

Keywords: *Thermoelectric module, Renewable energy, Calcium Cobaltite, Calcium Manganite*

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& LA/P/0006/2020, financed by national funds through the FCT/MCTES (PIDDAC). Authors would like to acknowledge the use of Servicio General de Apoyo a la Investigación-SAI, Universidad de Zaragoza.

Development and characterisation of new sustainable composite materials for the automotive industry

Matilde Oliveira[†,⋆,1], João Matias[1], Vítor Neves[2], Mariana Banea[3]

1. DEMaCDepartment of Materials and Ceramic Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
2. NewStampEstampagem de Componentes Metalicos, Lda., Rua da Paz, nž 113-115, Cacia, 3800-587 Aveiro, Portugal
3. CICECOAveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; matilde.c.oliveira@ua.pt; † Presenting author; Materials science and engineering.

Abstract. With the growing concern of various industrial sectors with the topic of environmental sustainability, the search for "green"materials has become imperative. Composites reinforced with natural fibres are seen as an excellent alternative to those reinforced with synthetic fibres, since natural fibres are renewable and recyclable resources and, for this reason, this market has been growing exponentially in recent years.
This project is developed in collaboration with the Newstamp Company with the main objective to develop and characterize more sustainable composite materials reinforced with natural fibers (flax, hemp and bamboo) for the automotive industry. The project explores the manufacture of these new sustainable composites using the VARTM (vacuum assisted resin transfer moulding) technique, with different materials (natural fibres and thermosetting resins). The focus is to access different strategies that can contribute to improve the sustainability of composites, without compromising their properties (e.g. hibridization and use of poweribs made of natural fibres). All the natural fibre-reinforced composites produced are characterized in terms of their mechanical, physical, and thermal properties, using the properties obtained for synthetic fibre-reinforced composites, that are currently used in the automotive industry, as a reference.
The preliminary results show the potential of this type of fibres to reinforce composite materials. The composites reinforced with natural fibres present lower densities than composites reinforced with synthetic fibres typically around half the density. Likewise, hybrid composites show a significant decrease in values for this parameter.
These composites may contribute to enhanced durability, weight reduction, cost-efficiency, and design flexibility while providing protection against environmental factors and contributing to improved environmental performance in the automotive sector. Future research efforts will focus on the development of new sustainable materials using bio-based resins derived from natural sources in conjunction with natural fibres to enhance the sustainability of composites. This approach not only reduces reliance on petroleum-based resins but also will contribute to a more circular economy by offering recyclable materials. Ultimately, this project aims to support Newstamp Company in adopting environmentally friendly practices and developing strategies essential for global decarbonization efforts.

Keywords: *Composites; Natural Fibres; Automotive Industry; Sustainability*

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Optimizing bauxite residue and biomass fly ash mixtures for 3D printed geopolymers: promising metal sorbents for wastewater treatment

Mariana M. Almeida[†,⋆,1], Nuno P. F. Gonçalves[1], Tânia Gameiro[1], Zélia Alves[1], João A. Labrincha[1], Rui M. Novais[1]

1.

⋆ Corresponding author; mmalmeida@ua.pt; † Presenting author; Materials science and engineering.

Abstract. The growth of industrial activities worldwide has generated vast amounts of waste, creating both challenges and opportunities for sustainable resource management (Ahmed et al., 2024). Red mud (RM) and fly ash (FA) are both abundant industrial wastes, from alumina industry and biomass burn (Pilla et al., 2024). RM and biomass FA residues have been explored as raw materials for the preparation of geopolymers (Carvalheiras et al., 2023; Novais et al., 2018). Geopolymers are low-cost and eco-friendly aluminosilicate materials with a wide range of potential applications in civil engineering (Ibrahim et al., 2020) or environmental remediation (Gonçalves et al., 2024). Geopolymers are quickly emerging as a promising solution to tackle the rising concern of water contamination caused by hazardous pollutants, both organic and inorganic. Their unique properties make them an ideal candidate for remediating polluted water sources (UNDP and UN Environment, 2018). The use of additive manufacturing (AM) has been highly effective for preparing geopolymeric structures with high open porosity and interconnectivity between pores, which are critical features in adsorption process (Gonçalves et al., 2023).

In this work, we report the synthesis of 3D-printed geopolymers containing high amounts (up to 80 wt.%) of unexplored industrial residues (FA and RM) for wastewater treatment applications. The impact of the FA incorporation content in the fresh-state (calorimetric and rheological characterization) and hardened-state (porosity and mechanical strength) were evaluated. The influence of key printing parameters, including nozzle diameter and geometry alignment, on the resulting properties of the lattices was also evaluated. The most promising compositions were evaluated as lead (Pb) sorbents under continuous flow. The waste-based 3D-printed lattices have demonstrated an exceptional adsorption ability, achieving >95% removal efficiency within 2 hours. This innovative approach not only mitigates waste disposal problems but also promotes eco-friendly materials as a sustainable alternative for addressing environmental challenges.

Keywords: *Industrial waste, Geopolymers, Adsorption, Additive manufacturing, Circular economy*

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Mathematics

Navigating contradictions: a paraconsistent framework and its applications

Juliana Cunha[†,⋆,1], Alexandre Madeira[1], Luís Soares Barbosa[2]

1. CIDMA, Dep. Mathematics
2. INESC TEC, Dep. Informatics

⋆ Corresponding author; juliana.cunha@ua.pt; † Presenting author; Mathematics.

Abstract. Any classical logic satisfies the Principle of Non-Contradiction, which states that from contradictory premises, any formula can be derived. However, in certain cases, this principle may be unreasonable; for instance, it's unjustified to assume that someone with contradictory beliefs necessarily embraces any belief whatsoever. Consequently, challenges arise when confronted with scenarios containing inconsistent information, particularly when attempting to derive conclusions from such data, as classical logics are ill-suited for this task.Paraconsistent logics provide a flexible and controlled manner for reasoning among contradictory information. Their main feature lies in their rejection of the Principle of Non-Contradiction; inconsistency and triviality cease to coincide, and logic may cope with contradictions without annihilation of the discourse. As part of the first author's PhD thesis, our focus is on a paraconsistent framework that generalizes the Belnap-Dunn four-valued lattice [1]. Within this framework, information is represented by a pair of weights, which are parametric to a residuated lattice: one weight denotes evidence supporting truth, while the other assesses the potential for falsity [2]. Consequently, this framework accommodates a spectrum of scenarios, from consistency, when weights complement each other, to vagueness or inconsistency, otherwise. Finally, using this framework, we will introduce a paraconsistent logic and explore its potential applications in quantum computations and robotics.

Keywords: *Non classic logics; Paraconsistent logics; Computational models*

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Acknowledgements. This work was financed by PRR - Plano de Recuperação e Resiliência under the Next Generation EU from the European Union within Project Agenda ILLIANCE C644919832-00000035 - Project n 46, as well as by National Funds through FCT, the Portuguese Foundation for Science and Technology, within the project IBEX, with reference PTDC/CCI-COM/4280/2021.

On Hypergeometric Motives and their application to Diophantine Equations

Franco Golfieri[†,1], Ariel Pacetti[1]

1. Universidade de Aveiro

* Corresponding author; † Presenting author; Mathematics.

Abstract. The study of Diophantines equations is probably one of the oldest research areas in mathematics, which got a lot of attention after Fermats statement that the equation x^n + y^n = z^n does not have any solution if n 4 besides the trivial ones. After Wiles groundbreaking proof of Fermats statement a lot of attention has been given to the study of the so-called generalized Fermat equation. Let A,B,C be non-zero pairwise coprime integers and let p, q, r be positive integers, and consider the affine surface given by the equation Ax^p + By^q = Cz^r.The general approach to study these equations is the following:
1) Associate, to a putative solution of the equation, a geometric object.2) Modular method: Use modularity to associate this object to a space of automorphic forms.3) Try to eliminate these forms arriving to a contradiction, for example, analyzing their finite points for different primes
Darmon studied these geometric motives and gave them explicitly for some equations such as the ones of signature (p,p,q) and (q,q,p). For the ones of signature (p,q,r) he mentioned that the Frey representations attached to these equations come from the study of Hypergeometric motives. Then, in the project that will be presented in this presentation, we started jointly with my advisor Ariel Pacetti the study of properties about Hypergeometric Motives, and how they are closely related to the the study of the equations mentioned above.
The main contribution of this project is that one can replace the geometric object described by Darmon by a more combinatorial one, namely an hypergeometric motive. A hypergeometric motive has attached a compatible family of Galois representations, so is well suited for the modular method, but also possesses a rich theory of congruences to other hypergeometric motives. Also, there is no need to find any particular equation for the underlying geometric object, since many properties can be deduced from the parameters of the Hypergeometric Motives.
The aim of the present talk is to give a brief introduction to Hypergeometric Motives and give some examples on how these are related in solving some Generalised Fermat Equations.

Keywords: *Hypergeometric Motives, Galois representations, Diophantine Equations*

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Acknowledgements. This work was supported by CIDMA and is funded by the Portuguese Foundation for Science and Technology, under grant UIDB/04106/2020 (https://doi.org/10.54499/UIDB/04106/2020)

New developments in analysing multivariate compositional data

Marta Maltez[†,⋆,1], Adelaide Freitas[1], Magda Monteiro[2]

1. Universidade de Aveiro
2. Escola Superior de Tecnologia e Gestão de Águeda

⋆ Corresponding author; martamaltez@ua.pt; † Presenting author; Mathematics.

Abstract. Principal component analysis (PCA) aims to summarize the multivariate data structure allowing dimensionality reduction with maximum variability. Compositional data are constrained positive data that reflect relative information about the parts of a whole, such as a histogram of an ordinal categorical variable or the percentages of the parts within a whole. A data set with multivariate observation defined by a composition of p D-compositional variables (i.e. p variables each with D-part compositional components), called (p-dimensional) compositional data vector, can be thought as a three-way array. In this work, we proposed a new PCA-based methodology for more complex datasets defined by a set of r sample units (regions) given by n compositions of p D-compositional variables.

Keywords: *compositional data vector; PCA; longitudinal data; three-way data*

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Acknowledgements. This work was supported by CIDMA and is funded by the Fundação para a Ciência e a Tecnologia, I.P. (FCT, Funder ID = 50110000187) under Grants https://doi.org/10.54499/UIDB/04106/2020 and https://doi.org/10.54499/UIDP/04106/2020, projects UIDB/04106/2020 and UIDP/04106/2020.

Mechanical engineering

Advanced design of meta-structures through additive manufacturing: a review

João Ferreira[†,⋆,1], Sérgio Tavares[1], Victor Neto[1]

1. TEMA - Center for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; joaolmf@ua.pt; † Presenting author; Mechanical engineering.

Abstract. Metamaterials have garnered significant attention in recent years due to their ability to manipulate electromagnetic waves, acoustic waves, thermal conduction, and mechanical forces in unconventional ways. Unlike conventional materials, the properties of metamaterials are derived from their meticulously engineered internal structures, designed to exhibit specific behaviours. A scoping search methodology was used to conduct a literature review, assessing the current development of metamaterials and their production using additive manufacturing (AM) technologies. This review aims to provide a comprehensive overview of metamaterials, highlighting their distinctive characteristics, engineering applications, and the advanced fabrication techniques employed in their creation.
The defining feature of metamaterials is their engineered internal structure, which gives rise to their unique properties. These properties result from the specific arrangement of unit cells within the material, often at the microscale or nanoscale, also known as meta-structures (Patel, 2022). Metamaterials have a wide range of applications across various fields, thanks to their ability to manipulate different types of waves and forces, and can be classified as electromagnetic, acoustic, mechanical, and thermal metamaterials. Recent research in metamaterials has focused on enhancing their mechanical robustness, scalability, and multifunctionality. Computational models and simulations play a crucial role in designing and optimizing these materials for specific applications, with experimental validations essential to ensure that theoretical predictions are practically achievable.
Additive manufacturing (AM) plays a pivotal role in the fabrication of metamaterials. AM techniques enable the precise control and design of complex internal structures essential for their unique properties of metamaterials. The flexibility and precision offered by AM are unmatched by traditional manufacturing methods, making it indispensable in the development of metamaterials. In this context, key contributions of AM include the ability to create intricate geometries and complex structures, the support for a wide range of materials including metals, polymers, and composites (Bandyopadhyay & Heer, 2018), and the fact that it facilitates rapid prototyping and iterative design, allowing the fine-tuning of meta-structures and hence the properties of the metamaterial to meet specific requirements (Askari et al., 2020).Metamaterials represent a significant advancement in material science, offering unprecedented control over various physical phenomena. Their unique properties open new possibilities in various fields, from telecommunications to aerospace. Ongoing research and development efforts are likely to further enhance the capabilities and applications of metamaterials, solidifying their role as a cornerstone of modern engineering and technology.

Keywords: *Additive Manufacturing, 3D Printing, Metamaterials, Meta-structure Design, Rapid Prototyping*

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Acknowledgements. This work is funded by the Recovery and Resilience Plan (PRR) and by European Funds NextGeneration EU under the Project AET Alliance for Energy Transition, nr. C644914747-00000023, investment project nr. 56, of the Incentive System Agendas for Business Innovation with the application 08/2024/BI/AgendasPRR and through the FCT Fundação para a Ciência e a Tecnologia, I.P. and, when eligible, by COMPETE 2020 FEDER funds, under the Scientific Employment Stimulus Individual Call (CEEC Individual) CEECIND/04748/2017/CP1459/CT0048, and under the scope of the projects UIDB/04057/2020, UIDB/00481/2020 and UIDP/00481/2020, DOI 10.54499/UIDB/00481/2020 and DOI 10.54499/UIDP/00481/2020.

Constrained optimization for implicit constitutive modelling using RNNs

Rúben Lourenço[†,1], Pétia Georgieva[2], António Andrade-Campos[3]

1. DEM, Centre for Mechanical Technology and Automation (TEMA), University of Aveiro
2. DETI, Institute of Electronics and Informatics Engineering of Aveiro (IEETA), Aveiro, Portugal
3. Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 AVEIRO, Portugal

⋆ Corresponding author; † Presenting author; Mechanical engineering.

Abstract. Constitutive models describe the relationship between stress and strain for a given material. Under plasticity, the material behaviour is highly non-linear and depends on the loading history. It is critical to accurately model this path-dependency in order to predict the material response under different loading conditions. Artificial Neural Networks (ANNs) can implicitly learn constitutive relations directly from data, without assuming a mathematical formulation (Hornik et al, 1989). Particularly, Recurrent Neural Networks (RNNs) can model temporal data by maintaining an internal memory of past inputs. As such, RNNs have been shown to be effective in capturing the effects of loading history for materials that exhibit path-dependent behaviour (Borkowski et al, 2022).

Implicit constitutive modelling approaches in the literature rely on training ANNs with paired data, usually stress-strain, from numerically generated datasets. Nevertheless, in a real experiment, variables such as stresses are not measurable and the training should be carried out indirectly, using experimentally measurable variables only. Although, in theory, any network could be able to learn the constitutive behaviour of a material, given enough data, it usually works as a black-box model, because its structure is not easily interpretable. Moreover, there is no guarantee that its predictions are usable, as they can violate fundamental laws of mechanics and thermodynamics. Thus, it is necessary to enforce physics-based constraints when using ANNs for implicit constitutive modelling. These constraints act as a regularization agent, reducing the space of admissible solutions, and can be enforced using custom architectures, weight constraints or penalty/regularization terms (Asad et al, 2022; Linka et al, 2022; Masi et al, 2021).

In the present work, the training of an RNN-based material model is carried out employing different physical constraints, added as a loss penalty term. Results have shown that specific terms allowed for substantial improvements on the networks response during inference, but also produced consistent solutions when subject to unseen data and different loading conditions.

Keywords: *constitutive model, elastoplasticity, recurrent neural networks, indirect training, constrained optimization*

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Acknowledgements. Rúben Lourenço acknowledges the Portuguese Foundation for Science and Technology (FCT) for the financial support provided through the grant 2020.05279.BD, co-financed by the European Social Fund, through the Regional Operational Programme CENTRO 2020. This paper was also supported by the projects UIDB/00481/2020 - FCT UIDP/00481/2020-FCT, UIDB/50008/2020 - FCT and UIDP/50008/2020 - FCT. This project also supported by the Research Fund for Coal and Steel under grant agreement No 888153.

The role of processing conditions on the density, morphology, and mechanical properties of extruded polystyrene foams

Carlos M. Correia[†,⋆,1], Idalina Gonçalves[2], Victor Neto[1]

1. TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
2. CICECOAveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Mechanical engineering.

Abstract. Recently the benefits of inducing density gradients within foamed materials for obtaining products with a unique set of properties has been highlighted. However, the production of density-graded foams (DGF) requires a thorough understanding of foam manufacturing technologies and their effects on the material properties. In continuous foam extrusion, processing parameters have a direct impact on the properties of the foams. Therefore, the purpose of this study is to investigate the influence of extrusion parameters on the density, morphology, and mechanical performance of expanded polystyrene (EPS)-based foams. The parameters investigated were the concentration of a chemical blowing agent (CBA) consisting of a mixture of citric acid and sodium bicarbonate, the extrusion temperature, and the screw speed. To assess the influence of each of these parameters on the properties of the extruded foams, a full factorial design of experiments (DoE) methodology with 3 variables including CBA concentration (0 wt.%, 1 wt.%, 2 wt.% and 4 wt.%), die temperature (125řC, 135řC, 145řC, 155řC) and screw speed (40 rpm, 60 rpm and 80 rpm) were considered, in a total of 48 experiments. The obtained results highlight the role of the CBA in foaming behavior of EPS, with concentrations as low as 1 wt.% contributing to a decrease of 85% in the foam apparent density in relation to the neat polymer. Higher die temperatures and higher screw speeds contribute to further decrease of the apparent density, but at the expense of a decrease in both longitudinal expansion ratio and compression strength of the extruded foams. Further experiments will be focused on using the gathered data to better comprehend the role of foam extrusion conditions in the production of materials with controlled cellular structure, thus paving the way for the continuous production of DGF.

Keywords: *density-graded foams; continuous foam extrusion; extruded foams; design of experiments*

Acknowledgements. This work is supported by FCT Fundação para a Ciência e Tecnologia the projects TEMA (UIDB/00481/2020 DOI 10.54499/UIDB/00481/2020 and UIDP/00481/2020 DOI 10.54499/UIDP/00481/2020) and CICECO (UIDB/50011/2020, UIDP/50011/2020, and LA/P/0006/2020). FCT is also acknowledged for the CMCs PhD grant with ref. 2023.01412.BD and by the Individual Call to Scientific Employment Stimulus (IG, https://doi.org/10.54499/CEECIND/00430/2017/CP1459/CT0032). The authors also acknowledge the financial support from the Project Agenda ILLIANCE [C644919832-00000035 | Project nž 46], financed by PRR Plano de Recuperação e Resiliência under the Next Generation EU from the European Union.

Recycled high density polyethylene composites: carbon dots as an optical tool for recycled polymer

Raul Simões[†,1], Joana Rodrigues[2], Teresa Monteiro[2], Victor Neto[3], Gil Gonçalves[4]

1. Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, Campus Universitário de Santiago, Aveiro, 3810-193, Portugal
2. i3N, Department of Physics, University of Aveiro, 3810-193 Aveiro, Portugal
3. TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal, LASI - Intelligent Systems Associate Laboratory, Portugal
4. Centre for Mechanical Technology and Automation (TEMA), Mechanical Engineering Department, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Mechanical engineering.

Abstract. The worlds population is constantly increasing, and consequently the production of plastics as well with no viable solutions for the waste generated, that is uncontrollably piling up in landfills. (Kalali et al., 2023) This situation will soon be unbearable, so a simple and sustainable solution is demanded to face this growing issue. Since plastic products are part of our society and everyday use items in our lives it is important to find a solution that is both environmentally friendly and complies with manufacturers' requirements for the final product. In the past, carbon-based nanoparticles (i.e. carbon nanotubes, graphene, etc.) have been proposed and studied as reinforcement material to improve polymers mechanical properties and processability.(Zhang et al., 2024) In this work, a nanocomposite was prepared using carbon dots (CDs) to improve not only the polymers mechanical properties, but also to take advantage of its optical properties (Simões et al., 2024). Additionally, the prepared composites were recycled to study their structural and mechanical properties and compare them with the recycled polymer in an attempt to obtain a better-performing recycled polymeric material. Characterization techniques such as, X-ray diffraction (XRD), differential scanning calorimetry (DSC), and mechanical testing were used to evaluate the effect of the CDs content on the polymert's properties, namely, crystallinity degree, tensile strength, yield strength and hardness modulus. For a 0.5% CDs concentration, an increase in tensile strength of 17% was verified after being recycled, with a strain at maximum load of 11%, far better than the virgin sample while maintaining its crystalline nature. Furthermore, the composites luminescent behavior was also studied and measured luminescence quenching was found to be strongly dependent on the CDs content. To confirm the possibility of processing such composite after being recycled, 3D printing specimens using the recycled materials for each concentration were prepared with the successful identification of each recycling cycle. Therefore, a composite with improved mechanical properties was obtained, maintaining the initial crystalline structure of the polymer, and with great potential to be used as an optical tool to identify if a certain high density polyethylene (HDPE) sample was recycled, and how many times it was recycled.

Keywords: *Recycling; HDPE; Carbon Dots; Optical Properties*

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Opportunities in the water supply systems: a systematic literature review on smart predictive digital twins

Tiago C. Pereira[†,⋆,1], Ramon Vilanova Arbos[2], António Andrade-Campos[1]

1. Universidade de Aveiro, 3810-193 Aveiro
2. Universitat Autònoma de Barcelona (UAB), Campus de la UAB, 08193 Bellaterra (Cerdanyola del Vallès), Barcelona, Espanha

⋆ Corresponding author; † Presenting author; Mechanical engineering.

Abstract. The Digital Twin, introduced by Grieves (2015), is a technological paradigm that has gained traction with the popularization of Industry 4.0. Similarly to several industrial fields, the water sector has seen potential in using Digital Twins. Traditionally, a Digital Twin encompasses a physical entity, its virtual counterpart (i.e., the Digital Model), and communication channels. The Digital Model accurately simulates reality by being continuously updated, enabled by real-time information exchanges. This technology enhances the management of Water Supply Systems (WSSs) by upgrading hydraulic modeling and handling of data streams (Berglund et al., 2023). Some architectures (e.g., Shafiee et al., 2018) capitalize on the upgrade of the WSSs sensory infrastructure and its data management, advancing analytical and decision-making capabilities. Consequently, this has led to the emergence of Smart Predictive Digital Twins (SPDTs). These systems repurpose the core concepts of Digital Twins, while highlighting predictive and decision-making enhancements. This evolution is also a byproduct of the rising popularity of machine learning and control algorithms, alongside the increase of data availability. The current literature on SPDTs applied in WSSs is virtually non-existent. Therefore, this work addresses the subject by separately reviewing three topics specifically applied to WSSs: Digital Twins, Machine Learning, and Real-time Control and Decision Support Systems. This allows for both an independent analysis of the selected topics and a macroperspective view, with the technologies interrelationships. Subsequently, this provides an in-depth analysis on technological trends, research gaps, and development directions of SPDTs. Overall, it was observed a significant focus on identifying/mitigating issues related to the physical infrastructure of WSSs, with a relative lack of research efforts in the minimization of operational costs. Although numerous issues were tackled across the selected topics, there was a lack of technological integration, hindering the development of a SPDT. This understates the maturity level of this new paradigm.

Keywords: *Machine Learning; Digital Twin; Real-time Control; Decision Support System; Review*

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How can poly(lactic acid) be reprocessed more times with minimal quality loss?

Tiago Gomes[†,⋆,1], João Dias-de-Oliveria[1], Victor Neto[1]

1. TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal, LASI - Intelligent Systems Associate Laboratory, Portugal

⋆ Corresponding author; tiago.emanuel.gomes@ua.pt; † Presenting author; Mechanical engineering.

Abstract. As the maturity of the technological solutions brought by Industry 4.0 grows, so do the opportunities to leverage them to tackle challenges faced when moving towards a circular economy. This has been increasingly happening in recycling, improving sorting technology and management, among other dimensions (Fang et al., 2023).
Meanwhile, a significant barrier that still hinders the use of multiple-times reprocessed poly(lactic acid) (PLA), similarly to other thermoplastics, is its properties deterioration stemming from thermomechanical degradation processes (Romani, Perusin, Ciurnelli, & Levi, 2024). This affects processability and final part performance, which leads to the manufacturer not trusting the material. Thus, at best, it can be recycled into products with lower quality requirements compared to the ones it is recycled from.
This work contributes towards an in-process solution based on real-time data acquisition, a degradation prediction tool, and adding a chain extender (CE) to meet desired behavior and/or properties, as necessary. To achieve this, the effects of consecutive extrusion and fused filament fabrication (FFF) cycles, and of varying 1,3-bis(4,5-dihydro-2-oxazolyl)benzene (PBO) CE concentrations, on (re)processed PLA properties were studied. A database has been compiled from literature and in-house studies on PLA degradation and used to develop an artificial neural network (ANN). An Arduino-based monitoring system has been prototyped, including software complete with a graphical user interface, to acquire real-time data from pressure and temperature sensors in contact with the molten material.
Experimental studies confirmed that PLAs thermal, rheological, and mechanical properties were affected by each processing cycle. Furthermore, PBO proved to mitigate these effects, fully recovering viscosity and tensile strength. The monitoring system was tested successfully in the challenging conditions of an injection mold at 10 Hz acquisition rate with multiple sensors. Additionally, the ANN showed limitations due to the low amount of available data, which are predicted to be overcome as more data is collected in future works.

Keywords: *Closed-loop manufacturing; Fused filament fabrication; Chain extender; In-process monitoring; Degradation classification.*

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Identification of regional water scarcity as a basis for the development of the air to water technology

Willy Hammer[†,⋆,1]

1. DBI

⋆ Corresponding author; † Presenting author; Mechanical engineering.

Abstract. Water scarcity, caused by factors such as climate change and population growth, is a major global challenge (United Nations, 2021). This study analyses possible key indicators to identify regional water stress. Three indicators, the Falkenmark Water Stress Indicator (FWSI), the Water Exploitation Index (WEI) and the Water Scarcity Index (WSI) are used to quantify the scale and impact of water scarcity. Using the indicators, it was possible to identify over 20 countries worldwide with a very high level of water stress.

AQUASTAT, a global information system on water resources and agricultural water management provided by the Food and Agriculture Organization of the United Nations (FAO), was used along with data analysis to explore the FWSI, WEI, and WSI.

The FWSI analysis showed that regions with high water stress have difficulties meeting demand, especially seasonally (Baggio et al., 2019). The WEI analysis showed that global regions are approaching or exceeding the limits of sustainable water use, indicating an increased risk of water scarcity. The results of the WSI revealed that a significant number of countries are facing moderate to severe water stress. Demand is outstripping supply, exacerbating the impact of water scarcity on communities and ecosystems (Food and Agriculture Organization of the United Nations [FAO], 2024).

Developing countries, particularly in South Asia, South America and sub-Saharan Africa, face major challenges due to population growth, climate change and inadequate infrastructure (Desbureaux et al., 2022; Wilkinson et al., 2022).

This study highlights the need for proactive action to reduce water scarcity and improve sustainable water management worldwide. The development of a technology to produce clean drinking water is focussed on regions with high water scarcity.

Keywords: *Water Scarcity, Water Stress, Water Stress Indicator*

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Acknowledgements. I am deeply grateful to my supervisors, Patrícia Santos and Mário Cerqueira, for their invaluable guidance and support throughout this research.

Towards a novel mechanical test for accurately characterizing sheet metals

Mafalda Gonçalves[†,⋆,1], Sandrine Thuillier[2], A. Andrade-Campos[1]

1. Centre for Mechanical Technology and Automation (TEMA), Intelligent Systems Associate Laboratory (LASI), Department of Mechanical Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. Univ. Bretagne Sud, UMR CNRS, IRDL, F-56100 Lorient, France

⋆ Corresponding author; mafalda.goncalves@ua.pt; † Presenting author; Mechanical engineering.

Abstract. Addressing sheet metal forming processes virtually requires a thorough understanding of the material behavior. Accurately integrating material parameters into simulation software enables a reliable reproduction of the material behavior and, consequently the manufacturing process. Parameter identification procedures rely on the mechanical information provided by experiments. Recent material testing approaches focus on developing innovative specimen designs capable of providing relevant information in a single experiment. This work follows the entire development process of a novel mechanical test designed via topology optimization. Starting from the design phase, where the maximization of the displacement field served as a criterion for the optimization process. Different configurations were explored to identify the initial design domain, resulting in a specimen design that offers rich insights into material behavior (Gonçalves et al., 2023).To evaluate the potential of the test compared to existing geometries proposed in the literature (Rossi et al., 2016; Jones et al., 2018), a set of Key Performance Indicators was formulated to measure the richness of the information provided and quantify its effectiveness in material characterization (Gonçalves et al., 2024). Although numerical analysis confirmed the relevance of the test over alternative geometries, experimental analysis of the developed test was required to validate its potential when using real-world data. From the experimental campaign, a large amount of material behavior information was extracted from the mechanical test using a multi-DIC system to take advantage of its out-of-plane behavior. Ongoing research explores the performance of the developed test in inverse calibration of plastic anisotropic material models. This work promises an innovative solution to overcome the laborious and costly task of material testing, working towards a more sustainable industry as new materials and forming processes emerge.

Keywords: *Heterogeneous test; Material behavior; Model calibration; Sheet metal*

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Acknowledgements. This project has received funding from the Research Fund for Coal and Steel under grant agreement No 888153. This paper was also supported by the projects UIDB/00481/2020 and UIDP/00481/2020 - Fundação para a Ciência e a Tecnologia, DOI 10.54499/UIDB/00481/2020 and DOI 10.54499/UIDP/00481/2020. M. Gonçalves is grateful to the FCT for the Ph.D. grant Ref. UI/BD/151257/2021 and to the ESAFORM association for the mobility grant. The results reflect only the authors' view, and the European Commission is not responsible for any use that may be made of the information it contains.

Computational modeling of constitutive behavior of 3D printed structure via fused filament fabrication

Yiyun Wu[†,⋆,1], Victor Neto[2], Robertt Valente[3]

1. University of Aveiro, Aveiro 3810-193, Portugal
2. TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal, LASI - Intelligent Systems Associate Laboratory, Portugal
3. Aveiro 3810-193, Portugal

⋆ Corresponding author; † Presenting author; Mechanical engineering.

Abstract. Additive Manufacturing (AM) has been showing significant advantages on raw materials saving, fast operation, and customized geometries for complex structure components (Altparmak, 2022). Adding nanomaterials such as carbon nanotubes to host matrices via AM technologies has the potential to enable greater capabilities in nanocomposites production (Shameem, 2021). Mechanical properties of carbon nanotube (CNT)-based nanocomposites are broadly discussed in the literature (Nurazzi, 2021).

Experimental evaluation of the material behavior of printed parts is tedious and expensive. An alternate solution is computational modeling of printed parts. Thus, to support analytical simulation and experimental attempts, it is valuable to develop numerical models to characterize mechanical behaviors of 3D printed nanocomposites.

The present study developed a constitutive material model of 3D printed parts via fused deposition modeling. Additive manufacturing of a part results in a complex microstructure which depends on the process parameters. Anisotropy is introduced into the material properties. The mechanical behavior of the printed parts is governed by the constitutive behavior of the material. Therefore, the stiffness matrix of the material of the final printed part needs to be estimated to accurately capture their behavior. The constitutive material modeling of the printed parts using numerical homogenization procedure is emphasized in this work. The mesostructure of layers of the printed parts was considered for finite element modeling of the representative volume element (RVE), and to determine their elastic moduli.

The computational models provided more insights on the final properties of 3D printed parts for different materials. Also, the lateral and transverse elastic moduli of layers were found to be approximately the same, and therefore the constitutive behavior of the layers can be treated as transversely isotropic material. In summary, this research work represents an important step towards enabling the effective design and analysis of 3D printed structures using computational methodology.

Keywords: *Additive manufacturing; Mechanical properties; Carbon nanotube; Microstructure; Computational modeling*

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Acknowledgements. This work is supported by the projects: UIDB/00481/2020 and UIDP/00481/2020 - FCT - Fundação para a Ciencia e a Tecnologia; and CENTRO-01-0145-FEDER-022083 - Centro Portugal Regional Operational Program (Centro2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund, and through a Chinese Scholarship Council 2020.

Coupling tool to assist mould design and engineering during hybrid fabrication

Sofia B. Rocha[†,⋆,1], Victor Neto[2], Mónica S. A. Oliveira[3]

1. Department of Mechanical Engineering, Center for Mechanical Technology and Au-tomation (TEMA), University of Aveiro, 3810-193 Aveiro, Portugal
2. TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal, LASI - Intelligent Systems Associate Laboratory, Portugal
3. TEMA Center for Mechanical Technology and Automation, Department of Mechanical Engineering, LASI - Intelligent Systems Associate Laboratory, Portugal

⋆ Corresponding author; sbmarocha@ua.pt; † Presenting author; Mechanical engineering.

Abstract. Tailored Temperature Control Systems (TCS) are gaining relevance in injection moulding (IM), particularly due to the growing demand for geometric/functional, and even aesthetic part requirements (Gao et al., 2023; Wang et al., 2023). Nevertheless, the design of an effective TCS is challenging, and requires new project rules with a compromise between thermal and structural constraints (Kanbur et al., 2020; Torres-Alba et al., 2020). This PhD work program has been designed to address the above issues, and previous work has shown that a considerable number of variables influence the heat extraction rate, temperature distribution and stress distribution in the mould. Consequently, to develop new, broader project rules, it is necessary to understand the fundamentals of the IM process, i.e., the ruling thermal, fluidic and mechanical processes and their relationship. To this end, the TCS thermal analysis (the different heat exchanges, the overall heat balance and the fluid dynamics involved in the process) has been studied with the aim of identifying the key parameters of the thermal and fluidic processes and the correlation between them. Initially, some simplifications were made for a more comprehensive analysis: the model considered an adiabatic frontier with its surroundings (Kanbur et al., 2020; Park & Kwon, 1998), a steady state condition was assumed, the mould was considered as a semi-infinite medium and the heat of the polymer is attained through the sensible heat. From the analysis of the analytical model, it was concluded that two different heat transfer mechanisms, convection (Qconv) and conduction (Qcond), are crucial during the IM process. Qconv is influenced by the coolant flow rate and the channel diameter, and Qcond is influenced by the moulds thermal conductivity and channel position. Overall, it was concluded that smaller diameters improve Qconv, as do higher coolant flow rates. Regarding Qcond, higher mould thermal conductivity and proximity between the channels and between channel and part, were seen to increase the heat extraction rate. Having identified the key parameters for the TCS thermal analysis, the TCS structural analysis must be investigated to determine the proper trade-off between part quality, productivity and mould life.

Keywords: *Injection moulding; Temperature Control System; Analytical model*

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Acknowledgements. The authors acknowledge the University of Aveiro, FCT - Fundação para a Ciência e a Tecnologia I.P. for the financial support of TEMA research unit (projects: UIDB/00481/2020 and UIDP/00481/2020 - Fundação para a Ciência e a Tecnologia, DOI 10.54499/UIDB/00481/2020 and DOI 10.54499/UIDP/00481/2020). This work was also supported by FCT - Fundação para a Ciência e a Tecnologia I.P., through the PhD grant ref. 2022.10869.BD (SBR).

Generative design to model metamaterial devices using reprocessed plastics

Laura Prior[†,⋆,1], M. S. A. Oliveira [1], V.F. Neto [1]

1.

⋆ Corresponding author; prior.laura98@ua.pt; † Presenting author; Mechanical engineering.

Abstract. Metamaterial (MM) embodies the concept of combining both the structure and the materials used. There are several types of MMs depending on their applicability, such as electromagnetic, acoustic, thermal and mechanical(Fan et al., 2021). Metamaterials with programmable or controllable thermal expansion coefficients are crucial for advancing actuation and sensing devices(Tian et al., 2023), offering the capability to shape-shift in response to environmental changes, in particular thermal alterations. This control is achieved by strategically allocating materials with differing coefficients of thermal expansion. However, the literature on polymer-based metamaterials exhibits notable gaps. Some researchers have explored metamaterials produced via 3D printing, namely by fused filament fabrication (FFF), focusing mainly on polyamide (PA) and polyvinyl alcohol (PVA) (Han et al., 2022; J S Raminhos, J P Borges, 2019; Tian et al., 2023; Wei et al., 2021). Nevertheless, PVA's pronounced hygroscopicity limits its utility in engineering applications. Another challenge lies in identifying materials compatible for multi-material printing. The latter highlights the need to investigate polymeric materials with properties better aligned with specific engineering requirements in this domain. Furthermore, while efforts have been made to simulate these polymer-based metamaterials, studies extending these findings to experimental validation are scarce. Addressing these research gaps will drive progress in polymer-based metamaterials, opening doors for new applications, especially in security, where their sensitivity to environmental conditions can be effectively used. To address the identified issues, firstly, a re-entrant structure identified from the literature will be employed(J S Raminhos, J P Borges, 2019), and alternative polymers will be incorporated. This process will begin with simulation followed by fabrication. Secondly, the feasibility of replicating the same structures using reprocessed polymers will be explored. Once material compatibility is validated, attention will turn to optimizing the geometry of the metamaterials. The aim of this work is to extend the range of thermal sensing and actuation devices. The proposed devices stand out for the fact that they are made from plastics that have already been processed, i.e. they have already had another purpose. In addition, these devices are passive, which offers a significant advantage over most of the options available on the market.

Keywords: *Metamaterial, Additive Manufacturing, Tailored properties, Sustainability*

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Acknowledgements. This work is supported by the projects: UIDB/00481/2020 and UIDP/00481/2020 - Fundação para a Ciência e a Tecnologia, DOI 10.54499/UIDB/00481/2020 (https://doi.org/10.54499/UIDB/00481/2020) and DOI 10.54499/UIDP/00481/2020 (https://doi.org/10.54499/UIDP/00481/2020). Laura Prior is grateful to FCT for the Ph.D. grant Ref. 2022.10836.BD.

Investigating electron beam welding for joining copper, stainless steel, and sluminum pipes in heat pump manufacturing

Sathishkumar Duraisamy[†,⋆,1], João Dias[1], Antonio Bastos[1], Ana Horovistiz[1]

1. University of Aveiro,Campus Universitário de Santiago. Av. da Universidade Aveiro 3810-193

⋆ Corresponding author; sathishkumard@ua.pt; † Presenting author; Mechanical engineering.

Abstract. Heat pumps are becoming more popular worldwide, with global sales rising by 11% in 2022, according to the International Energy Agency (IEA). Given their significance in moving towards a sustainable energy future, it is critical to prioritise cleaner and more efficient manufacturing methods for heat pumps and refrigerators. The manufacturing process for heat pumps and refrigerators entails numerous amounts of welding to connect their components using copper pipes. Currently, we primarily use brazing processes to connect these components and copper pipes. However, conventional brazing methods used in heat pump manufacturing present challenges related to production efficiency, reliability, worker safety, and environmental implications, including energy consumption and greenhouse gas emissions. Electron beam welding (EBW) is emerging as a precise, energy-efficient alternative. A strongly focused electron beam bombards a joint in EBW, a high-energy density fusion process. EBW provides accurate heat input control and avoids undesired microstructures and defects. Previous studies have primarily examined the microstructures, mechanical properties, and welding techniques of different materials using EBW "(Sun et al., 2022)".However, there has been limited exploration of the fusion zone microstructures, defects, and mechanical properties of joints welded using EBW. Understanding how the process parameters affect the quality of these joints is critical for investigating the suitability of EBW technologies in heat pump manufacturing and improving the reliability of heat pump system production (Siddiquee et al., 2024)". This study aims to explore the potential of EBW in joining copper/copper, copper/aluminium, and copper/stainless-steel pipes in heat pump systems. The results for copper/copper welding showed that sample 1 (9.5 mA, 55ř/s) achieved a more uniform heat distribution and complete welds compared to sample 2 (10 mA, 60ř/s), which exhibited a distinct heat distribution and incomplete fusion. Despite these differences, both samples showed satisfactory microstructures in the impact zone. Optimizing the current and welding speed parameters is recommended to enhance the quality of copper-metal welds.

Keywords: *Electron beam welding; copper pipes; welding joints; welding parameters; heat pumps; failure analysis*

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Acknowledgements. Acknowledgement: The present study was developed in the scope of the Project Agenda ILLIANCE [C644919832-00000035 | Project nž 46], financed by PRR Plano de Recuperação e Resiliência under the Next Generation EU from the European Union, and had laboratory support from the Centre for Mechanical Technology and Automation (TEMA), projects UIDB/00481/2020 and UIDP/00481/2020.

A scientometric study on the wire and arc additive manufacturing

Mehran Ghasempour-Mouziraji[†,⋆,1], Daniel Afonso[2], Ricardo Alves de Sousa [1]

1. TEMA and LASI
2. TEMA, LASI, EMaRT

⋆ Corresponding author; Mehran@ua.pt; † Presenting author; Mechanical engineering.

Abstract. Additive Manufacturing has been accentuated by different industries and companies due to its array of benefits (Williams et al., 2016). Wire and Arc Additive Manufacturing (WAAM) is an innovative process that utilizes an electric arc as a heat source to melt metal wire to build complicated three-dimensional parts (Jafari et al., 2021).In the current study, scientometric investigation employing CiteSpace software has been used to analyse the Wire Arc Additive Manufacturing (WAAM) process using 1435 documents as a database from the Web of Science (WoS) because it ensures a high level of scientific robustness (Zandi et al., 2019)(Davarazar et al., 2019)(Davarazar et al., 2020). Results indicate that China, India, and United kingdom have made the biggest contributions to WAAM, demonstrating their chromatic roles in the development of this technology. Articles and conference proceedings are the most common publication formats, and Elsevier and Springer Nature are the leading publishers in this field. A significant publication enhancement is seen yearly, peaking in 2022, highlighting the growing interest in WAAM. In the WAAM field, The Journal of Materials Processing Technology and Additive Manufacturing has the highest number of citations. Pan, Zengxi and Li, Huijun, indicate their significant contribution to WAAM research. The Materials Science, Multidisciplinary, Metallurgy & Metallurgical Engineering categories stand out as primary areas of interest in WAAM. Cranfield University and the University of Wollongong are the leading institutes in the field of WAAM.

Keywords: *Wire and Arc Additive Manufacturing (WAAM), scientometric, CiteSpace, Web of Science (WoS)*

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Acknowledgements. The authors greatly acknowledge the work which was supported by the projects UIDB/00481/2020 and UIDP/00481/2020 Fundação para a Ciência e a Tecnologia; and CENTRO-01-0145-FEDER-022083 Centro Portugal Regional Operational Programme (Centro2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund. Also, Thanks to FCT for Ph.D. scholarships No. UI/BD/151258/2021.

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

On the design of a strain path changing heterogeneous test for anisotropic plasticity model calibration

J. Henriques[†,⋆,1], A. Andrade-Campos[1], J. Xavier[2]

1. Centre for Mechanical Technology and Automation (TEMA), Intelligent Systems Associate Laboratory (LASI), Department of Mechanical Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. Research and Development Unit for Mechanical and Industrial Engineering (UNIDEMI), Intelligent Systems Associate Laboratory (LASI), Department of Mechanical and Industrial Engineering, NOVA School of Science and Technology, NOVA University Lisbon, 2825-149 Lisbon, Portugal

⋆ Corresponding author; joaodiogofh@ua.pt; † Presenting author; Mechanical engineering.

Abstract. Simulation software is now an essential tool in the engineering industry for improving process efficiency while lowering costs and part delivery times. This paradigm shift can be attributed to the increased computational power available and also due to the significant advances in the field over the last few decades. However, the accuracy of the simulations is reliant on the constitutive models and their proper calibration. There are numerous phenomenological constitutive models, and while some are simpler, others are more complex with greater mathematical flexibility to reproduce a wide range of phenomena, such as complex yield functions (Barlat et al., 2005), isotropic and kinematic hardening models, and other advanced formulations (Vegter et al., 2011). The calibration of such models has been an open challenge in the experimental mechanics community, mainly because of the high number of parameters that need to be calibrated, which leads to extensive experimental campaigns. Furthermore, while the significant advancements in full-field measurements and inverse identification techniques over the last decade have transformed the way experimental tests are conducted, current standard tests are not designed to provide rich kinematic information. Recently, a significant amount of research has been conducted on the development of new heterogeneous tests that take advantage of full-field measurements and inverse identification techniques; this new approach is known as Material Testing 2.0 (Pierron and Grédiac, 2021). This work aims to develop a new strain path-changing test for calibrating anisotropic plasticity constitutive models. The developed test draws inspiration from the Arcan test, except that the load direction can be changed during the test without unloading the specimen. The strain-path changing test is simulated on a DP600 steel, and the numerical results are used to calculate two heterogeneous criteria that are then compared to the results of the standard Arcan test. The first heterogeneity criterion is the IT (Souto, Thuillier, & Andrade-Campos, 2015), which evaluates the heterogeneity of the test according to the equivalent plastic strain and the ratios between the principal strains. The second heterogeneity criterion is the rotation angle (Oliveira, Thuillier, & Andrade-Campos, 2022), which indicates the sensitivity of the test to anisotropy. The results demonstrate that the new strain path-changing test provides significantly richer kinematic information. These improvements were quantified by the increased heterogeneity metrics, which were 26% higher, for the case of the rotation angle, than those obtained from the standard Arcan test.

Keywords: *Sheet metal forming; Inverse identification; Strain path changes; Heterogeneous test; Anisotropic plasticity.*

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Acknowledgements. J. Henriques is grateful to the Portuguese Foundation for Science and Technology (FCT) for the Ph.D. grant 2021.05692.BD. This project has received funding from the Research Fund for Coal and Steel under grant agreement No 888153. The authors gratefully acknowledge the financial support of the FCT under the project PTDC/EMEAPL/29713/2017 by UE/FEDER through the programs CENTRO 2020 and COMPETE 2020, and UID/EMS/ 00481/2013-FCT under CENTRO-010145-FEDER-022083. The authors also acknowledge the FCT (FCT - MCTES) for its financial support via the projects UIDB/00667/2020 (UNIDEMI).

Induction brazing of copper, stainless steel, and aluminum pipes for the manufacturing of heat pumps.

Eyuel Abate Lemma[†,⋆,1], João Dias[1], Antonio Bastos[1], Ana Horovistiz[1]

1. Center for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; eyuel.abate@ua.pt; † Presenting author; Mechanical engineering.

Abstract. Abstract
The growing demand for heat pump systems in residential and industrial settings has led to an increased need for sustainable and efficient manufacturing processes. Metal pipes, including copper, stainless steel, and aluminum, are commonly utilized in the production of heat pumps. Effective welding of these pipes is crucial for ensuring efficient heat transfer and leak-proof joints. Traditional torch brazing is commonly utilized to join pipes and components in heat pumps, but it often results in faults such as cracking due to thermal stress, faulty connections from poor manufacturing processes, and corrosion due to material composition and welding parameters (Aguilera et al., 2022). These faults can lead to environmentally harmful refrigerant leaks, posing environmental and economic challenges.

Induction brazing offers significant advantages over traditional torch brazing methods, including increased speed, controllability, and suitability for mass production. However, ensuring consistent weld quality, preventing thermal distortion, and maintaining weld integrity amidst varying thermal cycles remain critical challenges (Bobzin et al., 2020). Addressing these challenges necessitates the optimization of welding parameters. While previous studies have focused on individual parameters, there is a gap in understanding the combined effects of these parameters on induction welding processes.

This study aims to bridge this gap by conducting numerical simulations of the brazing process, followed by experimental investigations incorporating microstructural and mechanical analyses. Preliminary results from the experimental analysis of copper-to-copper induction brazing indicate that temperature, gap size, feed rate, and filler length are the main parameters affecting joint quality. The analysis from optical microscope showed that the gap size between the joints is a crucial factor, with a joint gap size less than 0.1 mm resulting in better filler penetration, joint quality, and fewer defects. SEM and EDS reports also show that achieving a homogeneous temperature gradient across components is essential for minimizing distortion and preventing cracks. Furthermore, insufficient cleaning of the surfaces to be joined, along with the brazing environmental conditions, determines the size of impurities in the brazed joint and can lead to the formation of pores and cracks within the braze layer.

The expected outcomes of this research include identification of optimal brazing parameters for different metal pipes, improved understanding of the effects of combined welding parameters. These findings also contribute to enhancing the efficiency, longevity, and functionality of heat pumps, ultimately supporting the development of more sustainable manufacturing of heat pump systems.

Keywords: *Induction brazing; copper pipe welding; stainless steel pipe welding; aluminum pipe welding; welding parameters; welding joint quality; heat pumps*

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Acknowledgements. The present study was developed in the scope of the Project Agenda ILLIANCE [C644919832-00000035 | Project nž 46], financed by PRR Plano de Recuperação e Resiliência under the Next Generation EU from the European Union, and had laboratory support from the Centre for Mechanical Technology and Automation (TEMA), projects UIDB/00481/2020 and UIDP/00481/2020.

Advances in integrated driving safety-volatility-emissions indicator for urban areas

Elisabete Ferreira[†,⋆,1], Paulo Fernandes [2], Eloísa Macedo[2], Margarida C. Coelho[3]

1. Department of Mechanical Engineering / Centre for Mechanical Technology and Automation (TEMA),
2. Department of Mechanical Engineering / Centre for Mechanical Technology and Automation (TEMA)
3. Department of Environment and Planning / Centre for Mechanical Technology and Automation (TEMA)

⋆ Corresponding author; † Presenting author; Mechanical engineering.

Abstract. Driving behavior has a significant impact on both safety and emissions and is typically classified as either normal or aggressive based on vehicle dynamics and real-world emissions data (Shahariar et al., 2022). The variability in driving decisions reflects the variability in vehicle motion, which helps in understanding behavioral patterns and predicting the likelihood of accidents (Khattak et al., 2021; Wali et al., 2019). While previous research has developed integrated indicators to characterize driving behavior using different parameters, their application in urban areas has been limited. Therefore, this study aims to create an Integrated Driving Indicator (iDI) specifically tailored for urban environments, taking into account safety, variability, and emissions-related variables.

The iDI was created through urban simulations using the VISSIM microscopic traffic model, which provided detailed, second-by-second data for each trip. To correlate instances of traffic conflict with driving errors identified by the iDI, trajectory files were analyzed using the Surrogate Safety Assessment Model (SSAM). An optimization process was used to assign iDI scores based on safety (evaluated by time headway and stopping distance), variability (measured by acceleration and vehicle jerk), and emission parameters (carbon dioxide and nitrogen oxides determined by the Vehicle Specific Power methodology), with each component weighted accordingly. A sensitivity analysis was performed to validate the proposed model. Subsequently, simulations were performed in an urban environment consisting of a signalized intersection, two stop-controlled intersections, and two roundabouts, where driving errors were evaluated in three different demand periods. Driving failures thresholds were established based on literature relevant to urban driving environments (Ferreira et al., 2024). Statistical analysis was applied to the results, and the solution with the lowest percentile distribution was selected. SSAM was used to compare the results and for further conflict evaluation.

The majority of conflicts were found to involve light-duty vehicles, which accounted for approximately at least 96% of each demand period. These vehicles represented over 72% of the total fleet, with iDI scores ranging from 20 to 30%. In addition, volatility and emissions failures emerged as significant factors of the iDI.

The proposed iDI provides a comprehensive approach to addressing urban driving challenges, potentially improving driver assistance systems while tackling safety, emissions, and urban driving concerns.

Keywords: *Integrated driving indicator; Driving behavior; Volatility; Emissions; Sustainable mobility*

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Multimedia in education

A Digital Platform for Creating Collectible Cards as a Tool to Promote Children's Environmental Education

Viviana Bonifácio[†,⋆,1], Pedro Beça[1], Mónica Aresta[1]

1. Universidade de Aveiro

⋆ Corresponding author; vivianabonifacio@ua.pt; † Presenting author; Multimedia in education.

Abstract. The purpose of this research is to explore an approach to promote environmental education in children aged 8 to 9 through the creation and use of collectible cards. This study focuses on developing a digital platform where children can create their own collectible cards related to the environment. Involving children in the learning process as creators not only promotes enthusiasm and involvement, but also promotes critical thinking, creativity, and teamwork.
Active participation in the creation of educational content encourages children to have a deeper and more personal understanding of environmental issues, developing responsibility and ecological awareness in them from an early age. The platform will allow youngsters to learn about diverse environmental themes, design their own cards, and share them with their friends, resulting in an interactive and interesting educational experience. Previous studies have shown that the social aspect and the creative process are fundamental to the effectiveness of collectible card games as teaching tools (Turkay et al., 2012). As a result, teachers can include the use of collectible cards in the classroom context to enhance learning, benefiting not only from student interaction, but also from encouragement and strategy development.
Focus groups and interviews will be used to collect data, allowing researchers to get insight into participants viewpoints and experiences. The expected outcomes include insights on the usage of cards as environmental education tools, as well as the identification of critical requirements for a digital platform to support this practice.
This study is expected to add to the field of environmental education by presenting a unique and practical strategy to engage youngsters in increasing ecological awareness. Furthermore, it is expected that the findings will drive the future development of a digital platform dedicated to the construction of theme charters, increasing access to and effect of this educational practice.

Keywords: *Collectible Cards, Environmental Education, Children (Aged 8-9), Digital Platform*

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A delphi study on teacher training for the implementation of active methodologies in flexible learning spaces

Gabriela Reses[†,1], Vânia Carlos[2], Sandra Soares[2]

1. CIDTFF
2. DEP

[⋆] Corresponding author; [†] Presenting author; Multimedia in education.

Abstract. The objective of this research is to propose a training model for higher education teachers that encourages the critical and reflective use of active methodologies in Flexible Learning Spaces. To this end, we sought to identify and systematise the training principles that should guide this model, based on a study structured using the Delphi method. Twelve specialists in teacher training, innovative learning environments and active methodologies from different universities in Portugal participated in this study. The Delphi study was carried out through three successive rounds of online surveys. The data were analysed qualitatively (content analysis) and quantitatively (descriptive statistics) using MAXQDA software. The results indicate that such training should prioritise training focused on active and peer learning, pedagogical differentiation for inclusion and accessibility, evidence-based pedagogical innovation, training based on Digital Enhancement for Teaching and Learning, and the design and implementation of learning scenarios in Flexible Learning Spaces. Furthermore, the data indicate the necessity for the development of a long-term training model based on mentoring processes, the creation of communities of practice and activities aimed at reflecting on pedagogical practice, combined with workshops on active learning, the adoption and development of interactive teaching resources and pedagogical management in active learning environments.

Keywords: *innovative learning environments; active learning; training model; teacher education; higher education*

Acknowledgements. This work is financially supported by National Funds through FCT Fundação para a Ciência e a Tecnologia, I.P., under the projects UID/00194/2020 (https://doi.org/10.54499/UID) and the doctoral scholarship under reference 2021.06815.BD (https://doi.org/10.54499/2021.06815.BD). P/00194/2020) and the doctoral scholarship under reference 2021.06815.BD (https://doi.org/10.54499/2021.06815.BD).

A criação de jogos digitais como estratégia pedagógica para a melhoria da aprendizagem dos alunos do 1ž ciclo

Edite Carmo[†,1], Pedro Beça[2], Mónica Aresta[2]

1. Universidade de Aveiro
2. Universidade de Aveiro, Campus Universitário de Santiago, Aveiro

⋆ Corresponding author; † Presenting author; Multimedia in education.

Abstract. Atualmente, a sociedade encontra-se imersa na imprevisibilidade e marcada por mudanças aceleradas e pela omnipresença e ubiquidade do tecnológico e do digital. Perante essas novas realidades, houve premência do sistema educativo se reconfigurar, surgindo novos desafios.
Nessa perspetiva, a Escola já não pode ser considerada como um simples repositório de conhecimentos, mas, pelo contrário, deve poder responder às novas exigências do século XXI e habilitar os alunos com novas capacidades e literacias para poderem responder e enfrentar os desafios complexos das novas e vindouras realidades. Por sua vez, os professores devem adaptar suas metodologias e estratégias pedagógicas às novas exigências tecnológicas e digitais, criando ambientes de aprendizagem ativa e significativa. Deve ser, do mesmo modo, repensado o papel do aluno, assumindo a sua essencialidade, tornando-o (co)autor e (co)construtor do seu saber. A abordagem Game Design-based Learning (GDBL) permite esse maior envolvimento do aluno e criar ambientes inovadores de aprendizagem.
Os videojogos, desde o seu surgimento, suscitaram um interesse contínuo e tiveram, com o avanço tecnológico, um crescimento exponencial. Os videojogos e jogos digitais, em dispositivos móveis ou fixos, tornaram-se numa presença assídua na quotidiano das crianças e dos jovens (Bulut et al., 2022). O seu potencial foi retomado no campo educacional, tendo sido amplamente investigado, e os seus benefícios no desenvolvimento de competências de aprendizagem dos alunos têm sido apontados por vários atores (Gee, 2003: Burke e Kafai, 2014). A abordagem GBDL aparece como um novo paradigma em educação, ao aliar a integração de conteúdos curriculares à visão construtivista da aprendizagem.
O presente projeto pretende investigar, numa abordagem exploratória, o impacto que a implementação de uma estratégia de aprendizagem ativa, nomeadamente a criação de jogos digitais educativos pelos alunos, tem no processo de ensino-aprendizagem. A auxiliar o processo de criação e desenvolvimento de jogos digitais, de forma autónoma e colaborativa, os alunos terão acesso à uma toolkit. O produto final será concebido no programa Scratch. A estratégia de aprendizagem será implementada no 1ž ciclo, a turmas dos 3ž/4ž anos de escolaridade. O projeto organiza-se em dois ciclos de investigação. No presente ano, iniciou-se o Ciclo I (pré-teste) que envolve uma turma piloto do 3ž ano.
Espera-se que os resultados do projeto evidenciem, no aluno, o incremento da motivação, do envolvimento e de competências curriculares e transversais, para além de competências para o século XXI ligadas à novas literacias como a literacia digital.

Keywords: *game design-based learning, aprendizagem, abordagem construcionista, jogos digitais educativos*

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Podcasts as an evaluation method: student engagement promotion in vocational education institutions

Elton Rubens Vieira da Silva[†,⋆,1], Pedro Beça[1], Mónica Aresta[1]

1. University of Aveiro, Santiago University Campus, 3810-193 AVEIRO, Portugal

⋆ Corresponding author; † Presenting author; Multimedia in education.

Abstract. Due to their versatility in content creation and accessibility, podcasts have become an ally in the teaching and learning process (Drew, 2017). Educators are employing podcast development as a didactic activity, aiming to increase student engagement with instructional content and the academic community itself (Harrison, 2023). This research aims to develop a pedagogical intervention that assists teachers and students in using podcast creation as didactic activity. Additionally, we present an important strategy for promoting student engagement with their studies and the academic community; it sheds light on the pedagogical reality in vocational education institutions and aims to construct a pedagogical intervention based on a versatile and engaging digital medium.

The Design-Based Research (DBR) methodology was chosen due to its framework based on iterative and interactive cycles, aimed at developing a solution for a pedagogical problem. DBR proposes, in its initial phase, an in-depth contextual study in the classroom to understand the real needs faced by teachers and students. We then conducted a pilot study with two vocational education classes, one in Brazil and one in Portugal, to understand how teachers and students react to the task of creating their own podcast program.

As results of the pilot study, we can highlight: the majority of students stated that creating their own podcast is a fun and engaging way of learning and that they would be willing to use this learning method on other occasions; students pointed out that by creating a podcast, they improved research, synthesis, oral, and communication skills; the technical aspects of podcast recording were seen as a minor obstacle compared to complaints such as diction problems and synthesis of researched content. Collaborative work between teachers-students and students-students was also perceived as an added value of the research.

Finally, a survey was conducted where students could record their impressions about the experience. Further observational studies will be conducted to understand other nuances of classroom dynamics.

The information obtained in the previous phases is treated as input for the design and testing phases, and subsequent development of the pedagogical intervention required by the DBR methodology. In this research, the pedagogical intervention takes the form of a toolkit aimed at guiding users through the stages of podcast development.

Keywords: *Podcast, student engagement, design-based research, vocational education.*

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Curadoria digital em comunidades de prática enriquecidas digitalmente: construção e validação de modelo

Luísa Flores[†,⋆,1], Carlos Santos[2], Luís Pedro[2]

1.
2. Departamento de Comunicação e Arte

⋆ Corresponding author; luisacflores@ua.pt; † Presenting author; Multimedia in education.

Abstract. Abordagens pedagógicas promotoras de uma educação de qualidade exigem uma constante adaptação dos recursos educativos às especificidades dos alunos. Assim, os recursos educativos abertos (REA), por serem do domínio público ou protegidos sob uma licença aberta [1], emergem como ferramentas valiosas para apoiar os professores na personalização do ensino. Apesar do crescente número de REA [2], a procura e seleção continua a ser morosa e desafiante, obstaculizando a sua adoção generalizada [3, 4].

A literatura aponta várias estratégias para promover uma adoção mais ampla de REA como o desenvolvimento de repositórios eficazes [1, 3, 4] e de comunidades de prática [5] orientadas para o trabalho curatorial colaborativo online, mas cuja implementação depende do desenvolvimento de soluções tecnológicas bem desenhadas que atendam às necessidades do utilizador.

O presente estudo pretende construir e validar um modelo que potencie uma curadoria digital bem-sucedida numa comunidade de prática enriquecida digitalmente de professores e segue a abordagem metodológica do Educational Design Research. A primeira etapa deste estudo, já concluída, teve por objetivo conhecer as perceções dos professores de biologia e geologia do ensino básico e secundário sobre as características desejáveis na intervenção. Aplicaram-se duas técnicas de recolha de dados: um inquérito por questionário (N=84) e uma entrevista semiestruturada em grupo focal (N=5).

Os resultados evidenciam a importância de os sistemas de catalogação do repositório digital incluírem informação semântica que imite o pensamento natural dos professores, pelo que metadados como tema, tipologia, disciplina, ano e direitos autorais devem ser incluídos. Ainda, informação semântica avaliativa relativa à qualidade científica, pedagógica e técnica de REA atribuída pelos membros da comunidade deve ser considerada para apoiar mecanismos de recomendação. Por outro lado, os resultados mostram que os participantes consideram que mecanismos de revisão aberta por pares pré-publicação são fundamentais para assegurar a qualidade dos REA.

Keywords: *Recursos educativos abertos, curadoria digital, comunidades de prática enriquecidas digitalmente, Co-design*

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Music

New perspectives on Portuguese wire-strung violas from the collections of the Museu Nacional da Música: collaborative insights and empowering narratives

Felipe Barão[†,1]

1. Universidade de Aveiro, Campus Universitário de Santiago

⋆ Corresponding author; † Presenting author; Music.

Abstract. This case study examines and discusses the collaborative process involving the Museu Nacional da Música (MNM), musicians, and luthiers/restorers, which I have been mediating during my Ethnomusicology doctoral studies at the University of Aveiro. This collaboration aims to integrate various specialized perspectives on the cataloging and describing of musical instruments of the museum collections and their social contexts, with a particular focus on plucked chordophones known as violas de arame (wire-strung violas).

This strategy is grounded in the critique advocated by Lavine and Karp (1991), who recommend associating the narratives and practices of the communities that built and/or used those instruments in museological curation. The authors suggest a disengagement from museological practices that highlight museums as 'temples' of artifacts legitimized by an assumed ethnographic authority, often reflecting the dynamics of prevailing political power. Instead, they propose the conception of the museum as a forum for dynamic interactions that promote the diversity of perspectives and act as agents of change.

The relocation of MNM to the National Palace of Mafra in 2024 offers a unique opportunity for the reformulation of exhibition discourses through dynamic interactions with various stakeholders (musicians, luthiers/restorers, communities). This process aims to expand current knowledge about each musical instrument, which has been confined to organologic and territorial demarcation, to encompass: (i) performance techniques, performance contexts, construction techniques, and repertoires, to enhance the educational dimension of the museum; (ii) the trajectories of musical performers and groups associated with these instruments, contributing to the social memory of associated communities; and (iii) the discussion of other curatorial narratives.

Keywords: *exhibiting traditional musical instruments; museological curation; violas de arame (wire-strung violas); collaborative curation*

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Acknowledgements. The author gratefully acknowledge the financial support from Portuguese Foundation for Science and Technology (FCT) through the Ph.D. grant 2023.03687.BDANA.

Nanosciences and nanotechnology

Pdms/knn/graphite flexible film aiming at sensors and renewable energy applications

Noelle C. Zanini[†,⋆,1], Alexander Tkach[1], Paula M. Vilarinho[1], Lars R. Jensen[2]

1. Department of Materials and Ceramics Engineering, CICECO Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Materials and Production, University of Aalborg, Fibigerstræde 16, 2-226, 9220 Aalborg Ø, Denmark

⋆ Corresponding author; noelle.czanini@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. Emerging electronics require flexibility and energy harvesting from natural sources. Triboelectric and piezoelectric devices can be an alternative for harvesting mechanical energy from abundant renewable sources, e.g., waves and wind (Zhang et al., 2018). While lead-based ceramics exhibit good piezoelectric properties, their rigidity and environmental concerns discourage their use for those applications (Panpho et al., 2024). Incorporating lead-free piezoceramics into triboelectric polymers can combine increased output power with flexibility (Anithkumar et al., 2023) while adding carbon-based particles can act as a conductivity path (Bairagi and Ali, 2020). This study aims to obtain a flexible composite film by mixing the polymer PDMS (polydimethylsiloxane) with 30 wt.% lead-free KNN (potassium-sodium niobate) and 2 wt.% graphite (G), followed by curing and polarization by Corona. Copper electrodes were fixated on both film sides and insulated with polyethylene packaging. Characterization of the PDMS/KNN/G film was done by scanning electron microscopy (SEM), roughness tests, mechanical tests, contact angle (CA) measurements, thermogravimetric analysis (TGA), and electrical measurements using a shaker setup with parameters set at 5-50 Hz, 5 Mega Ohms, and 1-5 N, including a reverse polarity test on both film surfaces. SEM micrographs confirmed the presence of fillers on the film surface, enhancing roughness and favoring triboelectric properties. Mechanical tests demonstrated flexibility attributed to low Young Modulus. CA measurements confirmed the hydrophobicity of the films. TGA demonstrated a maximum degradation temperature suitable for outdoor applications. Shaker tests showed an electrical power output of 0.2 micro W, suggesting future use in sensors and self-powered small devices to harvest natural energy.

Keywords: *triboelectric; piezoelectric; lead-free; energy harvesting; shaker.*

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Acknowledgements. This work was developed within the ECIU-FCT scholarship (PRT/BD/154320/2023), with the Aalborg University and within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MCTES (PIDDAC).

En route to obtain SiV nanodiamonds from hot-filament chemical vapor deposition for diverse biomedical applications

Bernardo L. Tavares[†,1], Marta Moniz R.[2], Nuno M.M. Oliveira[2], António J.S. Ferreira[3], Bárbara J. M. L. Ferreira[4], Ana P.M. Tavares[4], Miguel A.C. Neto[⋆,1]

1. CICECO Aveiro Institute of Materials, Department of Materials and Ceramics Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Physics, University of Aveiro, 3810-193 Aveiro, Portugal
3. I3N- Department of Physics, University of Aveiro, 3810-193 Aveiro, Portugal
4. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; mangelo@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. Nanodiamonds are amongst the most researched nanostructures and belong to the family of inorganic nanoparticles such as quantum-dots, gold nanoparticles, and iron oxide nanoparticles (Dahman, 2017). The main difference from other particles of the same family is that nanodiamonds are biocompatible and possess high chemical stability, while having an easy surface functionalization (Kumar et al., 2019). An ever-growing interest in introducing optical-associated defects in the diamond lattice such as nitrogen vacancy nanodiamonds, has led to the mass production of this nanoparticles, but despite being used for long-term bioimaging studies, their broad emission spectrum partly overlaps with many optical markers and cellular autofluorescence (Becker & Becher, 2017). Conversely, NDs with negatively charged silicon-vacancy centres have recently received attention as high-performance bioimaging probes due to their attractive optical properties with sharp near-infrared emission (Liu et al., 2022). The main challenge to obtain these particles is however the controlled insertion of these defects and the cost-effective production of silicon-vacancy centre containing nanodiamonds (Chen et al., 2024). In this work we propose a method to obtain silicon-vacancy centres in nanodiamonds from the fragmentation of hot-filament chemical vapor deposition grown polycrystalline diamond thin films on a monocrystalline silicon wafer.

Keywords: *HFCVD; silicon-vacancy centres; nanodiamonds*

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Development of Novel Electrolytes for Proton Ceramic Membrane Reactors

Alfredo Sango Buzi Luemba[†,1], Duncan P. Fagg [1], Allan J. M. Araújo [1], Francisco J. A. Loureiro [⋆,1]

1. LASI - Intelligent Systems Associate Laboratory, 4800-058 Guimarães, Portugal.

⋆ Corresponding author; † Presenting author; Nanosciences and nanotechnology.

Abstract. Global energy dependence on fossil fuels has been the most significant cause of global warming around the world, causing climate change as well as the significant increase in environmental pollution. In this context, the European Union (EU) has organized policies to foster the adoption of efficient and sustainable renewable energy sources, eclipsing the dominance of fossil fuels. This massive endeavor finds its foundation in the European Green Deal (EGD), a comprehensive framework designed to propel Europe towards carbon neutrality by 2050 while ensuring the provision of clean, affordable, and secure energy across the EU [1-2].

In line with the energy transition, biogas can play a very important role in this goal, as these gases can be used in the transformation of the global energy system in accordance with the International Energy Agency (IEA). However, leveraging biogas, particularly through reforming processes, offers a compelling avenue to generate H2-rich gasa versatile fuel or feedstock pivotal for sustainable chemical production and energy provisioning [3].

Aligned with these aims, the current study aims to propose an electrochemical device to form green syngas (a mixture of CO and H2) from a biogas precursor (CO2 + CH4), by direct electrochemical process through a proton-conducting ceramic-oxide membrane. Differing from traditional biogas to green hydrogen or biomethane routes, this process does not consider the CO2 content of biogas as a hindrance to be removed. Instead, the current pathway permits the conversion and utilization of the entire biogas composition.

Therefore, a major downside of this process is to find a suitable electrolyte with increased tolerance to biogas composition (CO2, CH4, and H2S) since the current materials suffer from poor chemical stability. For this purpose, chalcogenide perovskite proton-conducting ceramics made of BaZrO3-based compounds were successfully synthesized by mechanosynthesis. Preliminary results show increased tolerance in the presence of CO2 as well as in the presence of CH4. The obtained materials are, thus, ready for subsequent electrochemical characterization. Their prospective integration in electrochemical devices may offer a new green pathway for syngas production with important application in the energy and chemical industry sectors.

Keywords: *Proton ceramic membrane reactor; biogas; syngas; electrolyte.*

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Acknowledgements. The authors acknowledge the following grants/projects: https://doi.org/10.54499/2020.02797.CEECIND/CP1589/CT0030, https://doi.org/10.54499/PTDC/CTM-CTM/2156/2020, https://doi.org/10.54499/PTDC/QUI-ELT/3681/2020, https://doi.org/10.54499/2022.09319.PTDC, https://doi.org/10.54499/2022.02498. PTDC, https://doi.org/10.54499/UIDB/00481/2020, and https://doi.org/10.54499/UIDP/00481/2020 from Fundação para a Ciência e a Tecnologia (FCT), and CENTRO-01-0145-FEDER-022083 from Centro Portugal Regional Operational Programme (Centro2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund (ERDF). In addition, Alfredo Luemba is thankful to Instituto Nacional de Gestão de Bolsas de Estudos (INAGBE-Angola).

Optical and electrical analysis of radiation hardness of CIGS solar cells: 1 MeV proton irradiation and recovery

P. T. Patrício[†,1], J. Gomes[1], T. Fernandes[1], B. P. Falcão[1], A. F. Cunha[1], M. Peres[2], K. Lorenz[2], J. P. Teixeira[3], P. M. P. Salomé[1], J.P Leitão[⋆,1]

1. i3N, Universidade de Aveiro, 3810-193 Aveiro, Portugal
2. Instituto de Engenharia de Sistemas e Computadores - Microsistemas e Nanotecnologias (INESC MN), 1000-029 Lisboa, Portugal
3. INL - International Iberian Nanotechnology Laboratory, 4715-330 Braga, Portugal

⋆ Corresponding author; joaquim.leitao@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. Thin film solar cells based on Cu(In,Ga)Se2 (CIGS) have a high potential for space application due to the cell's reduced mass and record power conversion efficiency of 23.60% (Green et al., 2024). The space environment is quite aggressive for devices due to irradiation with different types of particles (protons, electrons, photons,) which seriously damages the devices, particularly around the interfaces between the various layers composing the cells (Afshari et al., 2020). The damage caused by incident radiation results in the creation of defects in the lattice that disrupt the dynamics of the charge carriers and, consequently, the current supplied by the solar cell and its power conversion efficiency. Additionally, the development of damage recovery strategies is important, as it increases the radiation hardness of the solar cell. One of the methods mentioned in the literature with potential to recover CIGS solar cells is annealing (Candeias et al., 2023). However, there are no exhaustive studies for the different energies and fluences of particles that establish the parameters (temperature, duration, atmosphere, lighting) that best promote damage recovery.

The characterization of defects caused by irradiation is important for understanding their impact on the solar cell performance. Therefore, in this work photoluminescence and current density-voltage techniques were used since they are quite sensitive to variations in the concentration of defects in the CIGS layer. A set of three CIGS solar cells with a traditional structure (SLG/Mo/CIGS/CdS/i-ZnO/ZnO:Al/Ni-Al-Ni) were irradiated with protons of 1 MeV in a fluence of 1013 cm-2. A significant decrease in cell performance is observed after irradiation, as shown by current density-voltage measurements. The photoluminescence analysis revealed a significant decrease of the intensity and the broadening of the luminescence. Partial recovery of cell damage was achieved through annealing with and without illumination. The relative importance of temperature and lighting is discussed in the work.

Keywords: *radiation hardness, CIGS solar cells; proton irradiation; recovery*

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Acknowledgements. We would like to express our gratitude to INAGBE Angola (National Institute for Scholarship Management). This work was developed within the scope of the projects i3N, LA/P/0037/2020, UIDB/50025/2020, and UIDP/50025/2020 financed by national funds through the Fundação para a Ciência e a Tecnologia.

Ethylene-regulating materials derived from agrifood byproducts for fruit packaging

Jéssica D. C. Santos[†,⋆,1], Selçuk Yildirim[2], Idalina Gonçalves[3], Paula Ferreira[4]

1. CICECO-Aveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
2. Institute of Food and Beverage Innovation, Zurich University of Applied Sciences, 8820 Wädenswil, Switzerland
3. CICECO Aveiro Institute of Materials, Department of Materials and Ceramic Engineering
4. CICECO Aveiro Institute of Materials, Department of Materials Ceramic Engineering, University of Aveiro, Aveiro, 3810-193, Portugal

⋆ Corresponding author; jessica.santos2604@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. Ethylene, a naturally occurring compound, serves as a ripening agent for fruit and vegetables [1]. However, excessive levels often contribute to significant food waste [1]. On the other hand, agrifood byproducts are abundant and typically discarded during food production and processing, yet retaining valuable biomolecules suitable for the development of new bio-based materials. In this PhD thesis, the potential of repurposing brewery spent grain, pine nut skin, and potato wastewater to develop porous particles with ethylene scavenging activity and ethylene-permeable biodegradable plastics has been studied. Thus far, porous brewery spent grain-derived activated carbons exhibit superior microporosity, ethylene adsorption kinetics and ethylene/ carbon dioxide selectivity compared to a commercial activated carbon. Concurrently, pine nut skin-derived cellulose and cellulose/lignin-based microparticles capable of adsorbing ethylene were developed. Though ongoing enhancements are required to boost their efficacy as active packaging agents and improve their water resistance, the presence of lignin has shown to potentiate ethylene adsorption capacity. Moreover, thermoformed bioplastic trays based on potato and pine nut byproducts with enhanced hydrophobicity and hardness were developed. Future assessments will scrutinize the ethylene adsorption and permeability of these thermoformed bioplastic trays to determine their suitability as bio-based packaging materials capable of preserving fruit quality and safety. Overall, this PhD thesis will provide valuable insights into creating sustainable active packaging materials for fruit preservation as an alternative to non-biodegradable plastics currently on the market. It also underscores new opportunities for valorizing brewery, potato, and pine nut processing byproducts through the development of packaging materials, thereby tackling real-world challenges in the food and plastic industries.

Keywords: *Ethylene, fruit packaging, biopolymers, circular economy, byproducts*

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Chrysin-based metallodrug as a promising approach towards melanoma

Ariana C. F. Santos[†,⋆,1], Ricardo F. Mendes[1], Filipe A. Almeida Paz[1], João Rocha[1], Fátima Martel[2], Helena Oliveira [3], Carmen S. R. Freire[4], Bárbara J. M. L. Ferreira[4]

1. CICECOAveiro Institute of Materials, Department of Chemistry
2. Biochemistry Unit, Biomedicine Department, Faculty of Medicine
3. Department of Biology, CESAM-Centre for Environmental and Marine Studies
4. CICECO-Aveiro Institute of Materials, Department of Chemistry

⋆ Corresponding author; arianasantos@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. Cancer stands as the second leading cause of death in Portugal (OECD, 2023). Despite cisplatins pivotal role in cancer therapy (Oun, Moussa, & Wheate, 2018), it carries significant drawbacks, including severe side effects and the development of drug resistance (Uivarosi & Munteanu, 2017). Flavonoid-based metallodrugs offer a potential avenue for developing novel anticancer agents with improved bioavailability, reduced general cytotoxicity, enhanced efficacy, and greater selectivity (Zhao, Yang, & Xie, 2019). In this work, we successfully synthesized and structurally characterized a flavonoid-based metallodrug by combining chrysin, 1,10-phenanthroline (phen) and Cu(II) ion. The compound was obtained by three distinct synthetic methodologies: traditional heating reflux, solvothermal, and microwave-assisted synthesis. Subsequent comprehensive analysis, including solid-state (powder/single crystal XRD, FTIR and FT Raman spectroscopies, elemental, and thermogravimetric analysis) and solution studies (UV-Vis) were conducted. The antitumoral activity of the compound was evaluated against malignant cell lines, specifically the human epithelial skin cell line (A375). Notably, the novel copper(II) chrysin phen coordination polymer exhibited greater cytotoxicity compared to the free ligands, with an IC50 value of 4.01 +/- 0.18 uM. This represents an 18-fold reduction compared to chrysin and a 1.5-fold decrease compared to 1,10-phenanthroline, suggesting its potential as a promising candidate for melanoma treatment.

Keywords: *natural-based metallodrug; flavonoids; solvothermal synthesis, microwave-assisted synthesis, antitumor activity*

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Microfluidic fabrication of core-shell nanocarriers for delivery of Li-filled carbon dots for neutron capture therapy

Duarte Almeida[†,1], Ricardo J. B. Pinto[2], Hélder A. Santos[3], Gil Gonçalves[⋆,1]

1. Centre for Mechanical Technology and Automation (TEMA), Mechanical Engineering Department, University of Aveiro, 3810-193 Aveiro, Portugal
2. University of Aveiro
3. Department of Biomedical Engineering University Medical Center Groningen University of Groningen, Groningen 9713 AV, The Netherlands

⋆ Corresponding author; ggoncalves@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. Conventional cancer therapeutic approaches have lacked a proper efficacy and selectivity, which results in unwanted side effects, as well as additional discomfort and cost to the patient (Racca, 2020). Neutron capture therapy (NCT) involves the delivery of stable isotopes, typically 10B, which accumulate within cancer cells before being irradiated by a beam of low-energy neutrons. Upon capture by the isotope, these neutrons emit short-range radiation, causing highly contained damage to the cancer cells with limited damage to surrounding healthy tissues. Notably, the 10B isotope has proven highly effective in NCT (Singh, 2021). However, due to its limited efficacy, researchers have explored alternative agents such as lithium, which has shown a great potential for NCT, but was only ever properly encapsulated within carbon nanostructures (Gonçalves, 2023). Moreover, because conventional boron-based drugs often lack the needed degree of biocompatibility for biomedical applications, carbon dots (CDs) have emerged as an alternative. Besides being biocompatible, these carbon nanostructures have shown outstanding optical properties that enable their use for bioimaging. Yet, their ultra-small size (<10 nm) compromises delivery efficiency due to rapid renal clearance, which reduces circulation time (Han, 2019).

This study sought to develop CDs containing 6Li, encapsulated within core-shell nanoparticles (CSNPs) in a precise microfluidic-based nanofabrication process, aiming to achieve a precise 100-200 nm range of CSNP diameters, to optimize the delivery of CDs by maximizing time in circulation (Jin, 2010).

After a hydrothermal reaction with lithium chloride, urea, and citric acid, the produced CDs were purified and characterized under UV-Vis spectroscopy, before being dissolved in a BSA solution. Through a double-chip coflow, this solution was pumped against a continuous flow of ethanol at a 1:4 flow rate ratio, with a converging side stream of diluted glutaraldehyde, before undergoing a double (chemical/thermal) crosslinking process. The resulting nanoparticle suspensions were filtered and characterized under SEM, TEM, DLS, and Zeta potential measurements.

This innovative procedure enabled the nanofabrication of highly stable narrowly distributed composite nanoparticles (6Li-CD-BSA) within the desired size range.

Keywords: *Multiphasic nanostructures, nanomedicine, continuous fabrication; delivery nanosystems, nanofabrication, theragnostics.*

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Interface and surface engineering of CIGS films to improve cell performance.

Sivabalan Maniam Sivasankar[†,⋆,1], Carlos de Oliveira Amorim[1], António F da Cunha[1], Rui Ramos Ferreira e Silva[2]

1. Thin Film and Photovoltaic Research Group, Department of Physics, University of Aveiro, 3810-193 Aveiro, Portugal
2. CICECO Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; sivabalanms@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. In an era where renewable energy sources are crucial to addressing global energy demands and mitigating climate change, advancements in photovoltaic technology are paramount. Copper indium gallium selenide (CIGS) thin films stand out as a leading material for solar cells, thanks to their high efficiency and versatility. To push the boundaries of CIGS performance, this study explores novel fabrication techniques and material enhancements, underscoring the importance of innovative approaches in both technological progression and societal impact.

This study specifically investigates novel approaches to fabricate high-performance CIGS thin films with superior structural properties. We examine the influence of precursor order, incorporation of thin metal oxide interlayers, and doping with alkaline impurities to achieve compact films with high crystallinity, large grain size, and minimal defects.

We challenge the conventional understanding of bi-layer precursor configurations (e.g., Mo/CuGa/In or Mo/In/CuGa). While these structures produce compact CIGS layers, the Mo/CuGa/In configuration suffers from poor cell performance due to void formation at the Mo/CuGa interface. Conversely, the Mo/In/CuGa configuration exhibits poor adhesion between CIGS and Mo, likely due to wetting challenges between indium and molybdenum (Kim & Min, 2018). Interestingly, these latter films, despite possessing voids and rough surfaces, demonstrate surprisingly high cell efficiencies.

To resolve the issues with both precursor configurations we tried a hybrid approach where we stacked multiple CuGa/In layers which were then annealed. We have observed that going for this hybrid approach resolves most of the issues we observed. In addition, it also improves the elemental distribution across the absorber (Kim & Min, 2018).

Furthermore, the study investigates the impact of post-deposition annealing techniques. While rapid thermal processing (RTP) yields significantly more compact films compared to in-chamber annealing, it poses a higher risk of substrate warping and absorber damage (Elanzeery et al., 2023; Karg et al., 1993; Probst et al., 1996).

To address these challenges, we introduce a thin bismuth (Bi) interlayer at the Mo/CIGS interface. This approach significantly enhances device performance by promoting improved film morphology (increased crystal size and compactness) (Zeng et al., 2022). Additionally, it leads to a rise in open-circuit voltage (Voc) and fill factor. Importantly, this Bi interlayer strategy offers a significant advantage due to its compatibility with existing CIGS manufacturing processes.

This research paves the way for fabricating high-quality CIGS films with improved efficiency and manufacturability.

Keywords: *CIGS, Solar cells, Thin-film deposition.*

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Acknowledgements. The authors gratefully acknowledge the financial support of the i3N and the Portuguese Foundation for Science and Technology (FCT) under projects UID/50025/2020-2023 and LA/0037/2020. This work was also developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020, and LA/P/0006/2020, financed by national funds through the FCT/MEC (PIDDAC). We express our sincere gratitude to Dr. Vileta Girão for her assistance with SEM imaging and EDX analysis, Dr. Maksim Starykevich for his help with GDOES analysis, and Dr. Artur Sarabando and Dr. Marco Oliveira for their support with XRD analysis.

Removal of pesticides from wastewaters through combined adsorption and sunlight-induced photodegradation using magnetic nanomaterials

Leonardo Amaral[†,⋆,1], Ana L. Daniel-da-Silva[1], João S. Amaral[2], Isabel del Hierro[3]

1. CICECO-Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. CICECO-Aveiro Institute of Materials, Department of Physics, University of Aveiro, 3810-193 Aveiro, Portugal
3. COMET-NANO Group. Biology and Geology, Physics and Inorganic Chemistry Department, ESCET, King Juan Carlos University, Madrid, Spain

⋆ Corresponding author; leonardoa@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. The agro-food industry produces pesticide-contaminated wastewater during processing. which typically contains high concentrations of pesticides. This wastewater often cannot be reused and is commonly discharged into treatment facilities. However, conventional treatment methods frequently struggle to effectively remove these contaminants. (Campos-Mañas et al. 2019) Acetamiprid, a persistent pesticide widely utilized to combat Hemiptera spp. infestations in fruits, vegetables, and ornamental plants, poses environmental hazards upon release. To address this challenge, affordable removal methods such as adsorption and photodegradation have been suggested. The nanomaterial form of the transition metal dichalcogenide molybdenum disulfide (MoS2) demonstrates considerable promise for use in both adsorption and photocatalytic processes. (Amaral and Daniel-da-Silva 2022) Additionally, the incorporation of magnetic components with MoS2 enables quick and cost-efficient separation from water, and also could potentially improve its effectiveness in degrading pollutants. (Amaral and Daniel-da-Silva 2022)
In this study, MoS2-Fe3O4 hybrid materials were synthesized via a hydrothermal method and subsequently characterized using powder X-ray diffraction, FTIR spectroscopy, transmission electron microscopy and BET analysis. These synthesized materials were employed in the photocatalytic degradation of acetamiprid in water samples, with HPLC utilized to monitor acetamiprid concentration. The produced materials successfully removed up to 82% of acetamiprid in solutions in 3 hours of irradiation. This study evaluates the performance of MoS2-Fe3O4 nanomaterials as photocatalysts and discusses their potential for subsequent regeneration, offering insights into novel strategies for mitigating pesticide contamination in water systems.

Keywords: *Acetamiprid, pesticide, molybdenum disulfide, photocatalysis*

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Acknowledgements. L. Amaral thanks the Fundação para a Ciência e a Tecnologia (FCT) for the PhD Grant UI/BD/151138/2021. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI:10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI:10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI:10.54499/LA/P/0006/2020)

Rare-earth implanted in -Ga2O3 single crystals

J. Zanoni [†,⋆,1], M. Peres[2], T. Monteiro [3], J. Rodrigues [4]

1. i3N, Departamento de Física, Universidade de Aveiro
2. INESC-MN, Instituto de Engenharia de Sistemas de Computadores Microsistemas e Nanotecnologia
3. IPFN, Instituto Superior Técnico, Campus Tecnológico e Nuclear
4. DECN, Instituto Superior Técnico (IST)

⋆ Corresponding author; julia.ines@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. -Ga2O3, known as monoclinic gallium oxide, is a transparent conductive semiconductor material with a wide bandgap energy of 4.9 eV at room temperature and a high 8 MV/cm breakdown field (Pearton et al., 2018). Due to its properties, -Ga2O3 is a versatile semiconductor used in many applications, including solar-blind ultraviolet (UV) detectors, luminescent materials, and power electronics, capable of enduring extreme environments.
-Ga2O3 is the most stable crystalline phase of gallium oxide in terms of chemical and thermal properties. This phase shows great potential as a host for incorporating various rare-earth (RE) elements, including Tm3+, Er3+, Tb3+, Pr3+, Eu3+, and others. It allows expanding the intrinsic UV and blue emissions of gallium oxide to yield green, red, and near-infrared luminescence (Guo et al., 2019). In-situ growth doping is commonly used for doping gallium oxide, although there are limitations due to solubility with high dopant concentrations. Alternatively, ex-situ doping using ion implantation allows for incorporating any RE element in the host and provides greater control over the doping profile (Alves et al., 2010). During ion implantation, the incorporation of dopants can cause defects in the lattice that affect the host's properties. Post-implant rapid thermal annealing (RTA) is often performed to reduce defects and promote ion optical activation (Peres et al., 2017). The importance of studying the nature of these defects is crucial for a better understanding of how the dopants behave in the host and how to design and optimize devices based on RE-doped -Ga2O3.
This work explores RE-implanted -Ga2O3 through structural and optical characterization to assess optically active defects. To do so, commercial -Ga2O3 single crystals were implanted with different RE ions with fluences 1Œ1015 cm-2, energy of 300 keV. RTA in an argon atmosphere was performed to promote the lattice recovery and ions' optical activation. The optical characterization of the samples was carried out using advanced spectroscopic techniques such as Raman spectroscopy, UV-VIS absorption, photoluminescence (PL), lifetimes, temperature, and energy-dependent PL. The data evidenced that the optical activation of the RE ions was achieved, enabling the identification of the main electronic states responsible for each emission and optically characterizing defects before and after ion implantation. The structural characterization using micro-Raman was crucial to verify the damage imposed by the implantation and the recovery of the lattice.

Keywords: *Ga2O3; rare-earth; defects; ion implantation; photoluminescence*

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Lidocaine-loaded pullulan microneedles for local anesthesia

João M. S. P. Leite[†,⋆,1], Bruno M. Neves [2], Carla Vilela[1], Carmen S. R. Freire[1]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Medical Sciences and Institute of Biomedicine - iBiMED, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; joaoleitesilvapinto@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. Pain management and alleviation is of utmost importance in several medical procedures and treatment protocols. Topical creams or hypodermal injections are two of the most frequently used ways to apply local anesthetics to the skin. However, topical ointments show a slow skin diffusion, and injectables must be administered by trained staff and can be rejected due to trypanophobia (Lee et al., 2020).Microneedles (MNs) have emerged as minimally invasive transdermal drug delivery systems that can overcome the stratum corneum barrier and deliver different drug molecules, including anesthetics (Fonseca et al., 2019). Herein, lidocaine-loaded pullulan microneedles were produced through micromolding and characterized in terms of morphology, mechanical properties, skin penetration depth, drug release profile and biological safety. The mechanical strength of these MNs proved to be adequate, being able to withstand forces up to 1.5 N per needle without breakage. Insertion studies in a skin parafilm model showed an adequate performance with MNs penetrating up to 381 ţm. These results were corroborated with an insertion test into excised human abdominal skin where it was observed that the MNs were able to overcome the stratum corneum barrier and reach the dermis. Also, they easily dissolved in an agarose gel skin model, with a complete dissolution of the MNs tips after 10 min. Cumulative release of lidocaine from the patches in PBS at 37ž C, pH 7.4 reached 79% after 10 mins. The safety of these MNs was evaluated against multiple cell lines (keratinocytes, fibroblasts, and macrophages), displaying high cell viability (>80 %) for all cell lines after being exposed to the produced MNs. In sum, this study shows the potential of these biopolymeric system for local anesthesia.

Keywords: *Pullulan, Microneedles, Lidocaine, Anesthesia*

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Magnetic calcium phosphate scaffolds: bone therapy solutions

T. S. S. Carvalho[†,⋆,1], P. M. C. Torres[1], J. H. Belo[2], J. Mano[3], S. M. Olhero[1]

1. Department of Materials and Ceramic Engineering (DEMaC) CICECO-Aveiro Institute of Materials University of Aveiro 3810-193 Aveiro, Portugal
2. Institute ofPhysics ofAdvanced Materials, Nanotechnology and Photonics (IFIMUP), Department of Physics and Astronomy University of Porto 4169-007 Porto, Portugal
3. Department of Chemistry CICECO-Aveiro Institute of Materials University of Aveiro 3810-193 Aveiro, Portugal

⋆ Corresponding author; tssc@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. The successful bone consolidation after a critical size bone loss is reduced and remains a challenge. Calcium phosphate (CaP)-based bioceramics present themselves as the prime materials for bone regeneration purposes, mainly due to their chemical similarity with inorganic part of the bone. Furthermore, magnetic biomaterials have been a subject of interest in the scientific community for their ability to accelerate the osteogenesis process in presence of an external magnetic stimulus (Carvalho et al., 2023; Carvalho, Torres, Belo, Mano & Olhero, 2023). In this work innovative magnetic scaffolds have been developed by extrusion-based 3D printing (robocasting), towards a high bone regeneration capacity. Self-setting inks combining CaP-based bioceramic magnetic and nonmagnetic powders were formulated and properly optimized for suitable printing. The composition, morphology, and magnetic properties of the developed iron doped calcium phosphate-based powders were assessed. The inks were fine-tuned by rheological properties while the scaffolds were evaluated by mechanical and microstructural performance.

Keywords: *Magnetic calcium phosphates; Injectable materials; Additive Manufacturing; Bone regeneration; External Magnetic Field (EMF)*

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Novel antibacterial biopolymeric-metallodrug systems for wound healing applications

Adriana C. C. Gomes[†,⋆,1], Carla Pereira[2], Ricardo F. Mendes[1], Filipe A. Almeida Paz [1], João Rocha [1], Adelaide Almeida [2], Carmen S. R. Freire[1], Bárbara J. M. Leite Ferreira[1]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193, Aveiro, Portugal
2. CESAM - Centre for Environmental and Marine Studies, Department of Biology, University of Aveiro, 3810-193, Aveiro, Portugal

⋆ Corresponding author; adrianagomes@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. Wounds have a significant impact on patients quality of life, but often go unrecognized and are referred to as a silent epidemic (Lindholm & Searle, 2016). On the other hand, according to the World Health Organization, antibiotic resistance is one of the greatest threats to global health as new resistance mechanisms are emerging and spreading around the globe, threatening the ability to control common infectious microorganisms (World Health Organization, 2020). Metal complexes (metallodrugs) could represent a promising class of biologically active compounds that can be incorporated into (bio)polymeric materials for the design of advanced wound dressings that successfully promote wound healing and inhibit the growth and spread of microorganisms. Metal complexes can exhibit 3D structures and mechanisms of action that cannot be achieved with organic molecules alone, as well as unique electronic, magnetic, and spectroscopic properties (Santos et al., 2022). In particular, flavonoid-based metal complexes represent an interesting class of metallodrugs as they exhibit many interesting properties, especially in terms of their biological activity (Kasprzak et al., 2015). In this context, the aim of this work is to develop innovative wound dressings composed of biopolymers (such as bacterial nanocellulose) combined with flavonoid-based metallodrugs. To this end, we have already developed two novel flavonoid-based coordination compounds, specifically zinc(II) complexes with quercetin or morin and the N-donor ligand 1,10-phenanthroline, which were synthesized by two less explored methodologies, namely solvothermal and microwave-assisted synthesis. The complexes have been structurally characterized and their biological potential is currently being investigated regarding their antioxidant and antibacterial activities.

Keywords: *Biopolymeric wound dressing materials, Biopolymers, Metallodrugs, Flavonoids, Biological activities, Wound healing applications*

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Enhancing the antidiabetic effect of chrysin through metal complexation and nanoencapsulation

Diogo Marinheiro[†,1], Cláudia Silva[2], João Rocha[1], Fátima Martel[2], Bárbara J. L. M. Ferreira[1], Ana L. Daniel-da-Silva[⋆,1]

1. CICECO-Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. Biochemistry Unit, Biomedicine Department, Faculty of Medicine, University of Porto, 4200-319 Porto, Portugal

⋆ Corresponding author; ana.luisa@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. Diabetes mellitus poses a significant global health challenge (Lin et al., 2020), demanding the development of innovative therapeutic strategies. We explored the potential of chrysin, a natural compound with inherent antidiabetic properties (Xiao, 2022), by enhancing its efficacy through metal complexation and nanoencapsulation. Cu(II)- and Co(II)-chrysin metal complexes were synthesized and characterized using XRD, TGA, and infrared and UV-VIS spectroscopy techniques to assess their structural integrity and composition. Biological evaluation on Caco-2 and Hep-G2 cell lines demonstrated promising antidiabetic potential with minimal cytotoxicity. Specifically, the complexes exhibited significant reductions in intestinal absorption of glucose and fructose, along with increased hepatic uptake of glucose. To address the low water solubility of the metal complexes and further optimize their therapeutic efficacy, we encapsulated them into mesoporous silica nanoparticles. Various loading approaches were explored, and their efficiency was evaluated. Additionally, the release profile of the loaded materials was studied to assess their applicability as potential diabetes mellitus treatments. Overall, this study presents a multifaceted approach to enhancing the antidiabetic potential of chrysin, offering insights into the development of novel therapeutic agents for managing diabetes mellitus through metal complexation and nanoencapsulation strategies.

Keywords: *Diabetes; chrysin; metal complexes; mesoporous silica nanoparticles.*

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Multifunctional magnetic bionanocomposites for simultaneous cancer treatment and bone regeneration

Joana Gonçalves[†,⋆,1], Liliana Ferreira[2], Maria Cruz[3], Helena Oliveira [4], Hélder Santos[5], Ali Shahbazi[6], Paula Ferreira[1], Claudia Nunes[1]

1. CICECO - Aveiro Institute of Materials, Department of Materials and Ceramic Engineering
2. Physics Department, University of Coimbra
3. Biosystems and Integrative Sciences Institute, Faculty of Sciences, University of Lisbon
4. CESAM, Department of Biology, University of Aveiro
5. Department of Biomaterials and Biomedical Technology, University Medical Center Groningen
6. University Medical Center of Groningen

⋆ Corresponding author; joanadfgoncalves@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. The treatment of bone tumors needs the development of new strategies to treat and to regenerate bones defects produced by the tumor resection (Liao et al., 2021; Wang et al., 2023). Multifunctional scaffolds have potential to address simultaneously the regeneration of bone defect and kill residual cancer cells (Liao et al., 2021; Wang et al., 2023). Our approach is to produce a hybrid scaffold composed by different materials that have a potential synergetic effect to simultaneously promote bone regeneration and prevent cancer remissions. Chitosan was chosen as the main matrix due to its biocompatibility and osteogenic behavior. Nano-hydroxyapatite (n-HA), due to its similarities with native bone, will be integrated to improve its mechanical performance and bioactivity. Magnetite (Fe3O4) nanoparticles (NP) will be also incorporated to increase its mechanical strength and to be used as heat mediators in Magnetic Hyperthermia Therapy (MHT). The freeze-drying method was the selected technique to produce the scaffolds since it is recognized to produced highly porous scaffolds a required feature for bone tissue engineering. These scaffolds revealed high porosity and interconnectivity while an enhancing mechanical properties and reducing degradation was observed comparing with pristine scaffolds. Additionally, the scaffolds exhibited a high swelling capability promoting cell attachment. Human primary osteogenic sarcoma (Saos-2) cell line was seeded on the top of the scaffolds and after 3, 7 and 14 days, a live-dead assay confirmed the biocompatibility of the biomaterial. Furthermore, magnetic hyperthermia assays demonstrated the scaffold's potential for MHT. After a 10 min treatment at 42 řC, a reduction in cell viability was observed, confirming the scaffold's capability to produce a therapeutic heat capable of kill cancer cells.Overall, chitosan-n-HA-Fe3O4 scaffolds have potential for cancer therapy and simultaneously to support bone tissue regeneration.

Keywords: *Bone regeneration, cancer cells, scaffolds, chitosan, Magnetite, nano-Hydroxyapatite*

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Acknowledgements. This work was developed within the scope of the project CICECO - Aveiro Institute of Materials, UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020, financed by national funds through the FCT/MEC (PIDDAC). The financial support to CESAM by FCT/MCTES (UIDP/50017/2020 + UIDB/50017/2020 + LA/P/0094/2020), through national funds, is acknowledged. In addition, FCT is acknowledged for the research contract under Scientific Employment Stimulus to Helena Oliveira (DOI 10.54499/CEECIND/04050/2017/CP1459/CT0023). JG thanks FCT for the grants 2020. 06654.BD. CN is grateful to Portuguese national funds (OE), through FCT, I.P., in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of the article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19. M.C. and L.F. acknowledge FCT for Centre grants UIDB/04046/2020 and UIDP/04046/2020 to BioIS. COST action NETPORE (CA20126) is also thanked for the support of a short term scientific mission.

Piezoelectric oriented fibrous platforms for cardiac tissue engineering platform conceptualization, optimization and manufacturing

Luís Nascimento[†,1], Priscila Melo[2], Paula Marques[3], Gavin Richardson[1], Nathalie Barroca[⋆,2]

1. Centre for Mechanical Technology and Automation
2. Department of Mechanical Engineering
3. School of Engineering
4. Vascular Medicine and Biology Theme, Biosciences Institute

⋆ Corresponding author; nbarroca@ua.pt; † Presenting author; Nanosciences and nanotechnology.

Abstract. The field of cardiovascular disease intervention still face major constraints in providing treatments aimed at tissue regeneration, rather than mere supportive solutions that alleviate the symptoms and consequences. Amongst strategies to develop regenerative strategies, the exploitation of naturally occurring body processes/phenomenon hold great promise to advance the field. Amongst these, the integration of piezoelectric actuation as a regulator for native electro-mechanical cardiac tissue can be advantageous for tissue engineering approaches. (Gouveia et al., 2017) However, research on this field is still in a very early stage with piezoelectric platforms being manufactured using electrospinning as 2D randomly oriented nonwoven fiber mats. While the technique presents straightforwardness, ease of operation and scalability, it lacks precise 3D control, not offering personalized architectural cues for cardiac tissue construction.(Gomes et al., 2022)
Herein, the application of electrohydrodynamic (EHD) jet printing, also known as 3D jet writing for the fabrication of diverse 3D platforms using poly-L-lactic acid (PLLA) was investigated.(Mkhize & Bhaskaran, 2022; Reizabal et al., 2023) This technique combines pressure for ink extrusion and the application of an electric field between a conductive nozzle and a substrate to print and deposit single fibers with good precision and resolution. Unlike traditional melt-electrowriting, EHD does not require temperature for polymer melting, leveraging polymer solution optimization and thus expanding material choice.(Jordahl et al., 2018) To successfully produce PLLA microfibers (1) intrinsic properties related to ink formulation and (2) extrinsic ones related to operating parameters were thoroughly investigated. (Mkhize & Bhaskaran, 2022; Reizabal et al., 2023) Solvent selection took into consideration its capacity to dissolve PLLA with reasonably viscosity, conductivity and suitable evaporation rate facilitating fiber solidification without clogging the printing needle. We also discovered that solvent combination results in solution changes and ultimately in fiber diameter alterations. Additionally, voltage, needle-to-collector substrate distance were also considered. Subtle changes to these values resulted in different jetting regimes, sometimes within single architectural drawings. These included fiber coiling, near-field electrospinning, or complex EHD regimes present for high voltages and high feeding rates. Nonetheless, preliminary results show PLLA microfiber deposition, and even stacking in diverse 3D architectures fulfilling the objective and setting grounds for the exploitation of this technique for other polymer options.

Keywords: *Cardiac Tissue Engineering; Electrohydrodynamic Printing; Additive Manufacturing; Piezoelectricity*

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Acknowledgements. Luís Nascimento thanks FCT for the Ph.D. grant (10.54499/2023.01401.BD). This work was supported by the project Flexobone 2022.02424.PTDC, supported by the Foundation for Science and Technology, in its State Budget component (OE), DOI: 10.54499/2022.02424.PTDC (https://doi.org/10.54499/2022.02424.PTDC) and by the projects UIDB/00481/2020 and UIDP/00481/2020 - Fundação para a Ciência e a Tecnologia, DOI 10.54499/UIDB/00481/2020 (https://doi.org/10.54499/UIDB/00481/2020) and DOI 10.54499/UIDP/00481/2020 (https://doi.org/10.54499/UIDP/00481/2020).

Optoelectronic study of the crystalline Si/amorphous Si interface

M. B. Candeias[†,1], A. Zamchiy[1], G. Abbas[1], H. Águas[1], R. N. Pereira[1], J. P. Leitão[1]

1.

⋆ Corresponding author; † Presenting author; Nanosciences and nanotechnology.

Abstract. The reduction of production costs in Si-based photovoltaic technology is increasingly a decisive factor in its development. One of the paths followed is the reduction in thickness, which requires an increase in the quality of the epitaxial monocrystalline Si. The chemical treatment of the Si wafer [1] and the passivation of the crystalline Si (c-Si) surface with amorphous Si (a-Si) [2,3] is one of the most promising developments. The passivation of the interface between c-Si and a-Si emerges as a fundamental approach to mitigate carrier recombination losses, critical for the performance of photovoltaic devices, and to increase the efficiency of solar energy conversion and the useful life of devices.
The present work investigates the optoelectronic properties of the c-Si/a-Si interface, using the photoluminescence technique and focusing on the study of charge carrier recombination mechanisms in c-Si. Three experimental parameters were changed: i) chemical treatment of the Si wafer surface (KOH 45% at 45žC + RCA 1,2 + HF 5% vs. KOH 5% at 45žC + RCA 1,2 + HF 5%); ii) deposition conditions of the a-Si layers (pure silane vs. 50% H2); iii) thicknesses of a-Si layers. The obtained results suggest that the better chemical treatment is the one involving KOH 5%. In the case of the deposition conditions, both are acceptable from the point of view of the recombination mechanisms. Finally, the increase of the thickness above a few nm doesnt't result in an improvement of those properties.

Keywords: *crystalline Si, amorphous Si, interface, passivation, photoluminescence*

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Development of advanced biopolymeric nanostructured bioinks for 3D bioprinting applications

Maria C. Teixeira[†,1], Carla Vilela[2], Carmen S. R. Freire[1]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. CICECO Aveiro Institute of Materials and Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; † Presenting author; Nanosciences and nanotechnology.

Abstract. The 3D bioprinting technology consists on the layer-by-layer deposition of bioinks to biofabricate artificial living structures that can be used for biomedical applications like tissue engineering and drug-testing. However, the availability of high performance bioinks is still a major challenge in this field.(Teixeira, Lameirinhas, Carvalho, Silvestre, et al., 2022) Therefore, this project aims to formulate advanced nanocomposite bioinks with high performance in terms of bioprintability and mechanical stability, as well as cell density and viability, by incorporating biobased nanofibers, such as lysozyme nanofibrils (LNFs) and nanofibrillated cellulose (NFC), into biopolymeric hydrogels.
The first study involved the preparation and characterization of alginate nanocomposite hydrogel bioinks reinforced with different amounts of LNFs (1, 5, and 10 wt.%) to mimic skin tissue analogues.(Teixeira, Lameirinhas, Carvalho, Valente, et al., 2022) The obtained inks benefited from the addition of LNFs, showing appropriate shear-thinning behavior, good recovery properties (about 90%), and better printability. The loading of keratinocytes (HaCaT) cells (cell density 2 x 106 cells mL-1) in the ink formulation with better performance (A-LNFs 5%) resulted in high cell viability values (88%) after 7 days post-bioprinting.
The second study investigated the simultaneous incorporation of NFC and LNFs into pectin hydrogels for the bioprinting of melanoma in vitro 3D models. A Pectin-NFC (70:30) suspension, was selected to produce the final inks by adding different amounts of LNFs (5, 10, and 15% wt.%). The Pectin-NFC-LNFs (10%) ink demonstrated the best performance and was laden with A375 melanoma cells (3 x 106 cells mL-1). The cell viability after bioprinting was assessed up to 14 days, reaching 92%, and the bioprinted structures were then tested as a 3D-platform for drug screening, using doxorubicin as a model drug.
The final study is focused on the addition of LNFs to k-carrageenan hydrogels. The physicochemical characteristics, rheological behavior, and biological activity of these bioinks are being assessed, as well as their application on the development of 3D wound-healing patches.

Keywords: *Bioprinting; Bioinks; Hydrogels; Nanocomposites; Polysaccharides; Biobased Nanofibers*

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Acknowledgements. This work was developed within the scope of the projects of the projects CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MEC (PIDDAC), and project NANOBIOINKS (CENTRO-01-0145-FEDER-031289), financed by national funds through the Portuguese Foundation for Science and Technology (FCT)/MCTES. FCT is also acknowledged for the research contracts under Scientific Employment Stimulus to C.S.R.F. (DOI 10.54499/CEECIND/00464/2017/CP1459/CT0033) and C.V. (DOI 10.54499/2021.01571.CEECIND/CP1659/CT0024).

Physical engineering

Electric-field influence on Group-IV defects in diamond: A perturbative model approach

Afonso Lamelas[†,⋆,1], Ulrich Wahl[2], Lino Pereira[3], Adam Gali[4], Vitor Amaral[5]

1. Physics Department and CICECO, University of Aveiro, Campus de Santiago, 3810-193 Aveiro, Portugal
2. Department of Nuclear Sciences and Engineering and C2TN, Instituto Superior Técnico, Estrada Nacional 10, ao km 139,7, 2695-066 Bobadela, Portugal
3. Quantum Solid State Physics, KU Leuven, Celestijnenlaan 200D, 3001 Leuven, Belgium
4. Wigner Research Centre for Physics, Department of Atomic Physics from the Budapest University of Technology and Economics, and MTA-WFK Lendület Momentum Semiconductor Nanostructures Research Group, Konkoly-Thege Miklós út 29-33, 1121 Budapest, Hungary
5. Department of Physics and CICECO, University of Aveiro, Campos de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; alamelas@ua.pt; † Presenting author; Physical engineering.

Abstract. Group-IV defects in diamond show great promise for quantum applications, providing significantly improved properties over the more studied nitrogen-vacancy center. Their invertion center is a key contributer to this improvement. Such symmetry eliminates the coupling to electric fields at first order, making them resistant to electronic noise from, for example, nearby surfaces. However, despite their inversion center, they still couple at second order, resulting in inhomogeneous broadening at shorter time scales [1] and spectral drift over longer time scales. Therefore, with the overarching goal of achieving group-IV defects with reliable and consistent properties, it is not sufficient to focus solely on the optimization of creating the centers with the desired structure but also to study their coupling to electric fields. To clarify these issues, we developed a microscopic perturbative model of the electric field coupling to group-IV centers, considering the dipole approximation and including up to 4th order perturbations in the field, spin-orbit coupling and the Jahn-Teller effect. The electric coupling coefficients were calculated with the delta scf methodology, based on plane wave density functional theory. When considering only the effect of the field, it results in both a splitting of the transitions, with some tending towards higher energies and other lower. Including spin-orbit coupling splits the energy levels at 1st order perturbation, and these are no longer split at higher orders by the field. The model predicts quadratic behavior with the field, despite the additional perturbation orders and effects, while experiments show additional powers in the dependence [2,3]. Moreover, for the transition to the first excited state, an increase in energy with the field is predicted; however, a decrease is observed experimentally [2,3]. Therefore, additional considerations must be included to bring the model into agreement with observations.

Keywords: *Diamond, color centers, group-IV, electric field coupling, lineshift*

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Acknowledgements. We acknowledge the funding from Fundação para a Ciência e Tecnologia trough the 2022.11398.BD PhD studentship and the CERN/FIS-TEC/0003/2021 project. Moreover, this work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC).

Novel architectures on transparent rear contacts in bifacial ultrathin solar cells

André F. Violas[†,⋆,1], Enzo J. Ribeiro [2], António J. N. Oliveira[3], Jennifer P. Teixeira[2], Paulo A. Fernandes[4], Pedro M. P. Salomé[1]

1. Departamento de Física, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal and INL International Iberian Nanotechnology Laboratory, Avenida Mestre José Veiga, 4715-330 Braga, Portugal
2. INL International Iberian Nanotechnology Laboratory, Avenida Mestre José Veiga, 4715-330 Braga, Portugal
3. i3N, Departamento de Física, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal and INL International Iberian Nanotechnology Laboratory, Avenida Mestre José Veiga, 4715-330 Braga, Portugal
4. CIETI, Departamento de Física, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, Porto 4200-072, Portugal and INL International Iberian Nanotechnology Laboratory, Avenida Mestre José Veiga, 4715-330 Braga, Portugal

⋆ Corresponding author; andre.violas@inl.int; † Presenting author; Physical engineering.

Abstract. The transition to sustainable energy resources, as photovoltaic (PV) devices, requires a large amount of critical raw materials. Bifacial PV devices provide for a reduction of materials consumption by allowing light absorption from both the front and rear contacts, increasing the devices energy yield. Cu(In,Ga)Se2 (CIGS) based solar cells were used as testbeds in this study. In such solar cells, the bifaciality is deployed by replacing the rear contact from the standard Mo to a transparent one. However, CIGS based solar cells on transparent rear contacts are not competing with the cells on Mo contacts (Keller et al., 2022). Therefore, this work studied the impact of an ITO rear contact on CIGS based solar cells. Firstly, two different parameters affecting the ITO performance on the solar cell were tested, namely the NaF precursor layer thickness and the absorber growth temperature. The parameters values for an optimized solar cell performance were selected to be used with novel rear contact architectures, namely dielectric passivation and photonic crystals. The dielectric passivation on ITO rear contacts provide a solar cell performance enhancement of 1.2 % conversion efficiency absolute value compared to a bare ITO contact. Regarding the photonic crystals, they allow for a short-circuit current density (Jsc) increase of >6 mA/cm2 reaching 35 mA/cm2, in an ultrathin solar cell. This Jsc value competes with the standard cells with a fourfold thickness value. The work to be presented discusses the CIGS based solar cells performance on the developed rear architectures and supports the discussion with complementary optoelectronic simulations (Violas et al., 2024).

Keywords: *Bifacial; Ultrathin solar cells; CIGS; Rear passivation; Light management; Transparent contact*

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Acknowledgements. A. F. Violas and A. J. N. Oliveira acknowledge the financial support of the Portuguese Foundation for Science and Technology (FCT) through the PhD grant numbers 2020.07073.BD and 2020.04564.BD. J. P. Teixeira acknowledge the financial support through the grant number 2021.02405.CEECIND.

Developing a system for detection of leakages in closed circuits using luminescent nanoparticles

G. Marques[†,⋆,1], S. O. Pereira[1], J. Rodrigues [2], A. R. F. Carreira[3], L. Rino[4], J. P. Leitão[5], B. P. Falcão[1]

1. i3N-Aveiro, Department of Physics, University of Aveiro, 3810-193 Aveiro, Portugal
2. i3N, Departamento de Física, Universidade de Aveiro
3. Bosch Termotecnologia, S.A., 3800-533 Cacia, Portugal
4. Physics Department and i3N, University of Aveiro, 3810-193 Aveiro, Portugal
5.

⋆ Corresponding author; gabrielsmarques@ua.pt; † Presenting author; Physical engineering.

Abstract. Tightness tests for domestic water heating equipment are rigorous, prioritizing equipment performance and user safety. The use of water to detect leakages in such systems is a very common practice in the production industry of these systems, but it raises some issues. The major concern is the reliance on water, a limited natural resource, which also includes additional costs due to the need for drying before packaging. Additionally, the impossibility of accurately locating the leakage source leads to the equipments disposal since conducting individual and meticulous inspection is not commercially feasible.
To overcome these challenges, we are developing a dry method that uses aerosolized luminescent nanoparticles as optical probes to detect and precisely pinpoint the leak site. This approach offers several advantages, including its biocompability and non-toxicity nature, cost-effectiveness and scalability for industrial application.
The platform under development comprises 3 main units responsible for (i) controlling the dispersion of nanoparticles powder in gases, (ii) simulating leaks in pipes, and (iii) detecting and pinpointing the leakage site. To this end, we are exploring the functionalization of sub-20 silica (SiO2) nanoparticles via a two-steps process that is specifically tailored to achieve high luminescence quantum yields (Muradova et al., 2021; Shah et al., 2018; Shetty et al., 2021). The setup consists of a Venturi eductor connected to a vacuum pump, through which the nanoparticles are aerosolized into the perforated testing tube. On the outside, the powder is excited by a UV LED, its luminescence emission is captured by a camera, and the resulting images undergo computational analysis and processing. Besides the functionalization of nanoparticles, we are investigating different test conditions using the luminescent nanoparticles, such as different pressure levels, diverse carrier gases, and various configurations of the system components.

Keywords: *Optical leakage detection, Luminescent nanoparticles, Gas dispersion, Image processing, Sustainable and biocompatible nanoparticles.*

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Potential role of luminescent nanoparticles on pathogen detection in plants

Ana Brinca-Moreira[†,⋆,1], Cátia Pinto[2], Rita Branquinho[3], Florence Fontaine[4], Florinda M. Costa[5]

1. i3N, Departamento de Física, Universidade de Aveiro, 3810-193 Aveiro, Portugal
2. Associação SFCOLABLaboratório Colaborativo para a Inovação Digital na Agricultura, 2560-312 Torres Vedras, Portugal
3. i3N/CENIMAT, Department of Materials Science, Faculty of Science and Technology, NOVA University of Lisbon and CEMOP/UNINOVA, 2829-516 Caparica, Portugal
4. Unité Résistance Induite et Bioprotection des Plantes EA 4707 USC INRAE 1488, Université de Reims Champagne-Ardenne, 51100 Reims, France
5. i3N, Department of Physics, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; anabrinca@ua.pt; † Presenting author; Physical engineering.

Abstract.
Plants diseases are responsible for 20-40 % of agricultural production losses anually (FAO, 2021).In the particular case of grapevine, which in 2021 its subproducts constituted a trade market value of almost 42 bn (OIV, 2022), one of the major threat of its sustainability and productivity relies on the incidence of fungal diseases, in particular the Grapevine Trunk Disease (GTD) complexes (Gramaje et al., 2018).
One of the main challenges of GTDs relies on the undetermined latency period, in which the plants display an asymptomatic status, while the infection is progressing, misleading about its health status sometimes for years. In nurseries, this behavior poses a high risk of cross-contamination and GTDs uncontrollable diffusion (Gramaje et al., 2018). Therefore , disruptive tools for the early-stage diagnosis and monitoring are imperative to allow better integrated management strategies. Hence, nanotechnology-based sensing approaches may play a decisive role.
Luminescent nanomaterials are particularly advantageous for bioimaging and in vivo monitoring, as they offer enhanced sensitivity in depth. A similar approach is here proposed, foreseeing the development of bio-compatible functionalized luminescent silicate-based nanoparticles (NPs), obtained by pulsed-laser ablation in liquid (PLAL), targeting specific phytopathogens responsible for GTDs, in particular the Neofusicoccum parvum and Diplodia seriata.
To achieve this, spectral analysis of grapevine stems were performed. Results suggested the emission of materials should be in the 500-650 nm spectral range to avoid chlorophyll absorption bands. Therefore, Mn2+-doped Zn2SiO4 ceramic targets were firstly synthesized using solid state reaction. The aim is to optimize photoluminescence (PL) intensity and afterglow, adding different Mn2+ concentrations, assessing the influence of H3BO3, and using lanthanide ions as co-dopants. The targets were structurally and optically characterized using X-ray diffraction, Raman and PL techniques. To obtain the NPs, the targets will be submitted to PLAL, testing different laser wavelengths and solvents, among other parameters. The toxicity of the resulting NPs will be also assessed to ensure safety for plants, using strategies, such as foliar disc analysis.

Keywords: *nan*

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Acknowledgements. The authors gratefully acknowledge all the efforts and support being given by António José Fernandes, Alexandre Carvalho, Teresa Monteiro and Vincenzo Mondello throughout all the stages of development of this PhD project. This work is being developed within the scope of the project i3N, UIBD/50025/2020 & UIDP/50025/2020 & LA/P/0037/2020, financed by national funds through the Portuguese Foundation for Science and Technology, FCT/MEC. Also, the authors acknowledge Chaire Maldive financially supported by Grand Reims and the RE-C05-i02: Interface Mission - Collaborative Laboratories Call 01/C05-i02/2022. A. Brinca-Moreira also acknowledge the PhD grant i3N FCT UI/BD/152237/2021 and the funding from Programa PESSOA COTUTELAS 2022 FCT/CampusFrance.

Light management strategies in chalcogenide thin film technologies

A. J. N. Oliveira[†,1], J. P. Teixeira[1], A. F. Violas[1], E. J. Ribeiro[1], B. T. Sousa[1], P. A. Fernandes[1], M. R. P. Correia[2], P. M. P. Salomé[1]

1. International Iberian Nanotechnology Laboratory, Braga 4715-330, Portugal
2. Departamento de Física, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

* Corresponding author; † Presenting author; Physical engineering.

Abstract. Cu(In,Ga)Se2 (CIGS)-based technology is at the forefront of inorganic thin film solar cell absorbers, as it presents the highest light-to-power conversion efficiency value of 23.6 % (Keller et al. 2024). However, the current state-of-art is far from the monocrystalline silicon (mono-Si) record of 26.6 % (Yoshikawa, et al. 2017). A pathway for the CIGS market expansion consists of reducing raw materials consumption and increasing efficiency. An ultra-thin approach, through sub-micrometre absorbers, satisfies the low-cost requirement, although with a decrease in the conversion efficiency value due to incomplete light absorption losses (Oliveira et al. 2022). Hence, aiming to increase the conversion efficiency value and use thinned-down absorber layers, the ultrathin technology dissemination can benefit from developing and optimizing of light management strategies. Therefore, in this work, scattering schemes were idealized and optimized to compensate for the incomplete light absorption loss inherent to ultrathin CIGS-based devices. Two architectures are studied i) a plasmonic configuration with metallic nanoparticles integrated within a rear passivation scheme and ii) dielectric photonic crystals also integrated at the absorbers rear contact. Optical simulations were performed to optimize the JSC gain from the conceptualized scattering schemes, and the nanofabrication process flows of all the architectures were centred on cost-effective nanoimprint lithography processes.

Keywords: *Photovoltaics; CIGS; Light Management; Plasmonic; Scattering*

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Acknowledgements. FCT and FSE are acknowledged. A. J. N. Oliveira and A. Violas, acknowledge respectively 2020.04564.BD and 2020.07073.BD. J. P. Teixeira acknowledges 2021.02405.CEECIND. P. A. Fernandes and M. R. P. Correia acknowledge the i3N project, UIDB/50025/2020, UIDP/50025/2020, financed by national funds through the FCT/MEC. P. A. Fernandes acknowledges projects UIDB/04730/2020, UIDP/04730/2020. The Hi-BITS - High efficiency bifacial thin film chalcogenide solar cells project, grant agreement: 101122203, is acknowledged.

Piezo photonic materials for sensing applications

Joana Pronto[†,⋆,1], Lianshe Fu[1], S. F. H. Correia[2], A. R. Frias[3], Vitor Sencadas[4], R. A. S. Ferreira[1]

1. Department of Physics and CICECO - Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal
2. Instituto de Telecomunicações and University of Aveiro, Campus Universitário de Santiago 3810 - 193 Aveiro Portugal
3. Simoldes Plásticos S.A., Rua Comendador António da Silva Rodrigues 165, Oliveira de Azeméis, 3720-193, Portugal
4. Department of Materials and Ceramic Engineering and CICECO - Aveiro Institute of Materials, University of Aveiro, 3810-193 Aveiro, Portugal

⋆ Corresponding author; joanapronto@ua.pt; † Presenting author; Physical engineering.

Abstract. Mechano-luminescence consists in the conversion of mechanical stimulus into photon emission, giving rise to the possibility of emission by mechanical energy present in nature. Nevertheless, the emission of light upon mechanical stimulus is still an unexplored phenomenon. With the aim of understanding this effect, it is necessary to control the deformation imposed to the materials, and in this regard, the piezoelectric materials are an interesting material because of their intrinsic properties of mechanical deformation upon electrical stimulation and vice versa.
The piezo luminescence combines the luminesce with piezoelectricity (Hernandez et al., 2021; Ma et al., 2019, 2020; Zheng et al., 2019), providing new applications as multifunctional sensors (sensitive to several stimuli), optoelectronic devices, among others (Ma et al., 2019). Furthermore, the automotive industry seeks efficient, lightweight and eco-friendly solutions for interior applications (Olhan et al., 2021). Integration of the developed piezo photonic sensor contributes to the reduction of total weight of the vehicle and a streamline human-machine interface communication by converting mechanical forces into light feedback for users.
Preliminary results showed promising advancements in embedding Ln3+ complexes (Ln=Eu, Tb) within poly(vinylidene fluoride-trifluoroethylene) P(VDF-TrFE). The materials display efficient room temperature emission in the green and red spectral regions, while the flexible P(VDF-TrFE) matrix presented electroactive properties, suggesting the possibility of combining optical and piezoelectric properties in the same material.
In this work it is proposed a study of the interaction between piezoelectricity and luminescence in flexible polymeric materials modified by the addition of lanthanide ions. The produced materials will be systematically characterized, and the piezo-photonic performance will be assessed. Posteriorly these materials will be applied in prototypes in the automotive sector, as proof of concept of their applicability.

Keywords: *Piezoelectric, photonic, lanthanide ions, multifunctional sensors, optoelectronics, piezo photonics.*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials (UIDB/50011/2020, UIDP/50011/2020 & LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC) and Instituto de Telecomunicações (UID/EEA/50008/2021). JP thank FCT and Simoldes Plásticos (2023.03756.BDANA) and SFHC thank FCT (2022.03740.CEECIND/CP1716/CT0006).

Laser-induced local formation of electrical pathways on Nb2O5 ceramic surfaces

Henrique Gomes[†,⋆,1], Florinda Costa[1], Nuno Ferreira[1]

1. i3N, Department of Physics, University of Aveiro, 3810-193, Aveiro, Portugal

⋆ Corresponding author; henriquebpgomes13@ua.pt; † Presenting author; Physical engineering.

Abstract. Laser technologys ability to deliver high quantities of energy in a focused, precise and local mode makes it ideal for several interesting applications, such as, for example, the local modification of ceramic oxide surfaces. In this work, the viability of using laser technology to promote electrically conductive pathways, on the surfaces of insulating ceramic materials, was studied. For that, a continuous CO2 laser (= 10.6 m) was used to irradiate the surface of sintered ceramic samples of Nb2O5, resulting in a phase transformation into a conductive non-stoichiometric Nb2O5 phase along the laser pathways. The effect of the laser power and the sample speed on the morphological and electrical characteristics of the created pathways was studied. Through optimization of the laser parameters, it was possible to obtain a maximum pathway width of 267ś7 m and depth of 287ś7 m, as well as a maximum electrical conductivity of 18.3ś0.4 S/m, an increase of eight orders of magnitude when compared with the conductivity of the ceramic base (Makhlouf et al., 2013). This study allows further exploration of the application of laser technology to promote localized electrical pathways on insulator oxide surfaces, useful to create ceramic sensors.

Keywords: *Laser surface treatment, Localized phase transformation, Ceramic oxides, Electrical pathways, Niobium oxide (Nb2O5)*

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Acknowledgements. The authors are grateful to i3N (LA/P/0037/2020, UID-B/50025/2020 and UID-P/50025/2020) financed by COMPETE 2020 Program and National Funds through the FCT/MEC and FEDER under the PT2020 Partnership Agreement. This work is funded by National Funds (OE), through FCT Fundação para a Ciência e a Tecnologia, I.P., in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19.

Optical investigations in zinc germanate for luminescence-based applications

Maria S. Batista[†,⋆,1], Miguel P. Dias[1], Gabriel Marques[1], Ana V. Girão[2], Florinda M. Costa[1], Joaquim Leitão[1], Luís Rino[1], Ana Pimentel[3], Joana Rodrigues[1], Sónia O. Pereira[1], Teresa Monteiro[1]

1. i3N, Department of Physics, University of Aveiro, 3810-193 Aveiro, Portugal
2. CICECO-Aveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
3. i3N/CENIMAT, Department of Materials Science, NOVA School of Science and Technology, Campus de Caparica, 2829-516 Caparica, Portugal

⋆ Corresponding author; † Presenting author; Physical engineering.

Abstract. Zinc germanate (Zn2GeO4) is a wide-bandgap (4.4 to 4.9 eV [1,2]) semiconductor oxide with promising optical properties to be applied in several technological applications, such as UV photodetectors and emitters, broadband near-infrared (NIR) light sources, high-power electronics, solid-state phosphors, anticounterfeiting, photocatalysis, gas sensing, bioimaging and photovoltaics [1-3]. Nevertheless, is barely reported in the literature and considerable gaps in understanding its optical properties persist, warranting further investigation. So, this work aims to undergo a full structural, morphological, chemical, and especially optical investigation to establish a model for the nature of optically active defects and their recombination.
In light of this, undoped and intentionally chromium (0.5 %mol Cr) doped Zn2GeO4 (ZGeO and ZGeO:Cr, respectively) pellets were produced via solid-state reaction. The morphological, structural, and chemical characterization was assessed by scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDS), X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), and Raman and Fourier-transform infrared (FTIR) spectroscopies. Additionally, an exhaustive study of the optical properties of these oxides was performed by using UV-Vis-NIR absorption spectroscopy, photoluminescence (PL), PL excitation (PLE) lifetime, and persistent luminescence (PersL) measurements.
Employing this extensive analysis, it was possible to confirm that both samples presented the willemite-type crystal structure with a rhombohedral unit cell and exhibit a wide range of optically active defects (intrinsic and extrinsic) that give rise to the luminescent characteristics of interest for various applications. At RT, strong blue and green emissions are observed due to intrinsic defects and Mn2+ impurities. Moreover, Cr3+ and Cr4+ broad emission bands in the NIR-I (700-1000 nm) and NIR-II (1000-1700 nm) spectral regions are observed. Among these remarkable luminescent properties, PersL in the green and NIR I was measured, indicating a wide energy distribution of the traps in the produced samples.

Keywords: *Zinc germanate, manganese, chromium, photoluminescence, green emission, blueish emission*

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Bioglass modified with metal oxides for dental implant coatings: structural, morphological and biological characteristics

Imen Hammami[†,⋆,1], M.P.F. Graça[1], João Paulo Borges [2]

1. I3N and Physics Department, Aveiro University, 3810-193 Aveiro, Portugal
2. I3N-CENIMAT and Materials Science Department, NOVA School of Science and Technology, Campus de Caparica, 2829-516 Caparica, Portugal

⋆ Corresponding author; imenhammami@ua.pt; † Presenting author; Physical engineering.

Abstract. The domain of biomedical implants has undergone a transformation, shifting its focus from primarily mechanical attributes to a deeper comprehension that integrates essential biological characteristics. Historically, the mechanical properties of implants were of the highest priority in restoring normal tissue functions. On the contrary, recent research demonstrates the importance of incorporating biological factors such as osseointegration, tissue regeneration, and biocompatibility in the development of effective implants [1,2]. Recent years have seen an increase in the number of studies investigating the possibility of coating implants with bioactive materials in an effort to improve their biological performance, such as osteointegration, longevity, stability, and tissue regeneration [3,4]. An example of such bioactive material is the 45S5 bioglasső, which has gained significant attention, particularly in the field of bone regeneration [5]. In this work, bioglasses modified with the insertion of various concentrations of metal oxides were prepared and analyzed structurally and biologically. The results show that all of the bioglasses exhibited antibacterial activity against the tested bacteria and showed no cytotoxicity for the Saos-2 cell line at concentrations up to 25 mg/mL. The bioactivity test in simulated body fluid (SBF) revealed that all samples developed a calcium phosphate-rich layer on their surface within 24 hours.

Keywords: *Bioglass; Bioativity; Antibacterial; Biocompatibility*

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Acknowledgements. The Authors acknowledge the financial support of the FEDER funds through the COMPETE 2020 Program and National Funds through FCTPortuguese Foundation for Science and Technology under the project LISBOA-01-0247-FEDER-039985/POCI-01-0247-FEDER-039985, UIDP/50025/2020 and UIDB/50025/2020 of the Associate Laboratory Institute of Nanostructures, Nanomodelling, and Nanofabrication i3N., UCIBIO (UIDP/04378/2020 and UIDB/ 04378/2020) and Associate Laboratory i4HB (LA/P/0140/2020)

A finite-element analysis of the demagnetizing field induced magnetocaloric effect

Rodrigo Kiefe[†,⋆,1], João Amaral[1]

1. CICECO, 3810-193 Aveiro, Portugal

⋆ Corresponding author; rodrigokiefe@ua.pt; † Presenting author; Physical engineering.

Abstract. The magnetocaloric effect (MCE) is typically induced via an applied magnetic field change on the magnetic refrigerant. This is achieved by displacing either the magnetic field source or the magnetic refrigerant itself. A less explored method to induce the MCE is via a change of the demagnetizing field of the refrigerant, rotating the refrigerant between two direction with different shape-induced demagnetizing factors. To our knowledge, the first report on this approach was by Barclay et al., in a patent filed in 1984 (Barclay et al., 1984) where a sheet of Gadolinium with undisclosed dimensions was rotated under an applied magnetic field of 0.3 T, showing a peak MCE value of 0.8 K. This value is sufficiently high to raise questions on the applicability of this approach in magnetic refrigeration devices. The main advantage would be lowering the power requirements of the movement, which is simply the rotation of the refrigerant within a homogeneous field. This improvement can be particularly relevant, as the energy cost of movement/rotation in current magnetic refrigeration device prototypes can amount up to 78% of the total (Tura and Rowe, 2021, Masche et al., 2022). An improvement in the compactness of the refrigeration device, compared to the usual design, is also a possibility. In this work, we revisit the demagnetizing field induced MCE, by comparing experimental measurements with simulations. A finite-element approach allows to go beyond the approximation of a homogeneously magnetized refrigerant, showing the temperature profile of the refrigerant in different geometries. Experimental measurements were made on thin plates of Gd, rotated under an applied field of 1.2 T. The temperature profile of the experimental and simulated Tad (T) data show good agreement. Exploring finite-element simulations for Gd sheets, we find the demagnetizing field induced MCE reaches peak maximum Tad (T) for applied fields below 0.5 T.

Keywords: *Magnetocalorics; Magnetic Refrigeration; Finite element method*

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Physics - MAP-fis

Quantum transfer in high root topological insulators

G. F. Moreira[†,⋆,1], A. Lykholat[2], L. Madail[3], A. M. Marques[2], R. G. Dias[2]

1. Department of Physics I3N
2. Department of Physics i3N
3. Department of Physics, i3N International Iberian Nanotechnology Laboratory

⋆ Corresponding author; guilherme.maia.moreira@ua.pt; † Presenting author; Physics - MAP-fis.

Abstract. The possibility of implementing quantum information protocols in 1D systems which rely on the transport of a particle between the boundaries of the system is presently being explored. The advantage of such implementations is the possible protection against losses to the bulk, even in the presence of decoherence sources. One such implementation has been proposed recently that relies on the usage of 1D topological insulators with zero energy protected edge states (Zurita et al., 2023). In this work, the goal is to generalize the approach of these authors to high-root topological insulators such as the sine-cosine chains. This particular type of topological insulator was proposed recently (Dias & Marques, 2021). These topological insulators are characterized by multiple energy gaps and exhibit finite energy edge states in these gaps, which are symmetry protected, and which, in principle, should allow the quantum information transport of several qubits using a single chain.

Keywords: *High-Root Topological Insulators, Quantum State Transfer.*

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Acknowledgements. The authors acknowledge support from the Institute for Nanostructures, Nanomodelling and Nanofabrication (i3N) project UIDB/50025/2020, UIDP/50025/2020 and LA/P/0037/2020, which were financed by national funds through the Portuguese Foundation for Science and Technology (FCT) and the MEC of Portugal. AMM acknowledges financial support from i3N (Contract No. CDL-CTTRI-46-SGRH/22).

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Development of hybrid nanostructured electrochemical sensors for monitoring water contaminants

Tiago Moura[†,⋆,1], Raquel Queirós[2], Laura M. Salonen[3], Nuno Santos[4]

1. Department of Physics, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal.
2. INL, International Iberian Nanotechnology Laboratory, Av. Mestre José Veiga, 4715-330, Braga, Portugal.
3. CINBIO, Universidade de Vigo, Department of Organic Chemistry, Vigo 36310, Spain.
4. i3N, Institute for Nanostructures, Nanomodelling and Nanofabrication, Department of Physics, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal.

⋆ Corresponding author; tap.moura@ua.pt; † Presenting author; Physics - MAP-fis.

Abstract. In recent years, several contaminants, such as pharmaceuticals and biotoxins, have caught the attention of the scientific community and health organizations due to their presence in aquatic environments and their potential to harm the environment and human health (Geissen et al., 2015). Accordingly, there is a need for effective monitoring tools that allow an understanding of the occurrence and fate of these pollutants. Electrochemical sensors are interesting substitutes for traditional analytical methods owing to their dimensions, ease of operation, and cost-effectiveness (Maduraiveeran & Jin, 2017). However, to sense low concentrations in complex matrices, several aspects must be addressed such as transducer performance, response time, reproducibility, sensitivity, and selectivity (Geissen et al., 2015).
Herein, Laser-Induced Graphene (LIG) (Lin et al., 2014) transducing surfaces integrated with Covalent Organic Frameworks (COFs) as biorecognition moieties are proposed to fulfil the required needs for low-concentration electrochemical sensing. Laser-induced graphene surfaces were fabricated through direct laser irradiation of polyimide substrates, i.e. direct laser writing (Lin et al., 2014). The produced surfaces were extensively characterized to assess the effect of laser power, lasersubstrate distance, and number of irradiation steps on the morphology, structure, electrical, and electrochemical properties of the material, allowing their optimization for the intended (bio)sensing application. Thereafter, the growth of 1,3,5-Tris(4-aminophenyl)benzene (TAPB) and 2,5-Dimethoxyterephthalaldehyde (DMTP) COF (Xu et al., 2015) thin films on laser-induced graphene surfaces was studied. TAPB-DMTP-COF was synthesised via in situ polymerization on the LIG surface, thus LIG films on polyimide were directly immersed in the solution containing the TAPB and DMTP building blocks. Characterization through Raman spectroscopy and scanning electron microscopy indicated the formation of a TAPB-DMTP-COF film on the LIG surface, but also large micron-sized agglomerates. The presence of agglomerates can be minimized through the optimization of the COF synthesis, namely the duration and the homogenization of the solution. Subsequently, cyclic voltammetry (CV) and electrochemical impedance spectroscopy (EIS) were performed to the modified electrodes in ferri/ferrocyanide electrolyte solutions. After the growth of the COF layer, higher peak currents were obtained through CV, and EIS showed reduced charge transfer resistance. These results indicate that the COF layer does not limit the electrochemical response of the LIG electrodes, which constitutes a promising result regarding the application of COF/LIG hybrid nanostructures for biodetection.

Keywords: *electrochemical sensors, laser-induced graphene, covalent organic frameworks, hybrid nanostructures, water contaminants, environmental monitoring.*

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Acknowledgements. T.M. acknowledges the FCT - Fundação para a Ciência e a Tecnologia, I. P, for the Ph.D. research Grant 2022.13224.BD.

Self-interactions can (also) destabilize bosonic stars

Marco Brito[†,⋆,1], Carlos Herdeiro[1], Nicolas Sanchis-Gual[1], Etevaldo dos Santos Costa Filho[2], Miguel Zilhão[1]

1. Departamento de Matemática da Universidade de Aveiro and Centre for Research and Development in Mathematics and Applications (CIDMA) Campus de Santiago, 3810-183 Aveiro, Portugal
2. Departamento de Astronomía y Astrofísica, Universitat de València, Dr. Moliner 50, 46100, Burjassot (Valencia), Spain

⋆ Corresponding author; marcobrito@ua.pt; † Presenting author; Physics - MAP-fis.

Abstract. We study the dynamical stability of Proca-Higgs stars, in spherical symmetry. These are solutions of the Einstein-Proca-Higgs model, which features a Higgs-like field coupled to a Proca field, both of which minimally coupled to the gravitational field. The corresponding stars can be regarded as Proca stars with self-interactions, while avoiding the hyperbolicity issues of self-interacting Einstein-Proca models. We report that these configurations are stable near the Proca limit in the candidate stable branches, but exhibit instabilities in certain parts of the parameter space, even in the candidate stable branches, regaining their stability for very strong self-interactions. This shows that for these models, unlike various examples of scalar boson stars, self-interactions can deteriorate, rather than improve, the dynamical robustness of bosonic stars.

Keywords: *Boson stars; Proca Stars; Higgs field; General relativity; Numerical Relativity*

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Acknowledgements. This work is supported by the Center for Research and Development in Mathematics and Applications (CIDMA) through the Portuguese Foundation for Science and Technology (FCT Fundação para a Ciência e a Tecnologia) through projects: UIDB/04106/2020 (with DOI identifier https://doi.org/10.54499/UIDB/04106/2020); UIDP/04106/2020 (DOI identifier https://doi.org/10.54499/UIDP/04106/2020); PTDC/FIS-AST/3041/2020 (DOI identifier http://doi.org/10.54499/PTDC/FIS-AST/3041/2020); CERN/FIS-PAR/0024/2021 (DOI identifier http://doi.org/10.54499/CERN/FIS-PAR/0024/2021); and 2022.04560.PTDC (DOI identifier https://doi.org/10.54499/2022.04560.PTDC). This work has further been supported by the European Horizon Europe staff exchange (SE) programme HORIZON-MSCA-2021-SE-01 Grant No. NewFunFiCO-101086251. M.B. is supported by the FCT grant 2022.09704.BD. N.S.G. acknowledges support from the Spanish Ministry of Science and Innovation via the Ramón y Cajal programme (grant RYC2022-037424-I), funded by MCIN/AEI/10.13039/501100011033 and by ESF Investing in your future. N.S.G. is further supported by the Spanish Agencia Estatal de Investigación (Grant PID2021-125485NB-C21) funded by MCIN/AEI/10.13039/501100011033 and ERDF A way of making Europe. M.Z. acknowledges financial support through FCT grant 2022.00721.CEECIND with DOI identifier https://doi.org/10.54499/2022.00721.CEECIND/CP1720/CT0001. E.S.C.F. is supported by the FCT grant PRT/BD/153349/2021 under the IDPASC Doctoral Program. Computations have been performed at the Argus cluster at the U. Aveiro and at the Navigator Cluster at the LCA in U. Coimbra through projects 2021.09676.CPCA and 2022.15804.CPCA.A2.

PIIC - 1st/2nd cycles

Effects of Processing on CaMnO3 for Thermoelectric Applications

Francisco Batista[†,⋆,1], Diogo Lopes[2], Andrei Kavaleuski[2], Nuno Ferreira[3]

1. Department of Physics, University of Aveiro, 3810-193, Aveiro, Portugal
2. CICECO - Aveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
3. i3N, Department of Physics, University of Aveiro, 3810-193, Aveiro, Portugal

⋆ Corresponding author; francisco.batista@ua.pt; † Presenting author; PIIC - 1st/2nd cycles.

Abstract. As an alternative to commercially available thermoelectric materials, transition metal oxides that are cheaper, more abundant and more stable at high temperatures [1] have been studied for more reliable, scalable and environmentally friendly energy use, one of the promising families being calcium manganite (CaMnO3) doped with electron donors.This work analyzed the differences caused by processing using the laser floating zone (LFZ) method compared to the solid state method, such as the partial replacement of calcium with neodymium: Ca1-xNdxMnO3 (x=0; 0.05; 0.1) and the effects of heat treatments on the structure, microstructure and thermoelectric properties. LFZ processing proved to be a promising tool for fabricating CaMnO3-based ceramics and produces samples with better homogeneity and a higher power factor, 170 W m-1 K-2, for lower growth rates.Solid-state processing, for longer sintering times, results in denser samples with larger grains and fewer secondary phases.

Keywords: *Thermoelectric Materials, Laser Floating Zone Processing, Solid State Reaction, Oxides, Semiconductors, Nd Substitution, Electrical Properties, Thermoelectric Performance*

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Interaction of posaconazole with 2-hydroxypropyl-beta-cyclodextrin by co-milling

Maria Almeida Santos[†,⋆,1], Nádia E. Santos[2], Firas El-Saleh[3], Filipe A. Almeida Paz[4], Susana S. Braga[1]

1. LAQV-REQUIMTE, Departamento de Química, Universidade de Aveiro, Portugal
2. LAQV-REQUIMTE, Departamento de Química, Universidade de Aveiro, Portugal + CICECO Instituto de Materiais de Aveiro, Departamento de Química, Universidade de Aveiro, Portugal
3. Ashland, Life Sciences RD, Paul-Thomas Strasse, 56, D-40599 Düsseldorf, Germany
4. CICECO Instituto de Materiais de Aveiro, Departamento de Química, Universidade de Aveiro, Portugal

⋆ Corresponding author; malmeidasantos@ua.pt; † Presenting author; PIIC - 1st/2nd cycles.

Abstract. Posaconazole is a second-generation triazole antifungal agent used in the management of invasive (systemic) fungal diseases in adults and children. It is available as an intravenous solution, oral suspension, and delayed-release tablets. The intravenous formulations of posaconazole available in the market, Noxafil (1) and Posanol (2), contain sulfobutylether-beta-cyclodextrin (SBEBCD) in a molar ratio of roughly 7:1, i.e., there is a large excess of cyclodextrin. The need to use high amounts of a solubilising agent is a result of the high lipophylicity of posaconazole, classified as a BCS class II drug (low solubility and high permeability).In alternative to SBEBCD, (2-hydroxypropyl)-beta-cyclo-dextrin (HPBCD) poses as a more affordable and equally biocompatible solubiliser for posaconazole. Inclusion of posaconazole into HPBCD has been demonstrated to be possible in the solid state using co-freeze-drying, while solution studies showed that HPBCD had a strong solubilising effect on posaconazole, increasing its aqueous solubility from 0.12 mg/mL (pure form) to 9.88 mg/mL (complex) (3). In this work, we investigate the use of solid-solid mechanochemical reactions to include posaconazole into HPBCD or, at least, co-amorphise them. Taking into consideration the large dimensions and extended shape of the compound, two stoichiometries are tested, 3:1 and 2:1. The progress of the interaction over the time of co-milling is monitored using solid-state characterisation methods, namely powder XRD, FT-IR and DSC.

Keywords: *Posaconazole, antifungal, (2-hydroxypropyl)-beta-cyclodextrin, co-milling, solid-state*

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Acknowledgements. Thanks are due to University of Aveiro and Fundação para a Ciência e a Tecnologia (FCT/MCTES) for financial support to LAQV-REQUIMTE (Ref. UIDB/50006/2020, doi 10.54499/UIDP/50006/2020), and to CICECO Aveiro Institute of Materials (Refs. UIDB/50011/2020, doi 10.54499/UIDB/50011/2020; UIDP/50011/2020, doi 10.54499/UIDP/50011/2020; LA/P/0006/2020, doi 10.54499/LA/P/0006/2020) through national funds (PIDDAC) and, where applicable, co-financed by the European Regional Development Fund (FEDER), within the PT2020 Partnership Agreement.

Machine-learning aided fire detection systems

Rúben Santo[†,1], Carlos Couto[⋆,2]

1. Research fellow, MSc in Computational Engineering, Physics Department, University of Aveiro
2. RISCO, Civil Engineering Department, University of Aveiro, Portugal

[⋆] Corresponding author; ccouto@ua.pt; [†] Presenting author; PIIC - 1st/2nd cycles.

Abstract. Fire is the major accidental action responsible for the loss of lives, service disruption and building unusability with strong economic and social impacts among all the extreme events that may affect a building during its lifespan.
To reduce these impacts, different passive and active fire protection systems may be planned and co-exist in a building. Passive fire protection systems are those related to fire resistance and include for example, improved building designs against fire while active fire protection systems are those triggered by the fire. The latter, may include early fire detection systems (e.g. alarms), sprinklers automated fire doors, etc. In the field of early fire detection in residential and industrial buildings, existing systems are known to issue a great number of false alarms, which is particularly penalizing if a fire brigade is mobilized, thus a trade-off between automation and efficiency must be sought in order to improve the false alarms vs. true occurrences binomial.
In this context, there are several opportunities to develop and incorporate state-of-the art machine learning models for improved fire detection. In the scope of the running project SAFER-Fire we are developing machine-learning models capable of detecting fires at an early stage based on innovative algorithms capable of recognizing complex fire-related patterns. Indeed, we explore the potential for deep learning techniques to improve the accuracy and robustness of detection as well as establishing relevant performance metrics for fire detection accuracy and system efficiency. Our approach merges computer vision techniques for pattern detection with state-of-the art object detection machine learning models such as YOLOv8 and aims to deliver lightweight, fast, and accurate models that can run on a single-board computer, providing continuous 24/7 monitoring.
Therefore, our approach has the potential to deliver a cost-effective system that can be readily available in high-importance buildings, linked to other active fire protection systems, and overall contribute to increased safety against the extreme event of a fire.

Keywords: *Machine learning, computer vision, fire detection, early alarming system*

Space targeted Cu(In,Ga)Se2 based solar cells under proton irradiation: remarkable recovery via thermal and light treatments

T. V. Fernandes[†,⋆,1], P. Patrício[1], A. F. Cunha[1], J. P. Gaspar[2], N. Catarino[3], M. Perez[2], K. Lorenz[2], J. P. Teixeira[4], P. M. P. Salomé[5], J. P. Leitão[1]

1. Departamento de Física, Universidade de Aveiro, Campus Universitário de Santiago, 3810193 Aveiro, Portugal and i3N, Universidade de Aveiro, 3810193 Aveiro, Portugal
2. Instituto de Engenharia de Sistemas e Computadores - Microsistemas e Nanotecnologias (INESC MN), 1000-029 Lisboa, Portugal and DECN, IPFN, Instituto Superior Técnico, Universidade de Lisboa, 1049001 Lisboa, Portugal
3. DECN, IPFN, Instituto Superior Técnico, Universidade de Lisboa, 1049001 Lisboa, Portugal
4. INL - International Iberian Nanotechnology Laboratory, 4715330 Braga, Portugal
5. Departamento de Física, Universidade de Aveiro, Campus Universitário de Santiago, 3810193 Aveiro, Portugal and INL - International Iberian Nanotechnology Laboratory, 4715330 Braga, Portugal

⋆ Corresponding author; tiagofernandes00@ua.pt; † Presenting author; PIIC - 1st/2nd cycles.

Abstract. Present-day tendency in the space industry is based on reducing the size and weight of the satellites to reduce launch costs. On this behalf, CIGS based thin-film solar cells (SCs) arise as a great alternative for the typical Si, III-V materials and multijunction based SCs, since they feature high power conversion efficiency combined with low size and weight. Although, to achieve successful space missions, the satellite SCs should also exhibit high radiation tolerance, as it is identified as a major detrimental factor since the beginning of space exploration (Luque & Hegedus, 2003).In this study, we present an experimental study of Cu(In,Ga)Se2 (CIGS) based SCs irradiated with protons to simulate the harsh space environment, along with a procedure to recover the damages. The irradiation used different energies to create a broad distribution of defects across a large depth of the CIGS layer and in the CdS/CIGS interface.The radiation-induced degradation and recovery steps were investigated through current density-voltage (JV) and photoluminescence (PL) measurements. After irradiation, the observed drastic reduction in the power conversion efficiency, as high as 90%, indicates that the SCs underwent a near destruction from an electrical standpoint, which was accompanied by deep changes in the PL spectral shape as well as a significant PL quenching. The recovery of the proton-induced damage was promoted through the subjection of the SCs to several thermal annealing steps with increasing temperature (90-200 C) and intercalated with light-soaking (LS) treatments (Candeias et al., 2023). These conditions are compatible with the space environment. The incremental recovery was monitored after each treatment. At the end of the whole process, the SCs showed a remarkable recovery of the electrical performance (up to ~85% of the initial values) and PL spectra. These results show that, despite the severe damage caused by irradiation, the CIGS SCs kept working and the recovery methodology was able to recover the electrical operation of the SC. Nevertheless, the thermal annealing treatments revealed critical in the whole process.This study exhibits the importance of implementing SCs recovery strategies in space environment and reaffirms the potential of the CIGS technology in the actual context of space exploration.

Keywords: *CIGS solar cells, proton irradiation, recovery treatments, space application*

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Acknowledgements. T. V. Fernandes acknowledges the funding through grants 186/2023/BI/AgendasPRR and 43/2024/BI/AgendasPRR.

Comparative outcomes in patient blood management: evaluating the efficacy of complete versus incomplete PBM implementation

Beatriz Lau[†,⋆,1], Daniel Ramos[1], Vera Afreixo [2], Luís Silva [1], Ana Helena Tavares[1], Miguel Martins Felgueiras[1], Diana Gomes[1], Firmino Machado[3], Henrique Coelho[1]

1.
2. CIDMA Center for Research and Development in Mathematics and Applications, Department of Mathematics, University of Aveiro (UA), Aveiro, Portugal
3. Centro Académico Clínico Egas Moniz Health Alliance, Aveiro, Portugal

⋆ Corresponding author; beatrizlau@ua.pt; † Presenting author; PIIC - 1st/2nd cycles.

Abstract. Anaemia is prevalent among patients undergoing elective cardiac surgery, posing an elevated risk of mortality and morbidity during the post-surgical phase (Mueller et al., 2019). In recent years, the concept of Patient Blood Management (PBM) has emerged as a novel initiative defined as patient-centered and evidence-based, with the aim of preserving patients' own blood, thus reducing the necessity for allogeneic blood components (Dhir & Tempe, 2018). This comprehensive strategy spans the pre-, peri-, and postoperative phases, focusing on three core pillars: optimizing blood mass, minimizing blood loss, and enhancing patient tolerance to anaemia. Despite its recognition as 'good clinical practice,' barriers persist in its full implementation, occasionally hindering adherence to all outlined steps (Word Health Organization, 2021).
The purpose of this investigation is twofold: to determine whether failure to correct preoperative anaemia and non-implementation of the protocol, has an impact on the transfusion of red blood cells and the duration of hospitalization among patients scheduled for elective cardiac surgery, when compared to full adherence to the PBM protocol, and to ascertain the extent to which these outcomes are affected by type of surgery and other health related factors. Evaluation will be conducted through the application of a multinomial regression. Additional regression models will be employed, and other predictive models will be implemented (Levi et al., 2021).
A total of 332 patients were analysed, of whom 124 completed the PBM protocol, 126 did not, and in 82 cases PBM was not implemented. Significant differences were observed in the incidence of 1-unit blood transfusion between patients where PBM was not implemented and those who completed the protocol (OR = 4.24, 95% CI 1.39-9.30) and between uncorrected preoperative anaemia and those who completed (OR = 2.76, 95% CI 1.38-5.53). A similar pattern was observed in the case of transfusions of two or more units. However, no statistically significant differences were observed in the length of hospitalisation.

Keywords: *Patient Blood Management, Cardiac Surgery , Blood Transfusion, Machine Learning*

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Acknowledgements. This work was supported by CIDMA and is funded by the Fundação para a Ciência e a Tecnologia, I.P.(FCT, Funder ID: 50110000187) under Grants UIDP/04106/2020 (https://doi.org/10.54499/UIDP/04106/2020)

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Exploring the impact of fluorinated porous materials on CO2 capture

F. D. Amaro Costa[†,1], Tiago Morais[1], Mirtha Lourenço[⋆,2], Mariana Sardo[3], Luis Mafra[1]

1. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
2. Department of Chemistry, University of Iceland, Science Institute, Dunhaga 3, 107 Reykjavik, Iceland
3. CICECO - Aveiro Institute of Materials

⋆ Corresponding author; † Presenting author; PIIC - 1st/2nd cycles.

Abstract. Growing concerns about climate change arise due to the escalated CO2 emissions resulting from the combustion of fossil fuels, which lead to increased global temperatures and adverse environmental effects (Shakoor et al., 2020). Several strategies, such as the adsorption methodology, have been proposed to capture CO2 from large point sources. Research efforts focus on developing optimal adsorbents with characteristics such as high CO2 uptake capacity, selectivity, durability, rapid uptake, cost-effectiveness, ease of regeneration, and low toxicity (Gür, 2022). Therefore, it is relevant to understand the effect of certain functional groups on CO2 adsorption to synthesize effective adsorbents. One of the smart functionalities that can be introduced during the synthesis of porous materials is fluorine, which imparts hydrophobicity, making this option particularly attractive for application in moist environments where water competes with other gases for the same adsorption sites. The role fluorine plays in adsorption is yet ambiguous in literature, needing further research (Tchalala et al., 2019; Zhao et al., 2013).
Periodic Mesoporous Organosilicas (PMOs) are periodic, tunable, exhibiting mechanical, thermal, and hydrothermal stability, and amenable to functionalization, making them excellent model materials for investigating the role of fluorine in CO2 uptake (Karimi et al., 2022). This work aims to fill the gap in the field of fluorinated PMOs by developing them for a comprehensive study of fluorine's effects on CO2 capture. Initial steps involve synthesizing precursors for fluorinated and non-fluorinated PMOs, where the distance between silanols and the presence of fluorine is tested, with yields between 30 - 40 %. This step was followed by the synthesis of PMOs and standard characterization. The synthesized PMOs are ordered materials, presenting a specific surface area between 730 - 760 m2/g. Correlation studies combining CO2 adsorption and PMO textural properties are being performed to help understand the effect of fluorine on CO2 capture.

Keywords: *Periodic mesoporous organosilicas (PMOs), Fluorinated materials, synthesis, CO2 adsorption*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) &

LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). This work has also received funding from the European Research Council (ERC) under the European Unions Horizon 2020 research and innovation program (Grant Agreement 865974). FCT is acknowledged by MAOL for a Junior Researcher Position (CE-ECIND/01158/2021). MAOL further acknowledges funding from the European Unions Horizon Europe research and innovation programme No. 101090287.

Preliminary evaluation regarding the feasibility of producing acoustic panels by additive manufacturing using geopolymeric inks containing biomass fly ash wastes

Carolina M. Pereira[†,⋆,1], Guilherme Ascensão[2], Nuno P.F. Gonçalves[3], Rui M. Novais[1], Idalina Alcântara[4]

1. Dept. of Materials and Ceramic Engineering/CICECO-Aveiro Institute of Materials
2. RISCO, Department of Civil Engineering
3. Dept. of Chemistry/CICECO-Aveiro Institute of Materials
4. Estrada Nacional 16, Km 3,7, R. Vale Caseiro 149, 3800-627 Cacia

⋆ Corresponding author; carolinap@ua.pt; † Presenting author; PIIC - 1st/2nd cycles.

Abstract. Due to the accelerated populational growth and improvement of living conditions, energy consumption has greatly increased over the past years, particularly in buildings, transportation and industry [1,2]. In tandem with the intensive energy usage are carbon dioxide (CO2) and other greenhouse gases (GHG) emissions, which promote global warming (GW) [2]. The extreme temperatures boosted by GW lead to a higher demand of heating and cooling solutions, however, the energy supplied for their operation is often from fossil sources, generating more GHG [3]. To tackle this distressing scenario, innovative and sustainable solutions are in huge demand. Heat pumps emerged as one of the most promising technological solutions [2], since their operation enables the use of renewable energy to transfer heat[4,5]. Heat pumps are expected to reduce 500 million tons of CO2 emissions until 2030 [6]. However, despite the inherent sustainability, the compressor and the fan [7,8], fundamental parts of the equipment, generate noise pollution, that poses long-term harms to individuals [9]. Additive manufacturing techniques, such as Direct-Ink-Writing (DIW) are highly effective to produce structures with controlled porosity in size, shape and distribution [10,11],which can be tailored to maximize the performance of acoustic panels [12].

The present work intends to develop waste-based 3D-printed geopolymers that can mitigate the noise generated by heat pumps. This will be achieved using locally available biomass fly ash wastes, derived from the cellulose industry, as a solid and reactive precursor blended with metakaolin [13]. The ink used to produce the panels was characterized regarding the rheological and calorimetric properties to ensure suitable printing conditions. Then, samples with different geometries were produced and characterized regarding their porosity, acoustic absorption coefficient, transmission loss and compressive strength.

Keywords: *Heat pumps; acoustic panels; geopolymers; additive manufacturing; circular economy.*

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Investigation of potential angiogenic coatings for dental implants

Bárbara S. Baptista[†,*,1], Beatriz G. Neves[2], Sónia S. Ferreira[3], Luís M. Pereira[1], Nuno M. Ferreira[4], Manuel A. Coimbra[3], Mariana B. Oliveira[2], Joana Mesquita-Guimarães[5]

1. TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal
2. CICECO Aveiro Institute of Materials, Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
3. LAQV-REQUIMTE - Department of Chemistry, University of Aveiro, 3810-193 Aveiro, Portugal
4. I3N, Physics Department, University of Aveiro, Aveiro, 3810-193, Portugal
5. TEMA - Centre for Mechanical Technology and Automation, Department of Mechanical Engineering, University of Aveiro, 3810-193 Aveiro, Portugal AND LASI - Intelligent Systems Associate Laboratory, 4800-058 Guimarães, Portugal

* Corresponding author; † Presenting author; PIIC - 1st/2nd cycles.

Abstract. Globally, 350 million people's quality of life was impacted by tooth loss in 2019 (World Health Organisation, 2022). Oral health is crucial to overall health and well-being, extending beyond just maintaining healthy teeth and gums. Dental implants are the intraosseous treatment for tooth loss replacement. In the last decade, several global dental implant companies have invested in commercialising and developing solutions for zirconia implants (Nishihara et al., 2019).
Dental implants are designed to withstand the occlusal load, safely transferring it gradually to the interfacial tissues (Dhatrak et al., 2015). In addition, they allow bone-to-implant contact at the first stage of osseointegration and, later, after 3 to 6 months, the secondary stage of osseointegration after bone regeneration.
Angiogenesis and osseointegration facilitate a functional bond between the dental implant surface and the surrounding host tissues, the hard tissue (alveolar bone) and the soft tissue (marginal and attached gingiva) (Saghiri et al., 2016). Moreover, adding angiogenic agents to the implant surface reduces the risk of implant failure (Alghamdi & Jansen, 2020).
In this work, two laser surface texturisations, an aligned texture and a random roughness, similar to the commercial surface treatment, were developed for zirconia substrates. This was followed by applying a mesoporous 58S bioactive glass coating, and then a phytotherapeutic agent, aloe vera polysaccharide acemannan, with angiogenic ability, was added.Acemannan was extracted directly from Aloe vera leaves and purified by dialysis to obtain the angiogenic polysaccharide.
Laser surface textures and coatings were characterised by SEM/EDS, profilometry to measure surface quality and topography, GC-FID, and acetylation and methylation degree to identify acemannan polysaccharides. The angiogenic potential will also be analysed.

Keywords: *Dental implants, Zirconia surface modification, Bioactive coating, Angiogenesis*

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Acknowledgements. This research had the financial support of the following projects UIDB/00481/2020 (https://doi.org/10.54499/UIDB/00481/2020) and UIDP/00481/2020 (https://doi.org/10.54499/UIDP/00481/2020) - FCT - Fundação para Ciência e Tecnologia; and CENTRO-01-0145-FEDER-022083 - Centro Portugal Regional Operational Programme (Centro2020), under the PORTUGAL 2020 Partnership Agreement, through the European Regional Development Fund. It also acknowledges the CLEAN MOLD project with reference POCI-01-0247-FEDER-070290. and FCT in the scope of the framework contract foreseen in the numbers 4, 5 and 6 of article 23, of the Decree-Law 57/2016, of August 29, changed by Law 57/2017, of July 19.

PIIC - students@Digimedia

Development of a transmedia awareness campaign for digital inclusion

Ana Patrícia de Sousa[†,1], Antero Rio[1], Nuno Chaves[1], Stella Corrá[1], Francisca Lourenço[⋆,2], Rita Oliveira[2], Oksana Tymoshchuk[2]

1. Department of Communication and Art, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. DigiMedia, Department of Communication and Art, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; franciscalourenco@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. Digital inclusion, which represents the democratization of access to digital technologies [1], is fundamental to ensuring that all people, regardless of their abilities, have the opportunity to access and benefit from the opportunities provided by technology, namely access to information, communication, education, employment, social and civic inclusion, entertainment, and health and well-being [2]. In this context, this project developed a transmedia campaign to disseminate assistive technologies that help children with disabilities and promote inclusive education. Using various digital communication channels, the aim is to raise awareness of the importance of digital inclusion for people with different types of disability.
Through an analysis of similar campaigns and research into good communication practices in this context, an engaging and educational narrative was constructed which, in addition to presenting an informative component on assistive technologies, also inspires and motivates the target audience to adopt more inclusive digital practices in their daily lives.
After this, several interviews were carried out with the team from the ICT (Information and Communication technologies) Resource Centre (CRTIC) of the Agrupamento de Escolas de Eixo, who, as experts specializing in assistive technologies in the field of inclusive education, helped to provide a solid basis for the development of the different types of content included in the campaign. The campaign begins by presenting the goal of the project, then moves on to the importance of these technologies, followed by an individual explanation of the characteristics of each device or product.
The implementation of the campaign involved publishing and distributing this content on the disseminating channels: Facebook, Instagram and Youtube, with the intention of reaching a wide audience and promoting digital inclusion, improving the quality of life of people with disabilities.

Keywords: *Digital inclusion, Assistive technologies, Transmedia Campaign, Education, Inclusive Education*

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Acknowledgements. This work is financially supported by national funds through FCT Foundation for Science and Technology, I.P., UIDB/05460/2020.

Development of an audiovisual campaign to promote the inclusion of people with disabilities

Francisca Rocha Lourenço[†,⋆,1], Rita Oliveira[1], Oksana Tymoshchuk [1], Frederico Rodrigues[2], Alexandre Sousa[2], Isadora Andrade[2], Ana Botelho[2]

1. Universidade de Aveiro - DigiMedia
2.

⋆ Corresponding author; franciscalourenco@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. The inclusion of People with Disabilities (PwD) plays a crucial role in promoting their autonomy and participation in society [1]. Recognizing this importance, this project aims to develop an audiovisual campaign that highlights the positive impact of activities that promote the autonomy and participation of these people. Based on real-life testimonies, this campaign aims not only to raise awareness, but also to empower the community to recognize and value inclusion as an essential component in society. To do this, an analysis was made of the narratives and strategies of similar campaigns, identifying the best audiovisual production practices in the context of promoting inclusive initiatives. Subsequently, an interview script was developed with questions that explore the individual perspective of participants in inclusive activities and the impact of these experiences on their daily lives. The interviews were conducted with a group of people with different types of disability, who were part of two different communities: one of polybat (adapted table tennis) and another of adapted sailing, promoted by Sporting Clube de Aveiro [2], of which the University of Aveiro is a partner. The recordings included not only the participants' testimonies, but also scenes of the practice of these two inclusive activities, highlighting the importance of the autonomy and social inclusion they provide. After the footage-taking phase, the editing and production process began for the campaign videos, which focused on creating a coherent and engaging narrative.The campaign was disseminated through the Youtube platform, with the goal of reaching a wide audience and promoting awareness of the importance of inclusion and improving the quality of life of people with disabilities.

Keywords: *assistive technologies, impaired people, audiovisual campaign, inclusion, inclusive activities*

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Acknowledgements. This work is financially supported by national funds through FCT Foundation for Science and Technology, I.P., UIDB/05460/2020.

Seniors make to play: Developing game dissemination strategies

Maria Terra[†,1], Ana Pereira[1], Francisco Regalado[⋆,2], Carlos Santos[3], Ana Isabel Veloso[4]

1. Campus Universitário de Santiago 3810-193 Aveiro Portugal
2. DeCA
3. Universidade de Aveiro, Departamento de Comunicação e Arte, Campus Universitário de Santiago, 3810-193 Aveiro
4. DigiMedia, Department of Communication and Art, University of Aveiro

⋆ Corresponding author; fsfregalado@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. Games offer great avenues to foster older adults active and healthy ageing (AHA). In particular, previous research (e.g., Ching-Teng, 2019; Gerling et al., 2015; Yang & John, 2020) has found ways to enhance their well-being through promoting social interaction and providing cognitive and physical stimulation. Motivated by the need to create simple, easy-to-replicate strategies that engage multiple seniors simultaneously, and ensuring an impact on AHA, the Seniors Make to Play project was developed under the Students@DigiMedia initiative.

The study began with a review of the state of the art, aiming to analyze both the developed game strategies and the communication methods used, such as videos, toolkits, or explanatory guides. Additionally , contact was made with two senior institutions in Aveiro, partners of the project Florinhas do Vouga and Fundação Casa do Pessoal da Segurança Social e Saúde do Distrito de Aveiro. The visits to these institutions were crucial for understanding several key aspects: (i) each institution has its own specific characteristics, emphasizing the need to create adaptable strategies; (ii) the creation of a repository of games using simple materials is essential, leaving the responsibility for creating these games to the institutions; and (iii) the use of video format is reinforced.

Thus, after analyzing the gathered information and assessing areas of opportunity for research, a strategy was developed in response to the challenge posed:

Game definition: using only paper sheets, the "Who Am I?"game involves guessing the object/person/concept written on the paper based on questions that can be asked to all other participants who have access to the guessing word;

Dissemination and engagement: resorting to Facebook, a page will be created to share the game with an explanatory video and script, thus enabling replication;

Sustainability: to ensure that the strategy can stand on its own, challenge strategies will be implemented within the institutions, such as creating shareable chants with the community, small competitions between institutions, and establishing challenge-based networks among various institutions.

Currently, the following steps are: (i) validation of the proposal with the project's partner institutions; (ii) evaluation of game dissemination tools with seniors; and (iii) assessment of the game proposal among seniors.

Ultimately, this project is expected to advance research on games applied to senior contexts as tools for promoting AHA, as well as presenting a model for the construction and dissemination of simple, easy-to-create games within institutions, while ensuring engagement and participation.

Keywords: *older adults, games, social media.*

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Acknowledgements. To acknowledge the Florinhas do Vouga and Fundação Casa do Pessoal da Segurança Social e Saúde do Distrito de Aveiro without whom this work would not have been possible. This work was supported by FCT Foundation for Science and Technology (Fundação para a Ciência e Tecnologia), I.P. nr. 2021.06465.BD, and DigiMedia Research Center, under the project UIDB/05460/2020.

Communicating science: creating interactive and appealing e-books

Mónica da Silva e Silva[†,⋆,1], Catarina Feio[1], Mirela Peloso[1], Fábio Ferreira[1], Oksana Tymoshchuk[1], Lídia Oliveira[1], Rita Branco[1], Joana Quental[1]

1. Universidade de Aveiro

⋆ Corresponding author; † Presenting author; PIIC - students@Digimedia.

Abstract. During swift technological progress and digitalisation, the spread of scientific knowledge has undergone substantial changes. Making scientific knowledge more accessible can lead to well-informed decisions at all societal levels. By embracing this kind of communication, the scientific community may effectively connect complex scientific concepts with the general population (Bajracharya et al., 2021). This methodology cultivates confidence and comprehension among scientists and the public, thereby advancing a more knowledgeable society in scientific matters. It fosters inquisitiveness, analytical reasoning, and a heightened recognition of the significance and influence of science in our everyday existence. Dynamic digital platforms are increasingly replacing or enhancing traditional means of scientific dissemination. It is essential to comprehend the methods of effectively communicating scientific information, specifically for this research by developing interactive and captivating e-booksthrough research collaboration (Pérez and Alamán, 2022; Rountree, 2020).

The analysis of data with a specific focus on emerging technologies in digital media (Mattoni, 2017) influences science communication. We discuss the difficulties and possibilities that arise when creating digital tools for science communication, such as concerns regarding projects and doctoral theses, as such trends of digital media field, like gamification and artificial intelligence.

Through collaboration between DigitalOBS and the Students@DigiMedia initiative by DigiMedia Research Centre, the main goal is to analyse existing tools for creating e-books and to develop a content presentation model for the final publication template, with the target of publishing in the platform of DigitalOBS (https://digitalobs.pt/). The methodology approach entails extensive study, meticulous planning, innovative design, and user-friendliness. Currently, the team already has four e-books published with themes such as Presentation of DigitalOBS; Trends in the FCT Projects; Trends, Methodologies and Contributions in Digital Media Doctorates; and Empowering Youth through Exploring the Role of Games in fostering Media Literacy during times of crisis.

As a result, it is expected to connect scientific knowledge to public comprehension, enabling individuals and organisations to research scientific trends and optimal methods. It aims to provide information to scientists, educators, publishers, and digital media professionals, helping them to effectively communicate science in an ever-growing digital environment.

Keywords: *science communication, interactive, e-books, Students@DigiMedia, DigitalOBS*

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Acknowledgements. This work is financially supported by national funds through FCT Foundation for Science and Technology, I.P., under the project UIDB/05460/2020.

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Appealing and effective questionnaires for young people: challenges of creation and application

Maureen Cerveira Carvalho[†,1], Diana Gaspar[1], Francisca Abelheira[2], Emanuel Videira[2], Oksana Tymoshchuk[1], Mónica da Silva e Silva[1], Lídia Oliveira[1], Carlos Fernandes da Silva[2]

1. DigiMedia, Departamento de Comunicação e Arte
2. Departamento de Educação e Psicologia

[⋆] Corresponding author; [†] Presenting author; PIIC - students@Digimedia.

Abstract. The application of questionnaires in scientific projects targeting young people poses various challenges, like possible misinterpretation of questions or declining response rates due to survey fatigue (Hirosawa & Oga-Baldwin, 2022). One significant hurdle is designing age-appropriate, engaging questions that accurately capture the needed information (Solans-Domènech et al., 2019). These issues underscore the need for researchers to adapt survey instruments to consider the questions' characteristics and the developmental stages of young people (Taherdoost, 2022).
This study sought to analyse new trends in online questionnaires to engage and involve young participants in scientific research. Conducted as part of the Digital Media Observatory (DigitalOBS) in partnership with the Students@Digimedia initiative, it involved a transdisciplinary team from the fields of digital technologies, art, and psychology.
The study started by benchmarking platforms that allow the creation of online questionnaires and analysing different ways of presenting questions using an explanatory study methodology. The team developed a standard questionnaire to determine which formats appeal most to younger audiences. After six experts validated this questionnaire, the team conducted focus groups with students from different departments at the University of Aveiro.The results emphasisethe importance of ensuring the questionnaire's language and context relate to the intended age group. The results show the significance of using informal language and interactive elements like videos, gifts, or AI-created characters to boost response rates and engagement.This study's results have paved the way for developing recommendations and best practices for conducting online questionnaires for young people. The findings suggest that a creative and interactive approach, combined with understanding the young audience's preferences and developmental stages, could enhance their motivation and involvement.The detailed results of this study will be made available on the University of Aveiro's DigitalOBs website (https://digitalobs.pt), allowing these findings tobe sharedwith the community.

Keywords: *Questionnaires, Digital platforms, Interactivity, Students@DigiMedia*

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Acknowledgements. This work is financially supported by national funds through FCT Foundation for Science and Technology, I.P., under the project UIDB/05460/2020.

REVIVE: 'Visual identity of the project whose name we can now reveal because it finally has one'

Beatriz Vieite[†,⋆,1], Rui Raposo[1], Pedro Reisinho[1]

1. DigiMedia, Departamento de Comunicação e Arte

⋆ Corresponding author; bea.vieite@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. Despite continuous academic research, there is currently no disease-modifying pharmacological medication capable of curing dementia, and available solutions merely allow for symptom management or slowing the progression of the syndrome (Durães et al., 2018). Pharmacological-based therapies have instigated the search for complementary strategies, such as reminiscence therapy, a complementary non-pharmacological intervention that is demonstrating a positive impact and effectiveness, primarily in terms of improving the quality of life and reducing neuropsychiatric symptoms (Algar et al., 2016; Berg-Weger & Stewart, 2017). Other studies have also highlighted benefits in cognitive functions and improvements in communication skills (Abu Khait et al., 2021; Woods et al., 2018). Within this premise, our research team designed the REVIVE project to explore virtual reality use during reminiscence therapy to promote storytelling in people with dementia. This research, conducted under the Students@DigiMedia#03 initiative, aimed to design a visual identity for the REVIVE project and for its current and future sub-projects.
The identity design process began with several meetings with the project coordinators to understand the aims and motivations of the project. The tasks defined for this design process were i) deciding on a name for the main project; ii) creating an identity that represented the motivations and goals of the project; iii) developing a logo for the main project capable of being an aggregator for existing and forthcoming sub-projects. The visual branding of the project will be presented during the tudents@DigiMedia#03 final event.

Keywords: *Visual Identity, Dementia, Reminiscence Therapy, Communication, Storytelling, Virtual Reality*

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Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

The influence of HMD on cinematic virtual reality experiences

José Abilheira[1], Tiago Pina[1], Pedro Reisinho[†,⋆,2], Silvino Martins[2], Cátia Silva[2], Rui Raposo[2], Mário Vairinhos[2]

1. Departamento de Comunicação e Arte
2. DigiMedia, Departamento de Comunicação e Arte

⋆ Corresponding author; pedro.reisinho@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. In the early days of virtual reality, synthesized worlds were considered the primary way to experience the technology (Jaunt, 2018; LaValle, 2019). Yet, the landscape seems to be balancing in the recent years. The capture of videos and panoramic images and their visualization in virtual reality represent a natural evolution from flat-screen experiences (LaValle, 2019), as the ones lived with cinema or television. This shift in paradigm branches virtual reality into two distinct axes: game-based and cinematic. While game-based virtual reality is more prevalent, cinematic virtual reality emerges not as a mere duplicate, but rather as a completely distinct way of engaging with the technology, involving different methods of production, reproduction, realism, interactivity (Jaunt, 2018), and, most importantly, telling stories. This research, conducted under the Students@DigiMedia#03 initiative, aimed to understand whether the hardware used while one is immersed in a cinematic virtual world can influence the sense of presence and the manifestation of cybersickness symptoms, as well as how does the visualization technology shape the user experience. To this end, the researchers defined a research question Can the visualization technology influence the cinematic virtual reality experiences? and proceeded to select three head-mounted displays Oculus Go, HTC Vive, and Meta Quest 2 and one cinematic content to be viewed across all HMDs a 360ž video related to the Festivities of S. Gonçalinho, an annual religious celebration in Aveiro, Northern Portugal. The study involved 45 participants, divided among three head-mounted displays. Each participant viewed a 360ž video for a maximum duration of 5 minutes and 30 seconds, with the option to withdraw earlier if experiencing any adverse symptoms. Currently, the research team is analyzing the data and anticipates sharing the results in forthcoming publications.

Keywords: *Virtual Reality, Head-Mounted Displays, Presence, Cybersickness, UX*

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Imagens para fins pedagógicos na área das Ciências Naturais

Gonçalo Soares[†,⋆,1], Sónia Duarte[1], Luísa Flores[1], Carlos Santos[2], Luís Pedro[3]

1.
2. Universidade de Aveiro, Departamento de Comunicação e Arte, Campus Universitário de Santiago, 3810-193 Aveiro
3. DigiMedia Research Centre, Universidade de Aveiro, Campus de Santiago, Aveiro

⋆ Corresponding author; goncalo.soares@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. Diariamente, na preparação de atividades pedagógicas, os professores do ensino básico e secundário de Biologia e Geologia recorrem a um vasto número de iconografias. Conscientes de que o conhecimento científico está em permanente mutação e da importância de uma cultura visual apelativa e funcional, a procura e a adaptação de imagens exigem do professor esforço e carga de trabalho. Como podem os professores recorrer a imagens de alta qualidade, atuais, com rigor científico, sem despenderem demasiado tempo e respeitando os direitos autorais? Para responder a esta problemática, propõe-se o desenvolvimento de um repositório de imagens digitais, que constituam Recursos Educativos Abertos [1], construído pelos próprios. Contudo, é essencial fornecer ferramentas que permitam a elaboração deste repositório. De forma a compreender quais as características de um banco de imagens que atendam às suas necessidades recorremos a uma revisão da literatura sobre os sistemas de metadados LOM [2], DCMI [3] e LRMI [4]; à identificação de bancos com potencial pedagógico para o ensino das ciências naturais; e a uma entrevista semiestruturada em grupo focal a cinco professores (N=5) para recolha das perceções dos mesmos. Como resultados, desenvolvemos uma listagem de bancos de imagens, com informação referente à gratuitidade, tipologia de conteúdos, temas, licenças autorais e idioma. Este índice deve ser acompanhado de tutoriais em vídeo que explicitem como fazer o download e citar o(s) autor(es). Os participantes referiram a necessidade de listagens de aplicações que permitam a adaptação do material pedagógico às suas demandas. Por fim, as imagens deverão ser catalogadas por tema, tipo de licença, descrição, data de emissão, origem, georreferenciação, referência à utilização de IA e resolução. A avaliação, ainda que considerada subjetiva e complexa, deverá ser implementada através de contadores de downloads e gostos, com revisão por pares antes da publicação.

Keywords: *Biologia e Geologia; Imagens; Metadados; Recursos Educativos Abertos; Repositório.*

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Anticipating the impact of academic projects with The Impact Plan a user guide for lecturers

Catarina Lelis[†,⋆,1], Patrícia Sousa[2], Daniela Gomes[2]

1. Docente
2. University of Aveiro, Department of Communication and Art

⋆ Corresponding author; lelis@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. The Impact Plan is a tangible and highly visual tool that aims at either/both a) simplifying the moment of choosing a project from a pool of many, by matching the projects anticipated impact with the project developer(s)s motivations, capacities, ambitions, and perceptions of value, or/and b) support the project developer(s) in organising the arguments that best sustain the project's rationale, purpose, leverage and positive impact (Lelis, 2022). After the tool's initial tests mostly with postgraduate students, it proved helpful in supporting students decision-making processes, and their ability to better align their very personal interests, career ambitions and the way they perceived themselves as contributing to a better world to specific projects, hence picking the most meaningful ones, where higher levels of engagement are expected. The second level of tests involved the autonomous use of the tool (and, consequently, the delivery of its associated workshop) by other lecturers and academics that had not been involved in its creation nor development. The tool's prototype includes a quick step-by-step to support any users on how to make the best of it and the expectation was that it should be enough for other lecturers to implement it in an independent way within their own contexts. It was found that several variables that had not been previously accounted for were hindering the smooth implementation of The Impact Plan by other academics, who were constantly resorting to its author for support.
Hence, the goal of this project was to design a simple yet complete user guide for lecturers, so they could feel increased confidence in implementing the tool with their students on their own. Three lecturers (two from the University of Aveiro and one from the University of Trás-os-Montes e Alto Douro) were available to share their views and their students' feedback on the experience associated to using the tool. We found that all lecturers were consistently more inclined to accessing the user guide in a digital web-based format, rather than a digital but printable one (such as a PDF). Such revelation would increase the possibilities of creating interactive features, namely by connecting variables and presenting to the lecturers (in this case, the user) different examples of teaching and learning scenarios and contexts of implementation. Hence, the narrative flow of this web-based user guide resorts to a structure based on the 5Ws and 1H: Who, Where, When, Why, What and How.

Keywords: *anticipation of impact, meaningful projects, lecturers support, user guide, web design*

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Ambientes Web Imersivos no ensino da música

Tiago Paralta[†,⋆,1], João Paixão [2], Daniela Silva[2], Maria Ferreira[1], Bárbara Cleto[1]

1. Universidade de Aveiro, Departamento de Comunicação e Arte.
2. Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro

⋆ Corresponding author; tiagoparalta@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. No mundo moderno, a tecnologia digital é omnipresente. Desde a saúde, aos transportes e até mesmo ao desporto, assistimos cada vez mais a uma mudança frenética do status quo. Não obstante toda esta evolução, o funcionamento da sala de aula, especialmente no ensino obrigatório, permanece intocado. A disposição da sala de aula é a mesma, as dinâmicas de poder são as mesmas e, em alguns casos, os próprios suportes de conhecimento são os mesmos. Como podemos alterar esta tendência? Como podemos trazer a educação para o século XXI?

Com este problema em mãos, resolvemos aplicar os Ambientes Web Imersivos (AWI), em especial a Realidade Virtual, na educação, mais propriamente, no domínio do ensino musical. Onde é promovida a aprendizagem de conceitos básicos de música através da interação direta dos alunos com os instrumentos musicais; com as atividades didáticas, nomeadamente: associar um instrumento a um som; identificar diferentes naipes de um coro através de um vídeo; reconhecer géneros musicais; identificar notas musicais, etc. Os alunos interagem com os objetos 3D, navegam na sala imersiva, conversam entre si, e resolvem problemas relacionados com as atividades, em grupo ou individualmente.

O AWI foi construída com recurso às aplicações informáticas, Blender e Unity, incluímos objetos gráficos obtidos a partir de aplicativos que armazenam e disponibilizam objetos 3D. Este AWI será testado pelos alunos do primeiro ciclo da região de Aveiro no início de junho. Importa, após os testes, recolher as opiniões dos alunos e dos professores com vista ao aperfeiçoamento do Ambiente Web Imersivo.

Nos AWI, os alunos estão representados por avatares e podem interagir uns com os outros comunicando em modo privado ou público, utilizando ferramentas de texto para leitura e escrita, nomeadamente, através do chat ou com recurso aos quadros brancos. Manipulam objetos, movem-se no espaço (Cao & Hsu, 2022; Warburton, 2009; Zhang et al., 2023).

Keywords: *Ambientes Web Imersivos; Educação; Ensino da Música; Conhecer Instrumentos Musicais*

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Acknowledgements. The study reported in this publication was developed in the scope of the students@digimedia initiative and supported by FCT - Foundation for Science and Technology (Fundação para a Ciência e Tecnologia) nr. 2022.10675.BD.

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

"Let's talk about... students@DigiMedia take two: promoting students participation in scientific research activities through mentoring programs

Aresta[1], Mónica[2], Carlos Santos[3], Gabriel Ribeira[4], Inês Severiano[4], Raquel Magalhães Cabral

1. DigiMedia Research Center, Department of Communication and Art, University of Aveiro
2. Universidade de Aveiro, Departamento de Comunicação e Arte, Campus Universitário de Santiago, 3810-193 Aveiro
3. Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro
4.

⋆ Corresponding author; † Presenting author; PIIC - students@Digimedia.

Abstract. "Let's talk about... students at DigiMedia: promoting students participation in scientific research activities through mentoring programs

DigiMedia is the research unit (IU) of the scientific area of Communication Science and Technology (CTC) of the Department of Communication and Art (DeCA). In order to stimulate student participation in scientific research activities, the UI has been implemented since the 2021/22 academic year the "students at DigiMedia"initiative.The initiative dynamics focus on involving students from all study cycles (1st, 2nd, and 3rd) in research activities, including data collection, app development, audio-visual content production, project management tasks, and other activities proposed by the various research projects. Participation in these activities is entirely voluntary, with participants (students and researchers) receiving a certificate of participation and being listed as co-authors of a scientific article if the research team deems it appropriate.

The first edition of students@DigiMedia was held during the 2021/22 academic year, with 31 students from all study cycles participating in 13 projects proposed by 24 DigiMedia researchers. The second edition saw the submission of 20 projects involving 51 students from all study cycles in the CTC area. In order to encourage interdisciplinary collaboration and the generation of new ideas, the initiative for the third edition (2024) was extended to first and second cycle students from a range of scientific disciplines, with particular focus on education, psychology, social sciences, design, computer science, languages, health and physics.

In this abstract, we present the "let's talk about... students at DigiMedia takeTwo", one of the research projects being developed. This project aims to collect data from the students and researchers that participated in the event's first edition to evaluate the impact and assess participants' perception regarding i) motivation, ii) expectations, and iii) experience participating in this initiative.

This project has as main objectives: to characterize the initiative, framing it in the scope of the challenge launched to the Research Units; to evaluate the impact of the previous and current editions; and to propose guidelines to be considered in future editions.Information is being collected through the application of a questionnaire to participants (researchers and students); and focus groups held with researchers and students that have participated in the initiative both newcomers and seniors. The information collected will allow to assess the impact of the students@DigiMedia innitiative and to structure a set of best practices that can be adopted by other IU in the organization of similar initiatives.

Keywords: *Mentoring Program, Higher Education, Communication Science and Technologies, Scientific Research Program*

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

Catalogação de Ferramentas com Tecnologias Digitais

Gabriel Rosa[†,⋆,1], Anabela Brandão[1], Luísa Flores[1], Luís Pedro[2], Carlos Santos[2], Nelson Zagalo[3]

1.
2. Departamento de Comunicação e Arte
3. DigiMedia

⋆ Corresponding author; gabrielr@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. Os professores do ensino básico e secundário enfrentam a dificuldade de encontrar as ferramentas digitais mais adequadas às suas necessidades pedagógicas pois a falta de organização e sistematização das ferramentas disponíveis dificulta a sua pesquisa e seleção (Jareño et al., 2016; Ok et al., 2016; Torres-Carazo et al., 2016). O presente projeto propõe recolher informação sobre ferramentas digitais com potencial pedagógico de forma a contribuir para a construção de um repositório online e facilitar o acesso à informação sobre as ferramentas. Assim, considera-se que implicitamente, se está a promover a sua integração nos processos de ensino e de aprendizagem.Inicialmente, foi feita a identificação de ferramentas utilizadas pelos professores através da aplicação de um inquérito por questionário online, através das redes sociais, ao qual responderam 48 professores. Adicionalmente, foram questionados sobre as dificuldades que sentem ao utilizar ferramentas em sala de aula e quais as suas necessidades de formação. A falta de internet e do domínio das tecnologias são identificadas frequentemente como dificuldades sentidas, bem como, a identificação e seleção de ferramentas digitais, expressa por 9 dos professores que sentem necessidade de formação nesta área. Paralelamente a esta recolha de dados, foram definidos metadados (7) de catalogação, tendo por referência o sistema Dublin Core Metadata Initiative (DCMI Usage Board, 2020), nomeadamente a descrição das funcionalidades, formato e público-alvo, bem como metadados relacionados com as condições de uso (pagamento), utilização de inteligência artificial, tratamento de dados pessoais e tutoriais. Finalmente, e de acordo com as respostas ao questionário, foi elaborada uma listagem de ferramentas (69) e criadas as respetivas fichas de informação utilizando os metadados previamente definidos. Com este projeto espera-se contribuir para a construção de um repositório online que facilite a pesquisa e a escolha de ferramentas adequadas a cada utilizador.

Keywords: *Ferramentas digitais, ensino básico, ensino secundário, metadados, repositório online, educação.*

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Exploring automatic translation tools for educational resources creation: Insights within the context of the Dig2Phy platform

Andrea Alves Abreu[†,1], Sofia Ribeiro[⋆,1]

1. University of Aveiro

⋆ Corresponding author; saribeiro@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. This study is part of an ongoing doctoral research entitled "Teachers digital development model: A digital platform to create tangible educational resources (Ribeiro, 2022). The Dig2Phy platform (under development) aims to empower teachers in designing educational resources for any school subjects. The studys aim is to explore the platforms capacity to foster collaboration among teachers (i.e. adapting resources from peers (Campos, 2012)) of different nationalities, by facilitating resources translation.

The scientific literature analyzed on translation machines and their application to educational resources (Sharma et al., 2023; Urlaub & Dessein, 2022) didnt provide any relevant information to identify the most suitable automatic translation tool to integrate into the Dig2Phy platform. So, due to a lack of comparative studies on the integration process of available translation tools, the focus shifted. The study turned to understand the current landscape of automatic translation tools, the experiences of translation professionals and the expectations of future professionals.

Firstly, a benchmarking analysis covered online translators, if they had free or paid versions, the integration widgets, and translation quality criteria (i.e., clarity, fidelity to original meaning, audience suitability, grammatical accuracy, technical term transposition, formatting, cultural preservation, and adherence to standards) across various text types (e.g., business emails, poetry).

Additionally, a survey will be distributed among students of translation courses at the Department of Languages and Cultures (University of Aveiro) and semi-structured interviews with industry professionals will be conducted. These insights, namely their experience and expectations, are expected to provide a comprehensive understanding of the potential of automated translation tools and guide future research and applications.

By examining automatic translation tools in the context of educational resource creation for the Dig2Phy platform, this study aims to enhance translation processes, foster collaboration among teachers from diverse backgrounds, and inform future research and practice directions.

Keywords: *Automatic translation tools, Educational resources, Translation machine, Resource translation, Benchmarking analysis, Online translators.*

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Acknowledgements. This work is financed by national funds through FCT Fundação para a Ciência e a Tecnologia, I.P., in the aim of the project 2022.10021.BD. Furthermore, it is part of the students@DigiMedia initiative, promoted by the DigiMedia

Research Centre (Department of Communication and Art, University of Aveiro).

Analysis of mainstream narrative video games according to game design criteria

Dalila Martins[⋆,1], Nelson Zagalo[1], Ana Patrícia Oliveira[1], Hugo Tavares[1], Eva Aguiar[1], Pedro Soares[1], Inês Santos[1]

1. DigiMedia, DeCA

⋆ Corresponding author; dalilamartins@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. It is estimated that only 10% to 30% of players finish games (Matusiak, 2016), and the reasons for abandonment are numerous, ranging from moving on to a new game (Richards, 2020); its length (Richards, 2020) or decreased attention span (Lorenz-Spreen et al., 2019). In the case of mainstream videogames, the impact of quitting is reflected in the game's reputation and sales value, but why is it that there are always video games that stand out in terms of the number of players who finish them compared to the rest?

As part of the Students@DigiMedia#03 initiative, an investigation was carried out with the aim of analyzing the most completed mainstream narrative games of the year 2022 (Martins, 2023) in order to understand which is the most impactful and/or exciting moment in the video game, which consequently influences the motivation to continue and finish the video game.

To achieve this goal, we began by playing four of the video games listed until the end: Marvel's Spiderman (2018); God of War (2018); Uncharted: The Lost Legacy (2017) and Horizon Zero Dawn (2017).After finishing each game, it was concluded which moment was the most engaging and then case studies were developed around that moment of greatest intensity based on Schell's (2020) game design criteria, i.e. mechanics, story, aesthetics and technology. Subsequently, an analysis was made of the comments on the Steam gaming platform in order to understand what players highlighted in the game under two engagement scales.

The case studies showed that family involvement and death are two dimensions that have an impact on the player. At the same time, the analysis of the comments showed that with the scale that focuses on the experience of engagement, players praise the narrative, gameplay, satisfaction and visual aesthetics. With regard to the scale that focuses on narrative, they highlight involvement with the story, empathy, presence and transportation as important factors in games.

Keywords: *engagement, game design, narrative, videogames*

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Theoretical innovation and methodological practices to improve women in technology communities work

Renata Frade †,1, Mario Vairinhos⋆,1

1.

⋆ Corresponding author; † Presenting author; PIIC - students@Digimedia.

Abstract. Activism, empowerment, education and technical improvement in entrepreneurship and technology, networking, inclusion, and advancement of professional careers. These are some of the main objectives of women in technology communities. In doctoral research to be completed by 2025, 124 female groups in IT, four of which were case studies (Minas Programam, Geek Girls Portugal, São Paulo WiMLDS and Women in Artificial Intelligence/MIA), were monitored on digital platforms to understand its organizational and communicational functioning in order to promote good practices to its diversity and inclusion work. These collectives represent an opportunity to optimize knowledge acquisition, access to job vacancies, scholarships, partnerships that no other institution offers to women. There is still a significant gap in opportunities in terms of accessing and occupying leadership positions in this job market between men and women.It was understood that it would be necessary to associate theoretical dimensions of technofeminism (Wajcman, 2006), transmedia storytelling (Jenkins, 2006) and interaction design (Carroll, 2013) to the empirical study to assess whether or not there were elements of technological feminism, of communication with more engaged participation and also the interaction and usability of women with the functionalities of the platforms chosen to publicize the work of these communities.Around 20 interviews were carried out, as well as focus groups, digital ethnography, a transmedia storytelling campaign implemented on digital MIA platforms and a technology prototype development were some of the research methods.Based on partial results, a communicational and organizational characteristics classification of the collectives were established, as well as a theoretical framework. These data, associated with theoretical contributions, were fundamental for the women in tech communitiest' communicational and organizational map developed, as well as the ongoing formulation of the feminist technology design proposal.

Keywords: *Tech feminism; Online communities; Transmedia; HCI.*

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Acknowledgements. The author gratefully acknowledge the financial support of the Fundação para a Ciência e a Tecnologia (FCT) under the doctorate scholarship (2020.06640.BD; DOI 10.54499/2020.06640.BD (https://doi.org/10.54499/2020.06640.BD) reference.

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

A benchmarking of applications for fostering social and emotional learning of high school students

Leonor Rodrigues[1], Raquel Magalhães Cabral[†,⋆,2], Luca Linardi[1]

1.
2. Universidade de Aveiro - Campus Santiago - Departamento de Comunicação e Arte

⋆ Corresponding author; raquel.magalhaes@ua.pt; † Presenting author; PIIC - students@Digimedia.

Abstract. Digital technology can support social and emotional competencies development. The education law in Portugal (2017) has highlighted the necessity of a "ready-for-the-future"student (Hirsh-Pasek et al., 2015). However, common sense points that technology is doing the opposite and destroying mental health, mainly from adolescents.This study seeks to understand which infocommunication characteristics digital technology should contain to facilitate the development of social and emotional competencies upon 12 years of compulsory education. For this, it aims to deliver an infocommunication model, through data collection rounds (focus group and interviews), that can be applied in digital technologies to enhance social and emotional learning (SEL).SEL (CASEL, 2023) is based in results that improve mental wellness, healthy behaviors, and lifetime outcomes up to 18 years later (Taylor et al., 2017). The questions that arises are: given the emergency of the theme and the empowerment it can cause in society in general, can SEL be potentiated by using digital mediation? Taking in consideration the use of mobile phones in a personal sphere, what gaps can be filled in order to sup-port the adolescents to be socially and emotionally healthier?As main contributes, the research will (i) produce new knowledge with an Iberian infocommunication model that can potentiate SEL for adolescents; (ii) create a European multi-disciplinary approach both original and with social impact on society; (iii) correlate findings of studies in English, Portuguese, and Spanish.The method will combine a systematic literature review, survey application, visits to the schools, and conduct interviews with teachers and educational experts and combine the findings into a model.

Keywords: *Digital Technology; Social and Emotional Learning; Infocommunication Model; High School*

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Psycology

The animacy effect in older adults: evidence from the memory for the past and for the future

Sara B. Félix[†,⋆,1], Marie Poirier[2], James S. Nairne[3], Josefa N. S. Pandeirada[1]

1. William James Center for Research, Departamento de Educação e Psicologia, Universidade de Aveiro, 3810, Aveiro, Portugal
2. Department of Psychology, School of Health Psychological Sciences, City, University of London, Northampton Square, London, UK
3. Department of Psychological Sciences, Purdue University, West Lafayette, IN, USA

⋆ Corresponding author; † Presenting author; Psycology.

Abstract. Evolutionary Psychology posits that human cognitive systems, including memory, evolved to enhance our odds of survival and/or reproduction. Therefore, memory functioning is hypothesized to have been tailored to solve adaptive challenges faced throughout evolution. One example is the animacy effect, which reflects better remembering of animates/living-beings (e.g., cat) than inanimates/objects (e.g., spoon). Indeed, animates were (still are) survival- and reproduction-relevant stimuli, as they could represent predators, prey, partners, etc. (Nairne et al., 2013). This effect is already established in young adults (YA) both in retrospective and prospective memory (PM) tasks (i.e., retrieving information from the past/remember future intentions, respectively). However, evidence for older adults (OA) is scarce (e.g., Bugaiska et al., 2016). Evolutionarily, as OAs (vs. YAs) survival and reproduction pressures may be less evident, one could question whether OA show the animacy effect. Using animacy word-ratings gathered from YA and OA (Félix et al., 2023), we conducted two studies to explore the mnemonic animacy effect in OA, both in retrospective and prospective memory tasks. Study 1 employed a free recall task (N=41 YA and 42 OA, English-speakers). Participants memorized a series of 24 words (half animate/half inanimate) for a later memory test (cf. Nairne et al.'s procedure, 2013). We replicated the animacy effect in YA and found it also in OA. Study 2 employed a PM task (N=71 OA). Participants performed an ongoing task (i.e., decide whether a word-presented in 1 of 7 possible locations on the screen-matched the position of any of the just presented squares; yes/no response). However, whenever any of the target word (one animate, one inanimate; e.g., nurse/phone) were presented, participants should provide an alternative response (PM response; press spacebar), instead of providing the yes/no response regarding the words location (cf. Félix et al.'s procedure, 2024, Study 2). Results revealed that animate (vs. inanimate) targets improved PM in OA. We compared these data with those obtained with YA reported by Félix et al. (2024). Both studies revealed no Age-related interactions, showing the persistence of the animacy effect in later life in both types of memory. These findings may hold potential practical implications, namely in enhancing older adults daily memory functioning/independence (e.g., medication intake; Zogg et al., 2012), one of major CHALLENGES posed by the unprecedented populational aging faced worldwide. Sample sizes were calculated a priori (G*Power). Both studies were pre-registered.

Keywords: *Aging; Animacy effect; Retrospective memory; Prospective memory; Memory for the future*

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Serial reversal learning with starlings: Testing the timing hypothesis.

Alejandra Salinas[†,⋆,1], Armando Machado[1], Marco Vasconcelos[1]

1. William James Center for Research, Departamento de Educação e Psicologia, Universidade de Aveiro, 3810, Aveiro, Portugal

⋆ Corresponding author; ale.salinas@ua.pt; † Presenting author; Psycology.

Abstract. Serial reversal learning tasks stand out as one of the most fruitful experimental paradigms for investigating animal intelligence, especially their ability to adjust behavior according to environmental changes. In one of these tasks, animals choose between two options, S1 and S2, for 80 trials. Rewards follow S1 choices during trials 1 to 40, and S2 choices during trials 41 to 80. That is, the reward contingency reverses at mid-session. Results with birds show that the proportion of S1 choices as a function of trial number begins near 1 and ends near 0, with indifference occurring around trial 40. Choices of S2 before trial 41 (anticipatory errors) and choices of S1 after trial 40 (perseverative errors) suggest that birds use the passage of time within the session as a cue to reverse preference from S1 to S2. This timing hypothesis predicts that doubling the trial density will shift the choice function to the left and halve its indifference point, whereas halving the trial density will shift the function to the right and double its indifference point. We tested the hypothesis with variable trial spacings. Fifteen starlings learned the task with random trial spacings averaging T seconds and then they were exposed to test sessions in which the random trial spacings averaged either 2T or T/2. The shifts in the psychometric function direction and magnitude were contrasted with the predictions of the timing hypothesis.

Keywords: *Serial reversal learning, timing, psychometric function, indifference point, trial spacings, starlings*

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Acknowledgements. This study was supported by the project: Making sense of animal misbehavior: Functional and mechanistic accounts, 2022.04861.PTDC

Suboptimal choice: the ephemeral reward task

Guilherme Hoffmann[†,⋆,1], Armando Machado[1], Marco Vasconcelos[1]

1.

⋆ Corresponding author; gui.hoffmann@ua.pt; † Presenting author; Psycology.

Abstract. In the ephemeral reward task, an animal faces two stimuli, A and B. If A is chosen, reward is given and the trial ends. If B is chosen, reward is given and the subject can still respond to A and collect another reward. Hence B yields twice as much food as A. Choices of B are thus labelled optimal, and choices of A suboptimalź. On an initial replication of the task with starlings, we learned that unlike pigeons and rats, the starlings learn how to perform this task optimallyš, §. The aim of this study was to identify possible reasons for this difference. Five starlings underwent daily sessions of the suboptimal task, featuring an infrared sensor at the feeder to ensure that whenever B was chosen, starlings collected the first reward before pecking at A to collect the second one. Despite these modifications, starlings consistently maximized their rewards. Once optimal choice stabilized, we introduced progressively longer delays, ranging from 1.5 to 20s, between the initial food consumption and the second choice following an initial B selection. We observed a shift in the animals' behavior towards indifference (choosing optimal on approximately 50% of the trials). This was the first experiment that successfully managed to change the strategy used by the animals in the task through the introduction of delays.

Keywords: *Ephemeral Reward Task, Suboptimal Choice, Animal Behavior, Experimental Psychology*

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Memory and mate selection: Deepening our understanding of this relation and exploring the role of carotenoid coloration

Jênnyfer C. A. Freitas[†,⋆,1], Josefa N. S. Pandeirada[1], Gün Semin[2]

1. William James Center for Research, Department of Education and Psychology, University of Aveiro, Santiago University Campus, 3810-193 Aveiro, Portugal
2. William James Center for Research, Ispa - Instituto Universitário, Rua Jardim do Tabaco, 34, 1149-041 Lisbon, Portugal

⋆ Corresponding author; † Presenting author; Psycology.

Abstract. From an evolutionary perspective, memory functioning is believed to have evolved to enhance humans' survival and reproductive success (Nairne & Pandeirada, 2016). Several phenomena have underscored this mnemonic advantage, including better memory retention when information is processed in contexts relevant to survival (Nairne & Pandeirada, 2016), contamination (Fernandes et al., 2017), and animates (vs. inanimates) (Nairne et al., 2017). However, the influence of reproduction-related contexts on memory remains uncertain, with conflicting findings across studies. This Ph.D. project seeks to address this gap in the literature, focusing on a characteristic that has received limited attention: carotenoid coloration. Such characteristic may serve as a potential indicator of mate value, linked to facial healthiness and attractiveness (Lefevre & Perrett, 2015), as well as critical indicators like reproductive success, photoprotection, and immune defense. Our project has two key goals. The first aims to examine how the facial carotenoid coloration of potential mates impacts participants' memory for descriptive information about those potential mates. Employing a methodology akin to Fitzgerald et al. (2016), participants will be presented with biographical paragraphs accompanied by images of opposite-sex faces. Importantly, such faces will vary on their carotenoid coloration levels. Following a distraction task, participants will be asked to recall the details (biographical) information regarding each target. We predict memory will be best when descriptions are accompanied by the high (vs. low) face coloration. The second goal aims to explore how variations in carotenoid coloration affect memory for the potential mates' faces. Participants will view images of opposite-sex faces with differing levels of carotenoid coloration, alongside neutral descriptors. Subsequently, a distractor task will precede a surprise face recognition task. We predict that faces displaying the high (vs. low) coloration will be better recognized. Additionally, we will need to investigate whether any advantages are related to mating (as predicted) or merely represent a general preference for high carotenoid coloration in females/males. To that end, the above-described procedures will be employed under a mating (vs. a non-mating; e.g., a worker) context. If that is the case, the advantages associated with the ideal carotenoid coloration should only occur (or be more significant) when information is considered in the mating (vs. the non-mating) context. Overall, this project will deepen our understanding of the broad purposes of memory, its potential involvement in human reproduction, and whether carotenoid coloration is a key player in such an important evolutionary process.

Keywords: *Adaptive memory; Reproduction; Carotenoid coloration; Free recall; Face recognition*

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Visual Gravitational Motion affects the magnitude of the Onset Repulsion Effect

Rodrigo Ribeiro Freitas[†,1], Nuno De Sá Teixeira[⋆,1], Samuel De Sousa Silva[2]

1. William James Center for Research
2.

⋆ Corresponding author; † Presenting author; Psycology.

Abstract. The perceived onset position of a moving target has been found to be systematically displaced backwards, in a direction opposite to motion direction, a phenomenon coined Onset Repulsion Effect (ORE). Albeit a full-fledged account for ORE is still lacking, some authors have suggested that it might reflect a cognitive proclivity to impute a natural history to dynamic events, akin to the windup which precedes throwing an object, resulting in a backward overcompensation of the targets onset location. Accordingly, and of particular relevance to the present work, ORE has been found to be increased for ascending, in comparison with descending, targets, putatively due to the greater effort required to launch an object upwards, against the gravitational acceleration. To further explore the role played by visual gravitational motion on ORE, two experiments were performed in both, participants were required to indicate the onset location of targets moving along one out of sixteen possible trajectories; the differences between the actual and the perceived motion onset were measured and subjected to a discrete Fourier decomposition. Results disclosed increased ORE for targets moving upwards (as indexed with the first harmonic component; experiment 1), and more so as an imposed retention interval increased, and a robust trend for that upward direction to be tilted in congruence with the orientation of a visual background context (experiment 2). These outcomes are discussed within the framework of internal models of gravity, human spatial orientation, and its effects on visual motion perception.

Keywords: *Onset Repulsion Effect; Gravitational Direction; Backward Displacement; Visual Cues*

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Public policies

Research Summit 2024
Research Forum of the University of Aveiro
16–19th July 2024, Aveiro. Portugal

PROJETO DE TESE: O MODELO DE INTEGRAÇÃO DE CUIDADOS E A PERSPECTIVA DA INTERSETORIALIDADE: DIÁLOGOS COM OS DETERMINANTES SOCIAIS DE SAÚDE

Luciana Rodrigues[†,1]

1. Departamento de Ciencias Sociais, Políticas e Território (DCSPT)

⋆ Corresponding author; † Presenting author; Public policies.

Abstract. O presente estudo visa analisar o processo de implementação do modelo de Integração de Cuidados em Saúde em Portugal sob a ótica da intersetorialidade, considerando os Determinantes Sociais de Saúde. A integralidade, um conceito basilar para a compreensão do modelo de cuidados, refere-se à abordagem que considera não somente a ausência de doença, mas também o completo bem-estar físico, mental e social, conforme preconizado pela Organização Mundial da Saúde (WHO, 1946). Neste sentido, (Santinha et al. (2023) sustentam que a saúde passa por campos multi e interdisciplinares e é influenciado por uma série de fatores contextuais, incluindo onde as pessoas nascem, crescem, vivem e envelhecem, os chamados determinantes sociais (p.6). Como indicado também por Buss & Pellegrini Filho (2007), esse enfoque transcende o modelo médico biológico, evidenciando a necessidade de levar em conta Determinantes Sociais de Saúde, econômicos e ambientais na promoção da saúde. A investigação busca compreender as políticas de integração de cuidados, as etapas de construção dessas políticas e a relevância atribuída aos determinantes sociais no seu desenho e implementação. A metodologia utilizada envolve uma revisão de literatura, análise documental e entrevistas. A revisão de literatura abrange políticas de integração de cuidados e sua relação com o conceito ampliado de saúde da OMS (WHO, 2008), enquanto a análise documental examina as dimensões e implementações das políticas em Portugal. As entrevistas com representantes de diversos setores envolvidos (acadêmicos da área da gestão e políticas de saúde; dirigentes dos diferentes níveis de cuidados em saúde e outros setores das políticas públicas, como a assistência social; profissionais da área social e da área da saúde) complementam a análise, fornecendo insights sobre a intersetorialidade e os diálogos entre os setores das políticas públicas que contemplam os condicionantes e Determinantes Saúde. Os resultados esperados incluem a identificação de experiências e barreiras na implementação do modelo, além de fornecer orientações para políticas mais eficazes e embasadas em evidências. Este estudo contribui para a compreensão da articulação intersetorial e a promoção de um sistema de saúde mais eficiente e equitativo, alinhado aos Objetivos de Desenvolvimento Sustentável da ONU.

Keywords: *Integração de Cuidados em Saúde; Modelos de Cuidados em Saúde; Intersetorialidade; Saúde em Todas as Políticas*

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A Institucionalização da Relação da Universidade com a Sociedade e seu Diálogo com o Pessoal Administrativo (Projeto de Tese)

Estela Cunha[†,1]

1. CIPES

⋆ Corresponding author; † Presenting author; Public policies.

Abstract. Nesta sessão apresentarei o meu projeto de tese no âmbito do Doutoramento em Políticas Públicas, com orientação dos Professores Teresa Carvalho e Ricardo Biscaia. A presente proposta tem como objetivo investigar o diálogo entre dois fenômenos, frutos do discurso da Sociedade do Conhecimento, que alteraram a dinâmica das universidades contemporâneas. De um lado encontram-se as mudanças estruturais que essas instituições abarcaram para dar resposta às necessidades de maior interação com a sociedade, do outro, está o crescimento e diversificação de posições não-acadêmicas. O estudo pretende caracterizar o processo de institucionalização da Relação com a Sociedade e o modo como o pessoal administrativo perceciona sua contribuição para esta institucionalização. Pouco explorado na literatura, este tema contribui para debates institucionais e de políticas públicas sobre a influência de uma retórica supranacional nas Instituições de Ensino Superior.
As questões de investigação abordam: (1) De que modo que as Universidades estão institucionalizando a sua relação com a sociedade? E (2) De que forma a institucionalização da Relação com a Sociedade impacta e é impactada pelo pessoal administrativo das Universidades?
Para respondê-las, optou-se por uma abordagem essencialmente qualitativa. A investigação será realizada em 4 etapas, conduzidas no âmbito do projeto Reuni4Future. Na primeira etapa, através de uma Scoping Review serão operacionalizadas as atividades de relação com a sociedade. Na segunda, através da análise de conteúdo de entrevistas com Vice-Reitores, buscar-se-á identificar estruturas relevantes para a realização de atividades de relação com a sociedade. A terceira etapa focará, através de uma Revisão Sistemática de Literatura, no entendimento das principais discussões relacionadas ao pessoal administrativo e sua relevância para a relação da universidade com a sociedade. A última fase consolidará os aprendizados das fases anteriores através da comparação entre 2 casos, caracterizando a evolução do pessoal administrativo, identificando a perceção sobre seu papel nas estruturas e discutindo oportunidades de melhoria da participação dessas pessoas nas atividades de Relação com a Sociedade. A tese será composta por 4 artigos.

Keywords: *ensino superior; staff não acadêmico; relacionamento com a sociedade*

Acknowledgements. A autora agradece o apoio concedido pela Fundação para a Ciência e Tecnologia (FCT) através do projeto Reconfiguração das missões da Universidade na Europa do conhecimento: a emergência da 'Universidade do Futuro' 2022.04049.PTDC.

The role of academy in local governance: case study

Laura Buarque Cortizo[†,1]

1. University of Aveiro

* Corresponding author; † Presenting author; Public policies.

Abstract. In a context in which policy increasingly involves a collective decision-making process and in which this collective operates in a complex network of actors and agencies (Latour, 2012), it seems increasingly important to take an analytical look not only at the dynamics of these processes but also to identify some patterns that can contribute to understanding such phenomena. In this sense, and considering the scope of local governance (Stoker, 2011) and the transmission of scientific knowledge to Western society, this paper seeks to investigate the role of academic institutions and research communities in elaborating and implementing public policies processes. We are interested in understanding whether, how, and under what circumstances the academy interferes in inherent disputes and decision-making in public policies, in order to explore this specific actor as a possible driver of the process of effective collaborative governance at the local level. Anchoring our investigation in Capibaribe Park (Recife/Pernambuco/Brazil) and Matosinhos Climate Transition Citizenship Laboratory (Portugal) cases, we operate theoretical repertoires of collaborative governance and Advocacy Coalition Framework (Koebele, 2019), as well as exploring the emerging field of local governance (F. da Cruz, Rode & McQuarrie, 2019), hoping to contribute with insights that can be university-based in future and deeper studies.

Keywords: *local governance; academic institutions; collaborative governance; policy; decision-making*

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Acknowledgements. This work was financially supported by the Research Unit on Governance, Competitiveness and Public Policies (UIDB/04058/2020) + (UIDP/04058/2020), funded by national funds through FCT - Fundação para a Ciência e a Tecnologia.

Performance evaluation of academics and the relationship with society: the case of Portuguese HEIs involved in European alliances

Susana Guerra [†,⋆,1], Ana I. Melo[2], Teresa Carvalho[1]

1. University of Aveiro, Campus Universitário de Santiago, 3810-193, Aveiro, CIPES Centre for Research in Higher Education Policies
2. School of Technology and Management (ESTGA), University of Aveiro, Aveiro, Portugal, CIPES Centre for Research in Higher Education Policies

⋆ Corresponding author; susana.guerra@ua.pt; † Presenting author; Public policies.

Abstract. Higher Education Institutions (HEIs) are expected to act not merely as experts or knowledge providers, but as active co-creative partners in research and development projects for society (Olsson et al., 2020). This action, known as the third mission, expects HEIs to demonstrate their commitment to society through knowledge application (Barker et al., 2014).The New Public Management has led to efficiency demands, leading to the introduction of measurement practices in HEIs, mainly directed into teaching and research.As a result, the measurement of third mission activities, which involve the generation, use, application and exploitation of knowledge and other academic capabilities outside academic environments - in other words, the HEIs-society relationship - is still scarce (Taieb, 2023; Molas-Gallart et al., 2002).
This research aims to understand whether and how the integration of the relationship with society dimension can lead to a more integrated and balanced academic Performance Evaluation (PE) in relation to the professional roles that academics perform in the Portuguese HEIs involved in European alliances, since the purpose of these alliances is related to the HEIs-society relationship.
Data will be collected through a systematic literature review on indicators for evaluating the relationship with society and a documentary analysis of the PE regulations for the 19 Portuguese HEIs, to map these models and the valuation given to each universities' missions.
After analyzing the PE regulations, cases will be selected, and semi-structured interviews with those responsible for evaluations (vice-rectors for quality, vice-rectors responsible for evaluating academics; directors of human resources, heads of department) and focus groups with professors and researchers will be conducted, to identify academics' perceptions of the PE indicators for teaching, research, and the relationship with society, and the valuation given to each.
Finally, some policies/practices will be proposed for policymakers to develop more integrated and balanced PE systems.

Keywords: *Academic Performance Evaluation; Higher Education Institutions; Relationship with society; European University Alliances; Third mission*

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A Avaliação do Desempenho na Administração Pública Portuguesa

Liliana Pereira[†,⋆,1], Ana I. Melo[1], Teresa Carvalho[1]

1. Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; a39797@ua.pt; † Presenting author; Public policies.

Abstract. A avaliação do desempenho é um sistema que permite estimar o nível e qualidade do desempenho dos trabalhadores num determinado organismo, seja público ou privado. Através deste processo, é possível medir e comparar as avaliações, bem como analisar as atividades nas quais o trabalhador teve um melhor ou pior desempenho durante o período de avaliação, podendo, no último caso, ser identificadas necessidades de formação por forma a reverter esse problema no ciclo avaliativo seguinte.
A avaliação do desempenho, enquanto instrumento de gestão, é reconhecida como sendo essencial para que os organismos atinjam os seus objetivos estratégicos, uma vez que tende a estimular nos trabalhadores elevados níveis de desempenho durante a execução das suas funções. Contudo, este processo não está isento de limitações e fragilidades.
Partindo da relevância do sistema de avaliação do desempenho enquanto instrumento de política pública de recursos humanos, esta investigação pretende propor sugestões de alteração ao modelo de avaliação do desempenho na Administração Pública Portuguesa, com vista à melhoria do mesmo.
A metodologia desta investigação é qualitativa, uma vez que permite uma análise mais rica e profunda dos fenómenos estudados comparativamente a uma abordagem quantitativa. Para aferição dos pontos fracos do sistema de avaliação atualmente em vigor e a discussão das características que um bom sistema de avaliação do desempenho deveria ter, considera-se importante obter as perceções dos atores envolvidos no processo de avaliação da Administração Pública (sejam eles trabalhadores, dirigentes ou decisores políticos).

Atualmente, esta investigação está a desenvolver-se com base numa fundamentação teórica, na qual estão a ser feitas revisões bibliográficas extensivas.No que se refere ao estudo empírico, está a ser realizada uma recolha de dados, centrada em três etapas (sendo que a primeira já se encontra em execução): i) análise documental, nomeadamente ao enquadramento legal que estabelece o sistema de avaliação do desempenho na Administração Pública Portuguesa e em outras administrações públicas europeias; ii) realização de entrevistas semiestruturadas; e (iii) realização de focus groups. A amostra será constituída por um conjunto criteriosamente selecionado de stakeholders (dirigentes superiores e intermédios, trabalhadores em funções públicas, e representantes de decisores políticos), com diferentes interpretações e ambições relativamente ao sistema de avaliação do desempenho no setor público, mas que têm em comum a sua participação no processo de avaliação, ainda que em diferentes fases.

Keywords: *Sistema de Avaliação, Desempenho, Administração Pública, Trabalhadores*

Race, racism, and higher education: a systematic literature review

Aruanã Emiliano Rosa[†,1]

1. Universidade de Aveiro

[⋆] Corresponding author; aruanaemprosa@ua.pt; [†] Presenting author; Public policies.

Abstract. Racism and violence against racial minority groups have been a growing global problem and a challenge for contemporary governments. Especially if we look at the post-COVID-19 health crisis, in which the phenomena of hate speech against racial minorities have increased according to the United Nations (UN, 2020). In this sense, this work seeks to reflect on how this theme has been inserted in the context of higher education, understanding this space as a societal territory. To answer this question, we sought to understand the state of the art on this topic through a search on the scientific platform Elsevier Scopus, conducting a systematic literature review (SLR) with the operationalization of Parsifal, NVivo, and MAXQDA software. From the investigation, 59 articles were gathered, including the geographic region of analysis, population, and methodology used. For the final session, three themes were introduced to enable a focus result in the field studied: (1) institutional racism, (2) racial discrimination, and (3) anti-racism (Arday et al., 2021; Allen, 2020; Baffour et al., 2023). Despite progress in some areas, systemic racism continues to manifest in admissions policies, campus climate, curriculum content, and faculty representation. The literature underscores the necessity for institutions to adopt anti-racist policies that go beyond mere diversity initiatives to alter the structures and practices that sustain racial inequities fundamentally. The subjectivities of each study are presented in an interdisciplinary manner, and we hope this review can contribute to future studies in the area.

Keywords: *Race; Racism; Higher Education.*

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Acknowledgements. This work is part of the PhD Grant PRT/BD/154715/2023 (FCT-ECIU) by the Foundation for Science and Technology (FCT-Portugal, I.P).

Migration Policies and Asian Immigrants in Portugal; Cases of Bangladesh,Iran, and Nepal

Ensie Loghmani[†,1], Cristina Sousa Gomes[⋆,1]

1.

⋆ Corresponding author; † Presenting author; Public policies.

Abstract. This research investigates the impact of Portuguese migration policies on the integration status of Bangladeshi, Iranian, and Nepalese immigrants. To establish a comprehensive framework for evaluating migration and integration, I synthesized integration indicators from MIPEX, OECD, and the European Commission, spanning economic, social, and political dimensions. This synthesis provides a holistic approach to assessing migrant integration. 1. Economic indicators encompass a) labor market participation and b) housing and accommodation. 2. Social indicators include a) education, b) language proficiency and language support, c) access to social benefits and healthcare, d) social inclusion and community engagement, and e) anti-discrimination legislation. 3. Political indicators encompass a) political participation and representation and b) citizenship, naturalization and family reunification. Based on these indicators, questionnaires and interview protocols were developed, tailored to the immigrant populations of the three countries as per the 2021 census. Utilizing Cochrans formula, the sample size for each country was determined. Approximately 1000 questionnaires and 12 interviews are anticipated. Interviews are conducted with respected individuals within the immigrant communities who possess deep knowledge of their respective communities. It is noteworthy that 500 questionnaires and 7 interviews have already been completed, indicating significant progress in data collection.

Keywords: *Migration, Portugal, Public Policy, Integration*

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Acknowledgements. URB. CHAVE, BL. 19_ 3 DT. FRENTE, Aveiro

Risk Perception and Resilience around floods: emerging contributions in the literature review

George Luiz Pereira Santos[†,1], Lucas Barbosa e Souza[2], Teresa Fidélis[3]

1. Programa Doutoral Território, Risco e Políticas Públicas
2. PPGCIAMB e PPGG
3. GOVCOPP

[*] Corresponding author; [†] Presenting author; Public policies.

Abstract. AbstractFloods are stressful and disruptive events. This type of disaster negatively affects the economic, social and environmental order of the affected population and causes damage (human and material) and losses (economic and social). Climate change has contributed to the occurrence of extreme events with increasing frequency and severe intensity. Associated physical-natural elements (threats) and social elements (vulnerabilities) result in disaster risks or their realization. The aim of this summary is to analyze how the scientific community looks at risk perception and resilience as dimensions that contribute to reducing risks and minimizing the impacts of floods. To this end, a bibliographic review of scientific articles was carried out, crossing the themes of floods, risk perception and resilience, from 2000 to 2023. The results showed a quantitative increase in the number of publications on risk perception and resilience to flooding. Despite the growing number of articles, there is a contrast between the high increase in flood events and the evolution of scientific articles on this subject. Among the articles identified, it is possible to observe five main structuring themes, including conceptual aspects, adaptive capacity, social participation, risk communication and governance. The literature review showed that, despite its relevance to risk prevention, it is not clear that the Sendai framework has been used as a driving force behind scientific production in this area. The location of the case studies identified is mainly in Europe and Southeast Asia. Among the challenges mentioned in the literature are strengthening the understanding of risks, disseminating information, formulating actions capable of involving communities and organizations, strengthening institutional capacity, and a level of adaptation consistent with the challenges posed by floods. Also worthy of special mention is the need to develop mechanisms for evaluating public policies aimed at preventing, preparing for, coping with and recovering from floods.

Keywords: *Flooding. Risk perception. Resilience*

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Acknowledgements. This work was carried out with the support of the Coordination for the Improvement of Higher Education Personnel - Brazil (Capes) - Funding Code 001.

De que forma as políticas públicas influenciam a criação de spin-offs académicas?

Pedro Fonseca[†,⋆,1]

1. Departamento de Ciências Sociais, Políticas e do Território

⋆ Corresponding author; † Presenting author; Public policies.

Abstract. O empreendedorismo universitário tem tido um papel preponderante desde a década de 50 do século passado, sendo um ativo cada vez mais valioso, promovendo o conhecimento existente nas instituições, com a transferência para o mercado através de spin-offs. A existência de spin-offs tem sido apoiada com a criação de atos legislativos que favorecem as universidades, gerando retorno através do desenvolvimento socioeconómico e da coesão territorial, aproveitando o modelo de inovação da tripla hélice e as estratégias europeias como a RIS3 (Research and Innovation Strategies for Smart Specialisation) e as EDP (Entrepreneurial Discovery Process) (Foray, 2018). Estes projetos colocaram a inovação como um foco central do desenvolvimento económico, procurando um aumento na competitividade e um equilíbrio entre as regiões mais favorecidas e desfavorecidas através da promoção do setor da investigação e desenvolvimento, sendo considerada uma das grandes bandeiras da União Europeia, que pretendia competir com os EUA e a China neste contexto, ampliando a contribuição do setor de I&D no PIB (Comissão Europeia, 2012).Desde o Bayh-Dole Act (ato legislativo norte-americano desenvolvido nos anos 80 do século passado) que as patentes universitárias ganharam relevância, comercializando-se o conhecimento universitário no mercado, espalhando-se pelo mundo e fomentando a capacidade de ligação com a indústria vigente num determinado território (Aranguren et al, 2023). Diversos exemplos de políticas públicas surgiram, levando-nos à pergunta de investigação: De que forma as políticas públicas influenciam a criação de spin-off académicas?. A influência das políticas públicas visa o crescimento económico, com a inovação a ser considerado como o setor que mais influência pode ter nesse mesmo crescimento, e a coesão territorial, devido à objetividade do impacto social, sobretudo ao nível da capacidade de emprego, dos benefícios sociais existentes e da melhoria geral da qualidade de vida, bem como gerar vantagens competitivas que atraiam capital humano e financeiro para desenvolvimento da região (Compagnucci & Spigarelli, 2020).Como principal objetivo, pretendemos compreender qual a influência das políticas públicas na criação das spin-offs académicas. Metodologicamente, trata-se de um estudo qualitativo, através de revisão sistemática da literatura, com recurso a documentos institucionais e legislativos, publicados, com o propósito de obter as informações necessárias para retratar a influência existente.

Keywords: *Políticas Públicas; Spin-offs; Empreendedorismo;*

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Rehabilitation sciences

EARLYMOTO | Early mobilization after stroke with Motomed: effects in functional recovery and quality of life during acute and chronic phases

Nelson Tomas Manuel[†,1], Sandra Vieira[1]

1. Campus Universitário de Santiago. 3810-193 Aveiro

* Corresponding author; sivieira@ua.pt; † Presenting author; Rehabilitation sciences.

Abstract. Abstract
O AVC é um síndrome clínico de início súbito de sinais focais neurológicos, devido a perda de função cerebral cuja duração ultrapassa as 24 horas (excepto quando ocorre morte) (Bray, 1997; Rosas, 1999). Uma primeira manifestação clínica de doença vascular cerebral poderá ser um acidente isquémico transitório (AIT). Este pode ser único ou pode preceder um AVC, sendo que um terço dos indivíduos que tiveram AIT tem um AVC (Bray, 1997; Rosas, 1999) Em todo o mundo, o AVC hemorrágico como isquémico causam perturbações neurológicas, são as principais causas de incapacidade físicas e mentais e a segunda principal causa de morte (Feigin et al. 2017). E em Angola e uma das principais causas de morte depois da Malária, Considerando o peso global das doenças neurológicas, o AVC aparece como o responsável pela maioria das mortes (64, 4%), bem como por anos de vida ajustados à deficiência (42, 2%) (Feigin et al. 2020). Em Angola Apesar do desenvolvimento da medicina moderna, as tendências demográficas, mostram o aumento modificáveis e não-modificáveis fatores de risco para acidente vascular cerebral (tais como o factor climático a pobreza a desigualdade social a educaçao para saúde e o envelhecimento respectivamente) suporte o fato inevitável de que o curso vai continuar a ser um problema urgente de saúde pública em todo o mundo (Feigin et al. 2020), O que determina a relevância de melhorar a prevenção de AVC, tratamento e reabilitação. Por isso, é urgente fornecer intervenções terapêuticas, reabilitativas e restaurativas eficazes, além de medidas preventivas reforçadas (Feigin et al. 2020). Além disso, é necessário melhorar a acessibilidade e o Funcionamento dos cuidados de saúde na periferia de todos centros e hospitais nas provincias do pais
A Organização Mundial de Saúde [World Health Organization] comprometeu-se a realizar significantes esforços para reduzir os fatores de risco as sequelas que podem causar o AVC até 2025. As sequelas como o estado neurulógico e a qualidade de vida dos Utentes após o AVC podem ser reduzidas significantemente através do atendimento organizado incluindo a criação de diretrizes de prática clínica baseadas em evidências assim como a reabilitação Precoce com a motomed que possa melhorar a qualidade de vida dos utentes.

Keywords: *AVC, Reabilitação física, Qualidade de vida, Motomed viva2*

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Acknowledgements. Agradeço à minha orientadora: seu apoio, orientação e idéias fizeram desta uma experiência inspiradora para mim. Também gostaria de agradecer à minha família por me apoiar durante todo o período do estudo e ao INABGE pelo apoio financeiro.

Brain Information Transfer Dynamics and Neurorehabilitation Effects of a Brain-Machine Interface Protocol in Spinal Cord Injury

José Gabriel Figueiredo[†,⋆,1], Miguel Pais-Vieira[1], Sandra I. Vieira[2]

1. Institute of Biomedicine (iBiMED), Department of Medical Sciences, University of Aveiro, 3810-193 Aveiro, Portugal
2.

⋆ Corresponding author; jose.gabriel.sf@ua.pt; † Presenting author; Rehabilitation sciences.

Abstract. Spinal cord injury (SCI) is a highly debilitating neuropathology, associated with impairment of sensorimotor functions, as well as the appearance of neurologic manifestations, such as neuropathic pain. Consequently, patients suffer from loss of autonomy and quality of life. Furthermore, it is coupled with difficulties and high costs for caregivers and healthcare systems (Ahuja et al., 2017). Despite currently having no cure, recent neurorehabilitation protocols combining brain-machine interfaces (BMIs), that use neurophysiological signals to control devices, have achieved relevant clinical improvements (Donati et al., 2016; Lorach et al., 2023; Pais-Vieira et al., 2024). Its neurorehabilitative effects are thought to originate from bypassing the limitations imposed by SCI and elicit neuroplasticity modulation (Nizamis et al., 2021). More specifically, protocols that allow the control of an avatar in virtual reality (VR), may promote them through coherent and synchronized inputs generated by sensory feedback combined with motor imagery outputs from the central nervous system (Donati et al., 2016; Pais-Vieira et al., 2024). However, there is still a lack of detailed descriptions of the neurobiology behind these processes, both in healthy participants and SCI patients. For example, it is still unknown which changes occur in brain information networks, as well as in the way information is transferred, with the recurrent implementation of the aforementioned type of BMI protocol. The main aim of this work is to comprehensively characterize the dynamics of brain information transfer induced by an improved BMI protocol with VR and multimodal feedback, with particular interest in altered activity leading to relevant clinical improvements in SCI patients rehabilitation. Here we propose to monitor and analyse EEG-based cortical activity of healthy participants and SCI patients subjected to a VR-based BMI protocol with multimodal (visual, auditive, tactile) feedback, over 24 sessions (2-3 months). The BMI will operate using an optimized algorithm to control an avatar through motor imagery, in an immersive VR environment. Neuroplasticity will be assessed through changes in brain information transfer, analysed from EEG recordings, and measurement of neuroplasticity-associated serum molecular markers. These measurements will be correlated, as well as with the clinical evolution of SCI patients. This study is expected to advance our current understanding on the neurophysiological basis of BMI-induced SCI neurorehabilitation, and help treating neuropathic pain, secondary to other pathologies, by developing innovative and non-invasive therapies.

Keywords: *Spinal cord injury; Information transfer; Brain-machine interface; Virtual reality; Biomarkers*

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Acknowledgements. This work was financially supported by National Funds through FCT Fundação para a Ciência e a Tecnologia, I.P., via the doctoral scholarship 2023.02051.BD, and the Intitute of Biomedicine - University of Aveiro (iBiMED), under the Grant UIDB/4501/2020 and UIDP/4501/2020. The authors also would like to acknowledge the support given by the Hospital Senhora da Oliveira - Guimarães (HSOG), the North Rehabilitation Center (CRN-ULSGE), and the Portuguese Catholic University - Porto (UCP).

A PILOT STUDY OF INTEGRATING NEURAL MOBILIZATION TECHNIQUES INTO AN EXERCISE PROGRAM FOR OLDER ADULTS WITH CHRONIC MUSCULOSKELETAL PAIN

Frederico M. Baptista[†,⋆,1], Eduardo Brazete Cruz[2], Milton Rodrigues Santos[3], Anabela G. Silva[4]

1. CINTESIS.UA@RISE, Department of Medical Sciences, University of Aveiro, Aveiro, Portugal
2. 2Department of Physiotherapy, School of Health, Setúbal Polytechnic University, Setúbal, Portugal
3. 3School of Health Sciences, University of Aveiro, Aveiro, Portugal
4. CINTESIS.UA@RISE, School of Health Sciences, University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; fredericobaptista@ua.pt; † Presenting author; Rehabilitation sciences.

Abstract. Chronic pain due to the presence of musculoskeletal (MSK) disorders is one of the main factors associated with disability in older adults (Leveille et al., 2009; Schwan et al., 2019). A physiotherapeutic intervention that has demonstrated positive effects in improving pain and disability is neural mobilization (NM) (Baptista et al., 2024). However, few studies have been carried out investigating its effectiveness in older adults (Baptista et al., 2024). Therefore, a first study was conducted aiming to evaluate the feasibility of NM techniques when coupled with a physical exercise program for older adults. A 2-arm randomized pilot clinical trial was performed with older adults with chronic MSK pain. The control group (CG) received a physical exercise program, while the experimental group (EG) received the physical exercise program plus NM techniques. The intervention lasted 8 weeks (twice a week). Primary outcomes were adherence and dropout rates, as well as acceptability measured qualitatively using focus groups. Secondary outcomes were pain intensity and disability measured with numerical rating scales. Thirty participants were evaluated at baseline (EG=14; CG=16). In both groups adherence rates were above 90% and dropout rates were below 15%. Pain intensity decreased from 5.69 (ś 1.28) and 5.15 (ś 1.69) to 4.18 (ś 1.53) and 4.17 (ś 1.9), and disability decreased from 3.97 (ś 1.80) and 3.04 (ś 2.56) to 3.26 (ś 1.76) and 2.23 (ś 2.1) in the EG and CG, respectively. As conclusion, adherence rates were high and dropout rates were low across groups. The focus groups revealed that the intervention program met participantt's expectations. Pain intensity showed a tendency for decrease in both groups at post-intervention. The inclusion of NM techniques in a physical exercise program for older adults proved to be viable for a future RCT with a larger and more representative sample of the target population.

Keywords: *feasibility study, neurodynamics, chronic musculoskeletal pain, older adults, pain, disability.*

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Acknowledgements. This work was supported by the National Funds through FCT Fundação para a Ciência e a Tecnologia, I.P., within RISE (Health Research Network: From the Lab to the Community, R&D Unit (reference DFA/BD/12526/2022).

Personalised community-based physical activities (PICk UP) through the lens of people with COPD

Patrícia Rebelo[†,⋆,1], Dina Brooks[2], Alda Marques[3]

1. 1 - Lab3R Respiratory Research and Rehabilitation Laboratory, School of Health Sciences, University of Aveiro (ESSUA) and iBiMED Institute of Biomedicine, University of Aveiro, Aveiro, Portugal. 2 - Department of Medical Sciences, University of Aveiro, Aveiro, Portugal.
2. School of Rehabilitation Sciences, McMaster University, Hamilton
3. and West Park Healthcare Centre, Toronto, ON, Canada.
4. Lab3R Respiratory Research and Rehabilitation Laboratory, School of Health Sciences, University of Aveiro (ESSUA) and iBiMED Institute of Biomedicine, University of Aveiro, Aveiro, Portugal.

⋆ Corresponding author; patriciarebelo@ua.pt; † Presenting author; Rehabilitation sciences.

Abstract. Pulmonary rehabilitation is the most cost-effective intervention for improving symptoms, exercise capacity and quality of life of people with chronic obstructive pulmonary disease (COPD). Nevertheless, its benefits tend to disappear within six to 12 months after completion. To tackle this problem, we designed and implemented the PICk UP programme, a personalized community-based physical activity initiative. After completing a pulmonary rehabilitation programme, the PICk UP programme offered people with COPD the opportunity to integrate various physical activities of their city council, based on their needs and preferences. This qualitative study, nested within a larger clinical trial (NCT04223362), aimed to explore the perspectives of people with COPD on the impact of the PICk UP programme. Regarding the methodology, pre- and post- PICk UP focus groups, employing semi-structured interviews, were conducted with people with COPD. Sessions were audio recorded, transcribed and underwent reflexive thematic analysis integrating deductive and inductive methodologies. Focus groups included 15 participants [14males, 70(8) years, FEV1 57.1(18.1) %predicted]. Results were summarized into two main themes. The first theme, Building upon past gains, we thrive and attain, encapsulated the effects of the PICk UP programme and comprised three sub-themes Taking the reins of life, Physical activity, the pathway to socialization, and Dont stop, keep moving. People with COPD identified several physical and psychological benefits that enabled them to reassert control over their lives. They also emphasized the importance of social inclusion within their communities and expressed a commitment to independently sustain their engagement with the community-based PAs. The second theme, The more, the merrier, encompassed participants suggestions for improving the intervention. Their suggestions underscored a desire for more physical activity (in terms of frequency, duration, intensity, and variety). The PICk UP programme emerged as a potential solution to encourage healthy lifestyles and extend the benefits of pulmonary rehabilitation in people with COPD.

Keywords: *Physical Activity; Pulmonary Disease, Chronic Obstructive; Community integration; Community Resources; Qualitative research*

Acknowledgements. The authors would like to thank Guilherme Rodrigues, Cíntia Dias, Ana Grave, Samuel Santos, Maria Gomes, Inês Agostinho and Carolina Monteiro, all affiliated to the Respiratory Research and Rehabilitation Laboratory (Lab3R), School of Health Sciences, University of Aveiro, for their contribution during the data collection. In addition, we would like to thank to the Institute of Biomedicine & School of Health Sciences of the University of Aveiro; and to the city councils and primary health care centres of Aveiro and Estarreja for all the support provided to this project.

Effects of high and low-resource pulmonary rehabilitation on patient-reported outcomes in people with COPD

Joana Antão[†,1], Alda Marques[⋆,2]

1. Lab3R Respiratory Research and Rehabilitation Laboratory, School of Health Sciences, iBiMED Institute of Biomedicine, Department of Medical Sciences, University of Aveiro, Aveiro, Portugal
2. Department of Research and Development, Ciro, 6085 NM Horn, The Netherlands
3. Department of Respiratory Medicine, Maastricht University Medical Centre, NUTRIM School of Nutrition and Translational Research in Metabolism, Faculty of Health, Medicine and Life Sciences, Maastricht University, Maastricht, the Netherlands
4. Respiratory Research and Rehabilitation Laboratory (Lab3R), School of Health Sciences (ESSUA) and iBiMED Institute of Biomedicine, University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; amarques@ua.pt; † Presenting author; Rehabilitation sciences.

Abstract. Pulmonary rehabilitation (PR) is a fundamental non-pharmacological intervention for chronic obstructive pulmonary disease (COPD); however, its access is limited. Settings with minimal resources have been suggested to increase availability. Nevertheless, evidence of the effects obtained in different settings is scarce. We assessed whether the effects of PR on disease impact, fatigue, and health-related quality of life (HRQoL) differ between low and high-resource settings in COPD.
A retrospective study including people with COPD enrolled in PR was conducted. PR programs delivered at the Respiratory Research and Rehabilitation Laboratory, School of Health Sciences of the University of Aveiro (Lab3R-ESSUA), or hospitals were considered high-resource settings, whereas those conducted in city council facilities or primary healthcare centres were considered low resources.
Outcomes of interest were disease impact, assessed with the chronic airways assessment test (CAAT), fatigue with the functional assessment of chronic illness therapy fatigue scale (FACIT-F), and HRQoL with the St. George respiratory questionnaire (SGRQ). Linear mixed-effects models were used to assess the effects of the setting, time, and their interaction while adjusting for age, sex, body mass index, forced expiratory volume in one second in percentage of predicted (FEV1%predicted), smoking status, dyspnoea assessed with the modified medical research council dyspnoea scale and functional capacity with the six-minute walk test.
157 people with COPD were included (79.6% male; median age 70 [IQR 65, 76]; FEV1 %predicted 52 [38, 65]). Changes in SGRQ after PR differed significantly between settings (4.5; 95%CI 0.9, 8.1) in favour of high resources. No significant differences were found between settings for changes post-PR in CAAT (1.4; 95%CI -0.6, 3.3) and FACIT-F (-1.1; 95%CI -3.3, 1.1).
Improvements following PR with minimal resources differed from PR delivered in high-resource settings for HRQoL, but not for disease impact and fatigue in COPD.

Keywords: *Pulmonary Disease, Chronic Obstructive; Rehabilitation*

Semiology associated with sacroiliac joint dysfunction: A Scoping Review

Luis Albuquerque[†,1], Mário Lopes[2], Diogo Silva[3]

1. Universidade de Aveiro
2. University of Aveiro
3. Polytechnic of Porto

⋆ Corresponding author; † Presenting author; Rehabilitation sciences.

Abstract. Sacroiliac joint (SIJ) plays a crucial role in mobility, stability, and resistance against shear forces and with the increase in average life expectancy has become an extremely prevalent problem (Gartenberg et al., 2021). There is a multitude of signs and symptoms associated with this dysfunction, not only in different locations, but also in terms of functional changes, as for instance asymmetrical gait and a depressed synergy between muscles providing sacroiliac joint closure when walking (Feeney et al., 2018), or patients with sacroiliac joint dysfunction, present an altered motor pattern of the local muscle system and global muscle system (Joseph et al., 2015).

Objective: To map the semiology of the SIJ disfunction registered in published studies, between 2013 and 2023.

Design: The scoping review was prepared by referring to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for Scoping Reviews (PRISMA-ScR).

Results: A total of 6572 records were identified through database searching. After removing duplicates, articles that did not mention the associated signs and symptoms, and articles without new data, 59 full text were included for analysis.

Conclusions: In the articles included in this scoping review, the relevant influence that sacroiliac dysfunction seems to exert at different levels was noted, contributing to relevant semiological changes, highlighting in terms of prevalence low back pain, pain in the groin and lower limbs. Important consequences are also highlighted, such as changes in balance, altered movement strategies, asymmetric gait, loss of speed, power and athletic performance, as well as a decrease in functional capacity.

Keywords: *Sacroiliac dysfunction related signs and symptoms, sacroiliac joint derangement, restoring pelvic position.*

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Acknowledgements. To Professor Mário Lopes for his extraordinary support.

Assistence for people with stroke in Angola

Lourenço José [†,1], Sandra Viera[⋆,2], Elsa Melo[2], Ana Pinheiro [2]

1. Centro Ortopédico dr. Agostinho Neto
2.

⋆ Corresponding author; † Presenting author; Rehabilitation sciences.

Abstract. Profile and care of stroke patients in Angola: Preliminary results of a longitudinal two-center study

José, L.1,2,3, Vieira, S.4, Melo, E.5, Pinheiro, A.R.51Centro Ortopédico e de Reabilitação Polivalente Dr. António Agostinho Neto, Angola
2Universidade Privada de Angola (UPRA), Angola
3Biomedical Sciences Department and School oh Health Sciences (ESSUA), University of Aveiro, Portugal
4Institute of Biomedicine (iBiMED), Biomedical Sciences Department (DCM), University of Aveiro, Portugal 5Institute of Biomedicine (iBiMED), School oh Health Sciences (ESSUA), University of Aveiro, Portugal Background: According to the World Health Organization, 17 million people have a stroke per year, which represents a global health problem, with an increasing burden in low- and middle-income countries. Despite the existence of international guidelines aiming to enhance stroke care, literature reports that they are not universally implemented. In Angola, there is a lack of comprehensive stroke epidemiological data, and no established stroke care guidelines seems to be in place. Objectives: This study aims to characterize the stroke profile and the health care provided for people with a stroke in Luanda, Angola. Methods: A prospective longitudinal study was conducted at two Health centers, from March to November 2023, enrolling stroke patients. Data was gathered using a survey created by the researchers and validated by a health panel of experts from Angola. Ethical approval and informed consent were obtained. Results: Preliminary results of a total of 186 patients are described, 122 from a Central Acute Care Hospital, with a mean age of 51.314.35 years old, a BMI of 26.74.15 kg/m2, 41% male, and 64 patients from a Rehabilitation Center, with 55.611.55 years old, a BMI of 27.03.8 kg/m2, 53% male. Ischemic stroke was reported as the most representative type in both centers (71.3% and 70.3%, respectively), though 100% of patients had no imaging diagnosis confirmation, neither data about the subtype was given. For patients admitted in the Hospital, discharge occurred before rehabilitation, and no follow-up was possible. No rehabilitation care was delivered in the first 7 days after stroke. In the Rehabilitation Center, patients rehabilitation started in the late subacute phase, after a mean of 171.811.5 days. Conclusions: Stroke diagnosis is lacking imaging confirmation, which is decisive for a proper treatment, and rehabilitation is starting during the late subacute phase. Key words: Stroke, personalized health care, functional recovery, quality of life, health policies

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Keywords: *Health , stroke*

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Acknowledgements. University of Aveiro

Impact of a breastfeeding intervention program in infant nutrition outcomes with migrant mothers in Portugal: a pilot study

Ana Cláudia Lopes[†,⋆,1], Marisa Lousada[2]

1. University of Aveiro, Aveiro, Portugal
2. Center for Health Technology and Services Research (CINTESIS.UA@RISE),
3. Center for Health Technology and Services Research (CINTESIS.UA@RISE), University of Aveiro, Aveiro, Portugal
4. Center of Linguistics of the University of Lisbon (CLUL), Lisbon, Portugal
5. School of Health Sciences (ESSUA), University of Aveiro, Aveiro, Portugal

⋆ Corresponding author; anac.lopes@ua.pt; † Presenting author; Rehabilitation sciences.

Abstract. Breastfeeding is vital for maternal and child health. The World Health Organization promotes it, especially for vulnerable groups like migrants (WHO, 2018). Despite the benefits of breastfeeding, the availability of high-quality studies on the subject is limited, particularly in humanitarian contexts (Lopes & Lousada, 2024). This study unfolds in two phases: i) a single-group pre-post pilot study; ii) a randomized controlled trial. This pilot study serves as the initial phase of a broader project that aims to examine the impact of breastfeeding interventions done by a Speech and Language Therapist in humanitarian contexts and was done with a cohort of migrant women (n=17) who received an intervention from a Speech and Language Therapist, with the support of an interdisciplinary team. This encompassed prenatal education, postpartum professional lactation support for both mothers and infants, and postpartum peer support to enhance social support. Data collection utilised a sociodemographic questionnaire and the Mother's Breastfeeding Knowledge, Attitudes, and Practices, a questionnaire to gather information on maternal characteristics before and after the intervention. In the first month after birth, an external element blind to the study used the Neonatal Oral-Motor Assessment Scale to provide insights into infant oral-motor patterns. The Postpartum Quality of Life questionnaire was also used to better describe the women's breastfeeding outcomes, in the first, third, and sixth months after birth. Preliminary findings show that there is a very high satisfaction rate regarding the intervention. Also, there are high rates of breastfeeding within the first hour after birth (100%), and one (100%) and three months (100%) after birth. The intervention demonstrates the potential to positively impact breastfeeding practices and related outcomes, highlighting the significance of a tailored intervention approach in promoting and supporting breastfeeding (Lancet, 2016).

Keywords: *breastfeeding; speech and language therapy; migrant; refugee; asylum seeker*

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Acknowledgements. This work was supported by national funds through FCT - Fundação para a Ciência e a Tecnologia, I.P., within CINTESIS, R&D Unit (UIDB/4255/2020 and UIDP/4255/2020), RISE - LA/P/0053/2020, and the Ph.D. Grant (UI/BD/152235/2021) and DOI identifier (10.54499/UI/BD/152235/2021).

Sustainable chemistry

Unraveling the composition of water-soluble extracts derived from raspberry seeds using microwave-assisted extraction for innovative food applications

Paloma Lopes[†,⋆,1], Isabel M.P.L.V.O. Ferreira[2], Manuel A. Coimbra[1], Sílvia Petronilho[3], Cláudia P. Passos[1]

1. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
2. LAQV-REQUIMTE, Department of Chemical Sciences, Laboratory of Bromatology and Hydrology, Faculty of Pharmacology University of Porto, 4050-313 Porto, Portugal
3. LAQV-REQUIMTE, Department of Chemistry, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
CICECO Aveiro Institute of Materials, Department of Materials and Ceramic Engineering, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; palomalopes@ua.pt; † Presenting author; Sustainable chemistry.

Abstract. Due to their perishability, raspberries are commonly processed into foodstuffs like jams, juices, and sauces. However, this processing results in significant quantities of discarded raspberry seeds, posing environmental concerns. Raspberry seed oil (RSO) is highly appreciated due to its richness in polyunsaturated fatty acids (PUFAs), which are known to have health-promoting properties in human nutrition. Despite that, commercial RSO has been widely applied in cosmetic fields (Ispiryan et al., 2021), with no food-related applications known for this oil. Furthermore, the information on the remaining composition of raspberry seeds (RS) is scarce, including its polymeric material, such as polysaccharides and proteins. As such, both RS biopolymers and oil could benefit from novel applications in the food industry. In this work, n-hexane Soxhlet extraction was employed to recover RSO from raspberry seeds, while the polymeric material was recovered by microwave-assisted extraction (MAE) (Passos & Coimbra, 2013), employing a design of experiments to control temperature (T), operation time (t), and solvent type (0.0-0.6% acetic acid). Chemical characterization confirmed RSO as a specialty oil (rich in PUFAs) with antioxidant properties (7.2 mM TOCeq). Meanwhile, the recovered RS biopolymers from the defatted seeds (yield up to 14% w/w of defatted seeds) revealed that RS are composed of arabinose-, glucose-, and xylose-rich polysaccharides (up to 45%). Moreover, MAE allowed to enrich soluble extracts by up to 4 times the original RS protein content (up to 31%). These biopolymers were used as building blocks for the preparation of solid support for RSO (aerogels-like), combining its plant-based healthier properties with the texture advantages of an animal fat. Thus, RS biopolymers and RSO have the potential to be repurposed as a renewable source of biomolecules for food applications, adding value and sustainability to the agri-food industry.

Keywords: *Raspberry Byproducts, Bioactivity, Circular Economy, Functional Food, Sustainability*

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Enhancing the photosensitizer efficiency of meso-tetraarylporphyrins against Gram-negative and Gram-positive bacterial strains through conjugation with triphenylphosphonium salts

Filipe M. P. Morais[†,⋆,1], Inês Chaves[2], Cátia Vieira[2], Maria Bartolomeu[2], M. Amparo F. Faustino[1], M. Graça P. M. S. Neves[1], Adelaide Almeida[2], Carlos Lodeiro[3], Nuno M. M. Moura[1]

1. LAQV-REQUIMTE, Department of Chemistry,
2. CESAM, Department of Biology,
3. BIOSCOPE Research Group, LAQV@REQUIMTE Chemistry Department, NOVA School of Science and Technology, NOVA University Lisbon, 2829-516, Caparica, Portugal

⋆ Corresponding author; filipemorais@ua.pt; † Presenting author; Sustainable chemistry.

Abstract. In today's landscape, antimicrobial resistance remains a pressing concern, underscoring the urgent need for viable alternatives. Both the medical and scientific communities concur that antimicrobial photodynamic treatment (aPDT) holds promise as an effective strategy against these resilient pathogens.(Hurst et al. 2019; Kashef, Huang, and Hamblin 2017) Within this realm of innovation, cationic porphyrins and related macrocycles have garnered significant attention as potent photosensitizers (PS) for aPDT.

Conventionally, porphyrin-based PS have been synthesized through N-alkylation of nitrogen-based components using alkyl halides, limiting the ability to finely adjust their properties. Yet, the advent of triphenylphosphonium-based compounds has opened a novel pathway. These compounds are celebrated for their precise targeting of mitochondria, showcasing both anti-tumoral properties and diagnostic utility. With their considerable hydrophobic surface area and evenly distributed charge, they boast a strong attraction to lipid membranes, rendering them potent antibacterial agents against a spectrum of bacterial strains.(BresolíObach et al. 2018; Kang et al. 2020) These insights have encouraged efforts to enhance antibacterial efficacy through the development of new porphyrin-based PS. This involves the conjugation of porphyrins with triphenylphosphonium moieties, aiming to exploit on a synergistic effect. This synergy involves the generation of singlet oxygen by the porphyrin macrocycle and the augmented membrane interaction facilitated by the presence of triphenylphosphonium moieties. (Inês Chaves et al. 2024) In this presentation, we investigate the synthesis of cationic porphyrin-triphenylphosphonium conjugates, their characterization, and the assessment of their efficacy in photoinactivating both Gram-positive and Gram-negative bacterial strains through photodynamic treatment. This effort represents a significant stride towards combating antimicrobial resistance and underscores the potential of aPDT as a pivotal therapeutic approach.

Keywords: *Porphyrin, Triphenylphosphonium, Antimicrobial Photodynamic Therapy, Photosensitizers, Bacteria*

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Acknowledgements. Acknowledgements: The authors thank the University of Aveiro, the University of Porto, and FCT/MCTES (PIDDAC) for financial support to the LAQV-REQUIMTE (LA/P/0008/2020, http://doi.org/10.54499/LA/P/0008/2020; UIDP/50006/2020, http://doi.org/10.54499/UIDP/50006/2020; and CESAM [(UID/AMB/ 50017/2019 and UIDB/50017/2020 + UIDP/50017/2020)] Research Units, and Portuguese NMR Network.
Funding: This research work received financial support from the University of Aveiro and FCT/MCTES (Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) to support the LAQV-REQUIMTE [(LA/P/0008/2020 DOI 10.54499/LA/P/0008/2020, UIDP/50006/2020 DOI 10.54499/UIDP/50006/2020 and UIDB/50006/2020 DOI 10.54499/UIDB/50006/2020)] and CESAM [(UID/AMB/ 50017/2019 and UIDB/50017/2020 + UIDP/50017/2020)] research units through national funds. N.M.M. Moura thank FCT for funding through program DL 57/2016 Norma transitória (CDL-CTTRI-048-88-ARH/2018) and Filipe. M. P. Morais thanks also FCT for their doctoral grants (UI/BD/154486/2022).

Development of biobased polyesters derived from 2,5-furandicarboxylic acid and their sustainable nanostructures

Luísa Figueiredo [†,⋆,1], Lorenzo Ceparano[1], Beatriz Agostinho[1], Vinícius de Paula[1], Sónia A.O. Santos[1], Ricardo J. B. Pinto[1], Andreia F. Sousa[2]

1. University of Aveiro
2. University of Aveiro

⋆ Corresponding author; † Presenting author; Sustainable chemistry.

Abstract.

Nowadays, the massive use of polymers has been steadily increasing, with the vast majority deriving from fossil resources. In this sense, the quest for potentially more sustainable alternatives has increased, with polymers of renewable origin emerging as promising options. New biobased polymers using renewable-based monomers, such as FDCA and derivatives with different diols from renewable origin, stand out as a perfect example, boasting compelling mechanical, thermal, and barrier properties (Loos, 2020), with promising applications, particularly in the packaging sector or as fibers for textiles. The development of nanostructures of these polymers could expand ever further their range of applications, including in high-specialised sectors such as medicine.
This work aims precisely to breakthrough the preparation of unexplored nanoparticles (NPs) of poly(ethylene 2,5-furanodicarboxylate), known as PEF, and poly(diethylene 2,5-furanodicarboxylate), known as PDEF, through the nano-precipitation method. The impact of various experimental parameters was assessed, including agitation methodology, choice of antisolvent and surfactants, as well as the precursors concentration and chemical structure. The influence of these variables on the size, morphology, and surface charge of the nanostructures was examined using electron microscopy, dynamic light scattering, and zeta potential analysis, aiming to establish reliable and scalable methodologies.

Keywords: *Nanoparticles, biobased polyesters, furandicarboxylic acid*

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Acknowledgements. This work was developed within the scope of the project CICECO-Aveiro Institute of Materials, UIDB/50011/2020 (DOI 10.54499/UIDB/50011/2020), UIDP/50011/2020 (DOI 10.54499/UIDP/50011/2020) & LA/P/0006/2020 (DOI 10.54499/LA/P/0006/2020), financed by national funds through the FCT/MCTES (PIDDAC). The FCT is acknowledged for the research contract under Scientific Employment Stimulus to AFS (CEECIND/02322/2020, DOI 10.54499/2020.02322.CEECIND/CP1589/CT0008) and for a doctorate grant to BA (2020.04495.BD). This work was supported by COST Action FUR4Sustain (CA18220) supported by COST (European Cooperation in Science and Technology). The research contract of RJBP was funded by national funds (OE), through FCT in the scope of the framework contract foreseen in the numbers 4,5,and 6 of the article 23, of the Decree-Law57/2016, of August 29, changed by Law 57/2017, of July19.

Exploring living and non-living macroalgae based biosorbents in interaction with complex multi-element mixtures a life cycle perspective.

Jessica Jacinto[†,1], Bruno Galinho[1], Eduarda Pereira[1], Nuno Lapa[1]

1.

* Corresponding author; † Presenting author; Sustainable chemistry.

Abstract. Macroalgae based sorbents have been explored as a more sustainable alternative technology for the removal and recovery of Critical Raw Materials (CRMs) [1], among them are the Rare Earth Elements (REEs). The scale-up of this technology implies different stages, such as the growing and cultivation of macroalgae. Moreover, their application at an industrial level requires further knowledge about the sorption process under relevant close to industrial conditions, such as the presence of competing ions and the presence of nutrients. There is also the need to apply certified methodologies, such as Life Cycle Analysis (LCA)[2] to measure the environmental burden that this technology would represent. From an initial comparison between the efficiency in the simultaneous uptake of an equimolar mixture of REEs, containing Hg (Mercury), Cd (Cadmium), Pb (Lead), and As (Arsenic) by Ulva lactuca and Gracilaria gracilis applied as living and non-living, several assays were made in order to optimize the removal conditions of Mercury and to study the mixture under the presence of nutrients. The elements As and Cd were less removed from the solution, while REEs and the elements Hg and Pb were removed by the living biomass above 80%. However, for non-living biomass, the removal percentages for REEs were significantly lower, in general, under 40%. The obtained results suggest that the element Mercury is not affected by the presence of other contaminants, nor the presence of nutrients. Life cycle analysis revealed that the major environmental burden of this technology is allocated to the energy requirements of the aeration processes, moreover, the productivity of each tank is a crucial factor in determining the environmental burdens. On the specific case of this pilot land based open pond system, major contributors for the environmental performance were in the categories of Global warming, eutrophication, terrestrial acidification and ecotoxicity.

Keywords: *macroalgae, biosorption, complex mixtures, Rare Earth Elements (REEs), Potentially toxic elements (PTEs); Life cycle analysis*

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Acknowledgements. This work received financial support from PT national funds (FCT/MCTES, Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) through the projects UIDB/50006/2020 and UIDP/50006/2020.
Jéssica Jacinto, Nicole Ferreira, Thainara Viana e João Pinto thanks FCT/MCTES (Fundação para a Ciência e Tecnologia and Ministério da Ciência, Tecnologia e Ensino Superior) and ESF (European Social Fund) through NORTE 2020 (Programa Operacional Região Norte) for their PhD grants ref. UI/BD/151290/2021, 2022.13017.BD, 2022.13015.BD and 2020.05323.BD, respectively. Bruno Henriques thanks FCT (Fundação para a Ciência e Tecnologia) for funding through the Scientific Employment (Ref. CEECIND/03511/2018).

Telecommunications - MAP-tele

Partial Chromatic Dispersion Compensation of 12.5G PON with Optimised FBG Design for Access Networks

Eronmhon Augustine Ogobor†,1, Mário Lima⋆,1, António Teixeira[1]

1. Instituto de Telecomunicações-IT

⋆ Corresponding author; mlima@ua.pt; † Presenting author; Telecommunications - MAP-tele.

Abstract. The study and use of the optical compensation technique to enhance the performance of communication systems has proven to be a viable approach over some time. With Fiber Bragg gratings (FBG), the main issue has not been its capability for functionality but increase in grating length with bandwidth, specification of optimal design parameters for maximum peak reflectivity, minimal side lobe reduction among other constraints. A previously conducted research for which specific Bragg gratings were studied based on grating length and index modulation revealed acceptable grating parameters including the analysis for various grating profiles needed to attain near 100 percent peak reflectivity where the optimum grating parameters were found to be 5 mm and a low modulation index of 0.0008 for the presented grating apodisation profiles even though it recommended a dimension of between 5 and 10 mm while focusing mainly on sensing applications (Shekar et al. 2021). Apart from the low losses and immunity to electromagnetic interference that come with FBGs, its use for chromatic dispersion compensation (CDC) in most linear systems has functioned to compensate around 100 km of Single mode fiber - a long-haul optical transmission system with data rate of 10 Gbps and grating length of 10 cm with added amplifier (Fathalla et al. 2022). While compensation in long distance communication systems is prevalent, attaining higher data rates with short reach access network is still under investigation. Above the traditional 10G PON systems, FBG optimisation will require systematic and numerical analysis to ensure the required trade-offs due to the anticipated data rate, bandwidth demand, dispersion levels experienced on the fiber medium, the grating period and other grating physical parameters. The incident and reflected fields can be represented by the gratingt's transfer matrix.

This work presents an optimised Bragg grating solution with optimum length and profile to partially compensate chromatic dispersion for 12.5Gbps in C-band using the NRZ modulation scheme. It showcases a cost-effective communication system with external modulation propagating over single mode fiber for short reach application in data centers, small and medium enterprises, and residential applications. The designed grating is further validated and is seen to improve the system performance and compensate for CD at the recommended BER threshold.

Keywords: *Single WDM System, Bit Error Rate, Partial Chromatic Dispersion Compensation, High Data Rate, Access Networks, Fiber Bragg Grating.*

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Multi-user IR-HARQ techniques for URLLC

Rafael Santos[†,⋆,1], Daniel Castanheira[1], Adão Silva[1], Atílio Gameiro[1]

1. Instituto de Telecomunicações - Aveiro

⋆ Corresponding author; d.rafael.santos@ua.pt; † Presenting author; Telecommunications - MAP-tele.

Abstract. Ultra-Reliable Low-Latency Communications (URLLC) for 5G and beyond was established to support applications with stringent requirements in terms of reliability and low-latency. However, there is a high heterogeneity of requirements, even among use-cases falling within the URLLC umbrella [1]. Indeed, the URLLC traffic can be periodic or sporadic, with latency and reliability requirements ranging from 0.25ms to 1ms and 1-10-2 to 1-10-9, respectively [1]. The concept of grant-free (GF) access is considered a promising building block for URLLC due to its ability to reduce uplink access time. Pairing GF access with IR-HARQ can be an important enabler of URLLC due to two facts. First, the URLLC traffic will be mainly comprised of small-sized packets, requiring their system to operate within the finite blocklength limit (FBL). This operational constraint results in a notable performance gap relative to Shannon capacity [2]. Second, it was shown that this performance gap to capacity can be greatly mitigated by using a feedback channel [3]. This second point prompted the development of several IR-HARQ optimization methods. The drawback of preallocating TOs to an IR-HARQ scheme, is that in the cases where the UE does not need all the TOs, these resources are effectively wasted, draining the system finite resources. To mitigate the amount of wasted resources, the NR enables a CG to be defined to a group of UEs instead of only one. Several group CG (GCG) schemes can be found in the literature [4] [5]. All these works rely on a variety of retransmission schemes. To mitigate the latency overhead of waiting for feedback before initiating the next transmission, some works employ blind retransmission schemes on shared resources, which results in collisions. Conversely, others wait for the feedback, possibly avoiding collisions but suffering from feedback delay overhead. Hence, one must choose between waiting for the feedback signal or allowing collisions, which lowers the reliability.
In summary, sources of delay, such as the feedback latency and the uplink access time are undesirable, especially on URLLC. In this work, we propose a GCG scheme that relies on a stop-and-wait IR-HARQ and can eliminate the feedback latency overhead, by pipelining the transmission of multiple users. We also consider the combination of this scheme with MU-HARQ [5]., improving both the energy efficiency and the latency performance.

Keywords: *URLLC, low-latency, grant-free, multi-user, control-networks, multi-user diversity, real time wireless communications.*

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Acknowledgements. This work is funded by Fundação para a Ciência e a Tecnologia (FCT) through the doctoral grant

2020/06241/BD and REVOLUTION project 2022.08005.PTDC.

3D Optical Wireless Communications Enabled By Unmanned Aerial Vehicles

Nwanze J. Nzekwu†,1, Fernando P. Guiomar⋆,1, Paulo P. Monteiro1

1. Instituto de Telecomunicações, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro

⋆ Corresponding author; guiomar@av.it.pt; † Presenting author; Telecommunications - MAP-tele.

Abstract. Free Space Optical (FSO) communications offer a solution to high-speed communications, offering terahertz point-to-point transmission for metropolitan, industrial, and space-based connectivity [1,2]. Nonetheless, line-of-sight obstruction by geophysical infrastructure poses a key challenge. A 3D FSO communication architecture using a vertically deployed Unmanned Aerial Vehicle (UAV) platform relaying FSO transmissions between terrestrial terminals without direct visibility, circumvents obstacles and is adaptable to relevant scenarios including disaster relief, high-altitude fronthaul/backhaul networks/swarms, and satellite communications [3].
Current UAV-assisted FSO relay systems employ non-actuated, passive payloads like Modulating Retro-reflectors (MRR) for simplicity [4]. However, these force a co-located ground terminal configuration, limiting the field of view (FOV) and hindering practical communication between separated terminals.
Owing to UAV dynamics, Pointing, Acquisition, and Tracking (PAT) activities must maintain a tight link alignment between the platform and terminals, accurately locating smaller air-to-fiber optical receiver apertures required to integrate multi-Gigabit coherent communication technologies. Conventional approaches confine PAT mechanisms to ground terminals, allowing tracking lags, leading to potential communication disruption.
Furthermore, atmospheric turbulence introduces signal distortion and power loss, thus its effects must be modeled and compensated. However, the platform dynamics aggravate these effects making traditional statistical models inaccurate [5]. Although machine learning methods leveraging experimental transmission data to model the effects show promise [6,7], their complexity and reliance on extensive datasets underscores the need for more efficiency.
Thus, this PhD aims to integrate a vibration-aware Fast Steering Mirror (FSM) payload capable of beam steering, stabilization, and agile PAT. This can synchronize with terrestrial advanced optical communications apparatus to correct/compensate signal impairments, minimize disruptions, and incorporate Wavelength Division Multiplexing (WDM) techniques to foster multi-Terabit rates. Moreover, turbulence effects will be addressed by employing Recurrent Neural Networks (RNNs) that can quickly adapt to smaller data sets [8]. Implementing these solutions will advance 3D FSO communications relay for future vertical architectures.

Keywords: *Free Space Communications, FSO, Unmanned Aerial Vehicles, UAV, Pointing Acquisition and Tracking, PAT*

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Acknowledgements. The authors gratefully acknowledge the financial support by FEDER, through the CENTRO 2020 programme, project ORCIP (CENTRO-01-0145-FEDER-022141), the MSCA RISE programme through project DIOR (grant agreement no. 101008280), and by FCT/MCTES through project OptWire (PTDC/EEI-TEL/2697/2021). Gil M. Fernandes acknowledges a contract program from FCT with code 2022.07168.CEECIND.

Block Chain Modelling and Optimization for Intelligent Digital Twin

Ayesha Jadoon†,1, Professor Daniel Corujo[2], Professor Shahid Mumtaz[2], Professor Rui Luis Andrade Aguiar [2]

1.
2. University of Aveiro

⋆ Corresponding author; † Presenting author; Telecommunications - MAP-tele.

Abstract. Integrating the Internet of Things (IoT), Artificial Intelligence, and software analytics into Digital Twin technology can revolutionize various industries, enhancing productivity and optimization processes. These innovations have been set to play an important role in shaping Industry 5.0 by enhancing efficiency and innovation [1]. However, as the Industrial IOT (IIOT) network continues to increase, optimizing networks and ensuring secure data transmission among interconnected IIOT nodes is a big challenge [2]. It is difficult to optimize the network and ensure secure transmission when the number of industrial IoT nodes increases [4].In early technologies, there was a lack of practical and reliable applications due to limited resources and unreliable channels in IoT [3]. So, we propose the Digital Twin Wireless network by incorporating Digital Twin technology integrated with the wireless network to transfer real-time data into digital data space effectively and securely. The proposed technology is a physical system with a digital strategy that enables nearest-instant and highly reliable wireless connectivity and communication in IoT. The proposed technology reduces latency and reliability by integrating wireless networks with digital twins.
A new paradigm for distributed AI algorithms has emerged to enhance data protection [4]. Due to privacy risks, existing federated learning-based models require only transmitting the locally trained parameters to the server while the original is stored with the user [4]. To overcome this problem, AI algorithms and enhanced data privacy assurance blockchains are offered [5].
The proposed architecture complement formulated a digital twin model by integrating it with a wireless network and blockchain for reliable, long-distance communication between the end user and edge servers, in wireless networks. We first introduce a digital twin with a wireless network of end users and base stations. Then for more secure data transmission, we integrate with a blockchain algorithm. Blockchain technology for secure transmission avoids data leakage in centralized servers. We exploit the machine learning algorithm to find an optimal solution for the problem, optimizing the network usage as well as the services running in it. The real-world dataset shows improved performance, reduced latency, and optimization compared to the previous techniques.

Keywords: *Digital twin, Wireless network, BlockChain*

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Acknowledgements. This work was supported by the European Unions Horizon Europe Marie Skodowska
Curie Action SCION under No. 101072375.
The author would like to thank to SCION family and teachers for their continuous support, patience, and motivation, to start this work and write up the paper.

Machine Learning for Radio Resource Allocation in Physical-Layer Network Coding-Enabled Mobile Networks

Ehsan Atefat Doost[†,⋆,1], Professor Jonathan Rodriguez[2], Antonio Navarro[3], Dr. Firooz Saghezchi

1. PhD student
2. Senior Researcher
3. Associate Professor

⋆ Corresponding author; † Presenting author; Telecommunications - MAP-tele.

Abstract. Relay communications is an effective technique to extend the coverage and capacity of wireless networks. Generally, two types of relay communication networks exist one-way relay channel (OWRC) and two-way-relay channel (TWRC). OWRC needs four time slots for exchanging information between a pair of user equipment (UEs). In contrast, TWRC needs only two time slots for completing the same information exchange. In the first time slot, known as the multiple access phase, both UEs simultaneously transmit their signals to the relay. In the second time slot, which is called the broadcast phase, the relay broadcasts the physical layer network-coded (PNC) signal to the UEs. Each UE uses this PNC signal to extract their peers data [1], [2]. Radio resource allocation (RRA) schemes are crucial in the performance optimization of wireless networks, and they are used to optimize an objective function, e.g., spectral/energy efficiency, under some constraints (fairness, transmit power, and so on). However, many RRA algorithms lead to a non-convex mixed integer nonlinear programming (MINLP) problem, which is NP-hard. Therefore, conventional optimization solvers end up in suboptimal solutions and fail to achieve globally optimal solutions in a realistic time frame, if they achieve any. In some scenarios, where the RRA problem may not be well-defined mathematically (e.g., due to the nonstationary and dynamic nature of the propagation environment and the mobility of the users), we may not be able to solve the underlying optimization problem with the desired accuracy. In addition, the computational complexity of well-known global optimization algorithms, e.g., the branch-and-bound algorithm, is exponential. Consequently, most of the existing solutions are limited to sub-optimal or heuristic algorithms. Nevertheless, the performance gap between these sub-optimal or heuristic algorithms to the optimal solution is usually difficult to quantify and control [3].Furthermore, mobile systems are becoming increasingly complex with different technological advancements, e.g., massive MIMO and reconfigurable intelligent surfaces to offer heterogeneous services with extreme and sometimes conflicting requirements (e.g., URLLC and Metaverse). This adds further challenge to RRA algorithms.Therefore, 6G networks call for new models and solutions for RRA and network management. To this end, machine learning is a promising tool that can extract knowledge from the system by gradual learning in the presence of inherent uncertainties. This PhD thesis aims to develop novel deep learning models to continuously learn and optimize resource allocation strategies in a dynamic environment in B5G/6G scenarios.

Keywords: *6G, Relay networks, Physical layer network coding, Radio resource allocation, Artificial intelligence, Machine Learning*

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Acknowledgements. The study is funded by the Fundação para a Ciência e a Tecnologia (FCT-Portugal) through the PhD grant with reference No. 2021.08263.BD.

A Packet-based Analog m-CAP Visible Light Communication System for IoT

Luís Rodrigues[†,1], Mónica Figueiredo[2], Luís Nero Alves[1]

1. Department of Electronics, Telecommunications and Informatics, University of Aveiro, 3810-193 Aveiro, Portugal
2. School of Technology and Management, Polytechnic of Leiria, 2411-901 Leiria, Portugal

⋆ Corresponding author; † Presenting author; Telecommunications - MAP-tele.

Abstract. This work introduces an algorithm for data clock synchronization in a hybrid multiband carrierless amplitude and phase (m-CAP)/quadrature amplitude modulation (QAM) system tailored for visible light communication (VLC) based Internet of Things (IoT) applications. With the progressive integration of Internet connectivity in electronic devices, the demand for reliable and efficient communication methods has grown. While RF-based communications currently dominate IoT applications, fail to cope with packet collision and spectrum limitations. VLC, utilizing LEDs for data transmission, emerges as a promising alternative for indoor IoT scenarios, mainly due to its directional propagation and unregulated spectrum. The synchronization of data clocks between the transmitter (Tx) and the receiver (Rx) is critical for reliable data transmission. However, existing synchronization methods like phase-locked loops (PLLs) or maximum likelihood estimation (MLE) usually require high-speed processing, thus they are not suitable for low-cost microcontroller implementation. The proposed algorithm focuses on achieving data clock synchronization with low-cost microcontrollers by structuring the data symbols into data packets with a synchronization header, allowing the Rx to synchronize at the beginning of each frame. Simulation results demonstrate the algorithm's performance in terms of frame error rate (FER), showing that synchronization can be achieved with a clock mismatch tolerance of up to 4200 ppm, supporting frames with a payload length of up to 624 octets. Additionally, by employing averaging window sampling instead of single-sample acquisition of each data symbol, the payload length can be extended by approximately 208 octets, reducing header to payload ration, thus enhancing system efficiency. Experimental results show a degradation of the synchronization algorithm accuracy related to jitter in the demodulated symbols, mainly due to intersymbol interference (ISI) from the Rx analog filters. Instead of using only one sample per data symbol, oversampling the symbols, and the provisioning of a tolerance for data clock recovery improves the algorithm performance. Experimental results indicate that the algorithm successfully synchronizes the data clock, ensuring error-free payload transmission for short distances. However, FER increases with distance due to noise and jitter, highlighting sensitivity to the channel impairments, as expected. Regarding the jitter issues, it was observed that by employing margin samples, the algorithm performance was improved from. In conclusion, the proposed algorithm offers a practical solution for data clock synchronization in hybrid m-CAP/QAM VLC systems, suitable for the IoT requirements of simplicity and low-cost.

Keywords: *Visible light communications, Internet of Things, data clock synchronization*

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Acknowledgements. This paper was raised under the frameworks of the COST Action NEWFOCUS (CA19111), supported by COST (European Cooperation in Science and Technology). This work is funded by FCT/MCTES through national funds and when applicable co-funded EU funds under the project UIDB/50008/2020-UIDP/50008/2020. The work of Luís Rodrigues was supported by the Fundação para a Ciência e Tecnologia (FCT), through the European Social Fund, under the PhD Grant 2022.12956.BD.

Tourism

Factores de lealdade em eventos de tango

Marisa Pelicano[†,1]

1. University of Aveiro

⋆ Corresponding author; † Presenting author; Tourism.

Abstract. Com a evolução continuada da tecnologia e a diminuição das horas de trabalho semanal, verificou-se, no séc. XX, um aumento significativo do tempo de lazer (Jefferson, 1991 e Steinecke, 1993). Nessa sequência, verificou-se o aumento do interesse, de uma parte da população, em explorar os seus interesses do tempo de lazer de forma mais séria - serious leisure (Stebbins, 1992). Registou-se, aliás, desde os anos 80, um aumento da procura por culturas corporais e de movimento estrangeiras (ex.: salsa, yoga, capoeira, flamenco, etc.) (Anzaldi, 2012), que desenvolve os seus interesses de lazer, não só na sua área de residência, mas que também viaja com esse objectivo - são disso exemplo os praticantes de tango (Skinner, 2018). Assim, e uma vez que o turismo de dança representa um campo de investigação pouco desenvolvido (Thimm, 2014), praticamente qualquer investigação desenvolvida nesse sentido será útil (McCleary et al., 2005).

Posto isto, com o objectivo de colmatar, de alguma forma, a limitação anteriormente apontada, optou-se por desenvolver um trabalho de investigação no âmbito dos eventos e festivais de dança, com especial enfoque no tango, que permita perceber, especificamente no que respeita aos participantes activos, que factores os levam a repetir a participação no mesmo evento inúmeras vezes ao longo do tempo.

Para se atingir o objectivo proposto, pretende-se implementar uma metodologia mista aplicação de entrevistas semi-estruturadas e inquéritos por questionário junto dos praticantes de tango. Tanto as entrevistas como os inquéritos por questionário serão implementados online com o objectivo de se obter uma população o mais abrangente possível.

Keywords: *dance tourism, events, festivals, tango*

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Acknowledgements. Gostaria de deixar um especial agradecimento à minha orientadora, Professora Maria João Carneiro, que tem sido fundamental na definição dos caminhos a seguir nesta investigação, praticamente desde o momento em que fui aceite no Programa Doutoral em Turismo. Não posso também deixar de agradecer à minha co-orientadora, Professora Celeste Eusébio, todos os seus inputs.

New network-based tourism governance models for coastal areas: the case of Barra/Costa Nova

Ana Luz[†,⋆,1], Filipa Brandão[2]

1. a.luz@ua.pt
2. filipa.brandao@ua.pt

⋆ Corresponding author; a.luz@ua.pt; † Presenting author; Tourism.

Abstract. Coastal governance faces significant challenges arising from the environmental, economic, and social complexity of coastal zones. The increasing pressure on these ecosystems, exacerbated by climate change and the rise in human activities, underscores the urgent need for innovative and adaptable management strategies. In this context, governance networks emerge as solutions capable of integrating multiple actors and facilitating inclusive and adaptive decision-making. This research focuses on the analysis of governance networks in Barra Costa Nova, a region distinguished by its unique biodiversity and intense economic and tourist development. The investigation aims to identify and evaluate the mechanisms through which governance networks can encourage innovative management practices, addressing local challenges and contributing to long-term sustainability. Adopting network analysis, an interdisciplinary approach will be used to quantify interactions between actors, employing metrics such as centrality, network density, and cohesion. The literature review reveals a significant gap in understanding how specific governance networks can be effectively applied in the context of coastal zones. This research aims to fill that gap, providing new insights into the effectiveness of networks in facilitating adaptive and inclusive decision-making processes. It is expected that the results of this research will offer significant contributions to the academic literature and inform coastal governance policies, promoting resilience, sustainability, and equity. Additionally, the generated results may guide more informed and effective strategies for coastal management, essential for climate change adaptation and sustainability. This research expands the theoretical and practical understanding of coastal governance and suggests future directions for comparative investigations in different coastal areas, fundamental for the evolution of governance practices at a global level.

Keywords: *Governance; Network Analysis; Coastal Zones; Barra/Costa Nova.*

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The critical success factors for tourism routes development

Filomena Martins[1], Zélia Breda[2], André Pedrosa[†,⋆,3]

1. Departamento de Ambiente e Ordenamento
2. Departamento de Economia, Gestão, Engenharia Industrial e Turismo
3. Departemento de Economia, Gestão, Engenharia Industrial e Turismo

⋆ Corresponding author; pedrosa.andre@ua.pt; † Presenting author; Tourism.

Abstract.
Tourism routes are the result of collaborative efforts between stakeholders to achieve common goals (UNWTO & ETC, 2017). These initiatives focus on enhancing tourism products and facilitating knowledge exchange through marketing campaigns and territorial development projects (Cloutier et al. 2019; Del Chiappa et al. 2019). However, despite their potential benefits, there is limited research on the factors that influence their overall success, in particular their critical success factors (CSFs) (Marais et al. 2017).
Five case studies were examined, each representing different themes, locations, implementation areas and organisational structures (UNWTO & ETC, 2017). Data was collected through semi-structured interviews with 31 current and former route members, conducted between May and December 2022. The interviews were guided by a structured questionnaire covering topics such as route objectives, perceptions of performance, CSFs and recommendations for future improvements. In addition, official documents, websites and promotional material from the case studies were analysed. The content of both interviews and official documents was analysed using WebQDA software (Costa E Amado, 2018).
The main findings highlight the CSFs for the development of tourism routes, which are organised into a conceptual model that includes product, objectives, resources, governance, activities and performance evaluation. The differences between routes are found to be related to specific objectives and contexts rather than to route typology. For example, objectives such as promotion and territorial development influence activities and performance evaluation. Furthermore, linear routes tend to prioritise stakeholder relationships more than network routes.
This study contributes to the theoretical understanding of the success of tourism routes by providing a detailed perspective beyond the existing literature on wine routes. It highlights the importance of activities such as marketing and territorial development projects, rather than focusing primarily on stakeholder relationships (Cloutier et al. 2019; Del Chiappa et al. 2019).
The research provides practical recommendations for initiating and enhancing tourism routes, which can contribute to achieving the Sustainable Development Goals (SDGs) in tourism, in line with the objectives of these routes. In particular, it can support SDG 11 by promoting connections between urban and rural areas, and SDG 17 by promoting partnerships between stakeholders.
A potential limitation of this study is the possible selection bias of participants, as those who participated may be more actively involved in route activities, and there was a predominance of public stakeholders from European countries. Further confirmatory research could validate the relevance of these CSFs in different contexts.

Keywords: *Tourism management, Tourism routes, Formal networks, Public-private partnerships, Critical success factors, Tourism governance*

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Acknowledgements. This work was financially supported by the Portuguese Foundation for Science and Technology (FCT) under Grant number SFRH/BD/144716/2019 .

Forecasting tourism demand in Portugal using online information sources

Le Quyen Nguyen[†,⋆,1], Paula Odete Fernandes[2], João Paulo Teixeira[3], Carlos Costa[4]

1. UNIAG-Applied Management Research Unit Instituto Politécnico de Bragança, Instituto Politécnico de Bragança, 5300-253 Bragança, Portugal
2. UNIAG, Instituto Politécnico de Bragança, Bragança, Portugal
3. CEDRI, Instituto Politécnico de Bragança, Bragança, Portugal
4. GOVCOOP, Departamento de Economia, Gestão, Engenharia Industrial e Turismo, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

⋆ Corresponding author; nguyen@ua.pt; † Presenting author; Tourism.

Abstract.
Accurate forecasting of tourism demand is critical for businesses and destinations to effectively allocate resources and make wise planning decisions. Predicting the number of tourists remains challenging, especially during a time of increasing uncertainties. However, the rapid growth of online content brings new opportunities. As travellers extensively rely on search engines, social media, and user-generated content for trip planning, these sources offer valuable predictive data inputs. While some studies have explored similar approaches in other countries (Chen et al., 2024; Colladon et al., 2019; De Luca & Rosciano, 2024; Höpken et al., 2021; Sun et al., 2022), limited research has used internet-based data for tourism demand prediction in Portugal. Therefore, this research aims to improve tourism demand forecasting for Portugal by developing models that incorporate online metrics as inputs.
This study will collect a comprehensive tourism dataset from search engines (e.g., Google Trends), social media (e.g., Facebook), online ratings and reviews (e.g. TripAdvisor) and other metrics from major travel platforms. The influence of online data sources on tourism demand will be examined through both correlational analyses (e.g., Spearman's rank correlation) and techniques that explore potential causal relationships (e.g., Granger Causality Test). Robust methodologies for sentiment and quantitative analysis will be selected to assess the impact and forecasting power of these online variables on tourism demand indicators, namely the number of tourist arrivals across demographics and destinations in Portugal. Potential biases in online data, such as self-selection bias in reviews, fake content or language bias will be addressed through appropriate statistical techniques. Models based on artificial neural networks will be developed and evaluated against traditional time series methods like Autoregressive Integrated Moving Average models to determine the optimal forecasting approach using these online data inputs. Evaluation criteria will include accuracy measures (e.g., Mean Absolute Percentage Error), stability (e.g., data consistency across different time horizons), and interpretability of results (e.g, sensitivity analysis).
The expected contributions are threefold: 1) Examine the importance of incorporating online data sources to improve the accuracy of forecasting models for tourism demand in Portugal; 2) Identify the most suitable forecasting techniques given the nature of the online data inputs; and 3) Explain how online sources influence travel decisions and destination awareness across different demographic segments to tailor marketing efforts to attract diverse tourist populations. More reliable demand forecasts can help tourism stakeholders with solid planning, investments, and policy decisions in pursuit of a competitive and sustainable tourism industry.

Keywords: *forecasting, tourism demand, online data, Portugal, artificial intelligence*

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Acknowledgements. This work was supported by national funds through FCT/MCTES (PIDDAC): UNIAG, UIDB/04752/2020 (DOI 10.54499/UIDB/04752/2020) and UIDP/04752/2020 (DOI 10.54499/UIDP/04752/2020), and through the individual research grant UI/BD/154750/2023 of Le Quyen Nguyen.

Criação de valor social e desenvolvimento socioeconómico através do geoturismo em territórios de baixa densidade: O caso Geoparks da UNESCO em Portugal

Naír Balula Chaves[†,⋆,1], Rui Costa[2], Cristina Barroco[3]

1.
2. rui.costa@ua.pt
3. cbarroco@estgv.ipv.pt

⋆ Corresponding author; nairchaves@ua.pt; † Presenting author; Tourism.

Abstract. Este estudo visa investigar o papel do geoturismo na criação de valor social e desenvolvimento socioeconómico dos territórios classificados como Geoparks da UNESCO em Portugal. A questão central é: Que fatores impulsionam a criação de valor social através do geoturismo?
Será utilizada uma metodologia mista (entrevistas e questionários) para avaliar o valor social gerado pelo geoturismo. A investigação será aplicada aos seis Geoparks portugueses (Naturtejo, Arouca, Açores, Terras de Cavaleiros, Estrela, Oeste).Os objetivos incluem a identificação dos fatores que promovem a criação de valor social, bem como a análise dos indicadores socioeconómicos relevantes para compreender o contexto em que ocorre essa criação de valor. Serão explorados os processos de gestão e governança dos Geoparks, visando propor recomendações para maximizar os benefícios socioeconómicos do geoturismo.
Para avaliar o valor social serão abordados aspetos relacionados com a perceção de bem-estar, impacto económico, participação comunitária e práticas sustentáveis. As entrevistas serão realizadas com responsáveis dos Geoparks, representantes de empresas locais e associações comunitárias, focalizando-se na perceção de valor social, impacto económico, grau de envolvimento comunitário e práticas de conservação. Os questionários serão aplicados aos residentes, abrangendo aspetos como qualidade de vida, benefícios sociais, satisfação dos residentes e conscientização sobre conservação do património.
Dowling e Newsome (2010) argumentaram que o Geoturismo é crucial para estratégias de conservação e desenvolvimento socioeconómico e exploraram o impacto socioeconómico do geoturismo. Kim e Park (2023), destacam o potencial do turismo para melhorar as condições das comunidades locais, discutem as perceções dos residentes, concluindo que o geoturismo pode melhorar a sua qualidade de vida ao promover a identidade cultural e a coesão social. Ramkissoon (2023) apresentou um modelo conceitual dos impactos sociais percebidos do turismo, enfatizando que o geoturismo, pode ter um impacto positivo significativo na qualidade de vida dos residentes, melhorando a satisfação com a vida e o bem-estar social.
A criação de valor social, fundamentada na Teoria do Valor Social (Mulgan, 2010), implica gerar um impacto positivo na comunidade e envolve a implementação de projetos que promovem a inclusão social, melhoram a qualidade de vida e abordam questões sociais cruciais.
Visa contribuir significativamente para o avanço do conhecimento no campo do turismo, geoturismo e valor social. Ao fornecer uma análise detalhada dos impactos do geoturismo nos Geoparks da UNESCO em Portugal e propor recomendações práticas, a investigação oferece uma base sólida para a formulação de políticas e estratégias que promovam o desenvolvimento sustentável e inclusivo.

Keywords: *Turismo; Valor Social; Desenvolvimento Socioeconómico; Geoturismo; Geoparks.*

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Competition as a driving force behind automotive industrial clusters in the promotion and dynamisation of industrial, sports and automotive tourism.

Evandro Baía[†,1], Dr. Armando Vieira[⋆,1], Dra. Emese Panyik[2]

1. Departamento de Economia, Gestão, Engenharia Industrial e Turismo
2. Faculdade de Filosofia e Ciências Sociais

[⋆] Corresponding author; aluisvieira@ua.pt; [†] Presenting author; Tourism.

Abstract. Automotive industry is very important because it allows for the production of a comfortable and affordable mean of private transportation, therefore essential to soften the transport of people and merchandise.
The improvements made to make this a reality are through automotive racing, developed and researched in-house.
Competition is essential, it draws attention to the winners of these events, which are holders of tested technology which once applied to the real world, will increase the comfort of daily commuters.
Competition pushes innovation through industrial tourism, sports tourism and automotive tourism through brand history, brand exclusive events, museums, collectors, customers, and automotive sporting events.
Victory in various fields of motorsport gives prestige, visibility and fidelity to the brand, as well as connections with stakeholders and other brands present in the market.
the research questions are formulated as follows:
Does a relationship between the automotive industrial clusters, local population and local economy exist?
Does a relationship between automotive industrial clusters and heritage institutions exist? (corporative museums, private museums, collectors);
Does a relationship between automotive industrial clusters and innovation exist? (in-house innovation departments, universities and independent facilities)
Do automotive industrial clusters have socio-economical impacts on host locations by providing their services and products?The methodology to be used is of mixed character, one part through two questionnaires, directed to the selected brands and various departments and directed to the host population and most influential sectors, to understand the relations between brand and people in three large areas economy, society and innovation. Thus creating a model encapsulating these three variables, able to determine how impactful the cluster can be in the host location.The qualitative part will comprise key interviews to critical sections of the automotive cluster as also critical stakeholders in the tourism sector.
It is expected that this research provides the following contributions:
- development of a model, with worldwide application, able to estimate accurately, regarding these three conditions, whether it is possible to build a solid automotive industrial cluster from scratch.
- suggest guidelines to increase the relationships between businesses within the cluster.
- suggest strategies to attract other sectors, necessary for building new products, while innovating existing ones inside the cluster in order to contribute for industrial tourism, sports tourism and automotive tourism.
- boost local economy as well as local tourism, increase quality of life, and the cluster itself.
- promote the region as a significant actor in the automotive industry.

Keywords: *Industrial Tourism, Sports Tourism, Automotive Tourism, Competition, Innovaiton*

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The use of digital technologies in destination management as enhancers of sustainable economic development in touristic coastal zones the case of Barra and Costa Nova

Margarida Cunha[†,⋆,1], Hélder Caixinha[2], Carlos Costa[3]

1. Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), DigiMedia - Department of Communication and Art
2. DigiMedia - Department of Communication and Art
3. Department of Economics, Management, Industrial Engineering and Tourism (DEGEIT), Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP)

⋆ Corresponding author; m.cunha@ua.pt; † Presenting author; Tourism.

Abstract. Tourism is a fast-growing sector, with 80% of activities occurring in coastal areas, which have sensitive ecosystems. Developing and implementing sustainable management practices in these areas is crucial due to their vulnerability to tourism's negative impacts. Effective management and planning can minimize these impacts and enhance positive outcomes (Archer et al., 2012). Sustainable management of coastal tourist destinations is vital to mitigate often overlooked negative impacts (Moritz et al., 2014). Digital technologies can provide innovative solutions to monitor and manage tourism's environmental impact, promoting a balanced and efficient approach (Buhalis & Amaranggana, 2013). The adoption of digital technologies in sustainable tourism is still in its early stages, requiring more theoretical and conceptual research (El Archi et al., 2023; Özköse et al., 2023). Therefore, this research aims to examine how digital technologies can enhance sustainable management practices in coastal tourist destinations, fostering sustainable economic development aligned with Sustainable Development Goal 9, promoting innovation and digitalization in tourism.

The first step involves a literature review on current trends in digital technologies for destination management. The most suitable technologies will be selected based on relevance to sustainable management, level of innovation, and potential impact. Envisioned management practices include natural resource management, sustainable mobility, and community involvement. Following this, a semi-structured interview script will be developed and applied to stakeholders in Barra and Costa Nova (in Ílhavo), including technology experts, visitors, private companies, and local public organizations. The interview script will cover topics such as the adoption of technologies, motivations, challenges, advantages, and sustainable habits. Then the construction of questionnaires will incorporate information from the literature review and qualitative results from the interviews, forming specific and structured questions. These questionnaires will be administered in person and online to facilitate dissemination.

By analyzing the impact of these technologies, new insights into the connection between technological innovation and sustainability practices will be drawn, strengthening a robust theoretical foundation that unites these fields. Practically, the study will provide recommendations for tourist destination managers, demonstrating how digital technologies can improve management and sustainability. The results will aid decision-making, public policy formulation, and business strategies, offering clear guidelines on digital tool adoption. These recommendations will enhance the tourist experience, improve the management of natural and cultural resources, and promote sustainable tourism practices that benefit both the local community and visitors. Although focused on Barra and Costa Nova, the results are intended to be transferable to other coastal destinations.

Keywords: *Costal Tourism, Destination Management, Digital Technology, Sustainability, Economic Development*

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Acknowledgements. This study was funded by the PRR Plano de Recuperação e Resiliência and by the NextGenerationEU funds at Universidade de Aveiro, through the scope of the Agenda for Business Innovation ATT Agenda Mobilizadora Acelerar e Transformar o Turismo (Project no. 47 with the application C645192610-00000060).

Spatiotemporal Behavior of the Côa Valley Tourist

Ruta Correia[†,1], Rui Augusto da Costa[⋆,2]

1.
2. Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP), Aveiro University, Portugal

⋆ Corresponding author; † Presenting author; Tourism.

Abstract. This research examines the spatiotemporal behaviour of tourists in the Côa Valley, a UNESCO World Heritage site characterized by low-density and significant cultural heritage. These regions, despite their attractiveness, face socio-economic challenges including limited development, underinvestment, and an aging population. This study addresses the need for sustainable tourism strategies that leverage the unique attributes of such territories to foster regional growth.

The proposed solution involves a comprehensive analysis of tourist behaviours through innovative technologies. The use of GPS applications, social media analytics, and artificial intelligence will allow for real-time tracking and prediction of tourist movements. This approach not only aims to enhance the visitor experience but also ensures the efficient use of local resources.Methodologically, the research employs quantitative methods, combining GPS tracking, social media data analysis, and questionnaire surveys to gather comprehensive data on tourist movements and interactions. This triangulation of data sources aims to provide a robust analysis of spatiotemporal behaviours. Advanced data analytics, including artificial intelligence, will be utilized to interpret the complex datasets, enabling the prediction of movement patterns and the assessment of tourist interactions within the heritage site.
Expected results include detailed behavioural maps that will inform the development of targeted tourism management strategies. These strategies will likely mitigate the negative impacts of tourism and optimize economic benefits for the local community. By understanding and predicting tourist behaviour, the project aims to support the sustainable development of the Côa Valley as a low-density heritage destination.

Keywords: *Spatiotemporal Analysis, Tourist Tracking, Sustainable Destination Management and Planning, Low-Density Territory*

Measuring the value generation from the interrelation between the creative economy and tourism: An index proposal

Larissa Fernanda de Lima Almeida[†,⋆,1], Rui Augusto da Costa[1], Adriana F. Chim-Miki[1]

1. Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP), Aveiro University, Portugal
2. Federal University of Campina Grande, Brazil

⋆ Corresponding author; † Presenting author; Tourism.

Abstract. The connection between creativity and tourism has become an important driver of economic growth and cultural enrichment and garnered scholarly attention because of its multifaceted implications. The creative economy, which emphasizes innovation and intellectual capital, is a growing part of national economies and plays a crucial role in shaping the tourism landscape(Richards, 2020). As tourists increasingly seek authentic and immersive experiences, the demand for creative products and services is rising, amplifying the economic relevance of creative enterprises within tourist destinations(Richards, 2011). Integrating the creative economy with tourism generates social value beyond economic benefits, such as social inclusion, improved self-esteem, and residents' well-being. Previous studies have looked at the positive impacts of creative tourism on local development(Pimenta et al., 2021), the placemaking effects of this integration(Marques & Richards, 2048), and regenerative capacity of creative tourism (Duxbury et al., 2021). This research will address the lack of a framework for measuring these impacts by offering a method to quantify the social value generated by this integration.
The research will follow these steps:
1. Establish a strong theoretical background through a systematic literature review on the relationship between the creative economy and tourism.
2. Map the value generation matrix to reveal the value creation dynamics within these territories' networks. Data will be collected through semi-structured group interviews with stakeholders of creative destinations in Portugal. Social Network Analysis and Similarity Analysis techniques will be employed to analyze the data.
3. Validate the theoretical model using face validity, content validity ratio (CVR), and content validity index (CVI). Partial least squares path modeling will validate the models measurement and structural components.
4. Apply the mathematical formulation used by the World Economic Forum in the Travel & Tourism Development Index (TTDI) to create an index of creative tourism value creation to be available as a management tool.
The research findings will benefit practitioners by offering tools to evaluate and enhance creative tourism offerings, ensuring they deliver maximum value to tourists and local communities. It will provide policymakers with practical tools and insights to craft strategies fostering sustainable regional and local development. The study's outcomes will support future academic research in creative tourism and related fields, identifying key areas of value generation and impact, and opening new avenues for exploration and theoretical development. Ultimately, this research promises to advance the field of tourism studies by providing robust, actionable insights and fostering sustainable development through innovative, participatory methodologies.

Keywords: *Creative Economy; Value Generation; Tourism Destination; Society- centric tourism model; Sustainable development; Assessment.*

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Current templar products in tourism: A critical approach

Mafalda M. Nascimento[†,⋆,1], Carlos Costa[2], Filipa Brandão[2], Luís M. Figueira[3]

1. GOVCOPP-UA, L-Tour.ipt
2. GOVCOPP - Research Unit on Governance, Competitiveness and Public Policies, DEGEIT, University of Aveiro.
3. GOVCOPP - Research Unit on Governance, Competitiveness and Public Policies, DEGEIT, University of Aveiro. L-Tour.ipt - Tourism Laboratory, Polytechnic Institute of Tomar.

⋆ Corresponding author; † Presenting author; Tourism.

Abstract. Portugal is a country where the Knights Templar had a strong presence, since they were responsible for founding the nation. There is a vast heritage built by the medieval religious-military Order spread from the north to the south of Portugal. Nowadays, the military side of history is highlighted by the public organisation Turismo de Portugal as a tourist attraction to be favoured. The heritage, spread across areas of low population density, contributes to diversifying the offer, reducing seasonality and boosting local and regional development. The material and immaterial Templar heritage is already a strong factor of attraction in some places, with various structured products for different target audiences.
Several products based on the Templar legacy have been developed, including routes, multimedia and re-enactment events, such as the Templar Festival, the Templar Days, the Templar Route of Portugal, and TREF - Templars Route European Federation.
The aim of this study is to identify, characterise and analyse the various Templar products that Portugal has been offering, within the framework of the documents in force in the tourism sector, to reanalyse the Templar theme in the Military Tourism line.
The methodology used includes qualitative analysis of official documents and texts of official online pages. In addition, indirect participant observation made it possible to describe motivations and actions, under the scopus of the contents of the official document Strategy 2027. A critical analysis was made based on current tourism guidelines.
A limitation of this research is the authenticity and subjectivity that may be inherent, due to possible bias in the interpretation of observations. Quantitative studies will be carried out in the near future.
This study will open up the possibility of rethinking existing products, presenting proposals for innovation, involving governance and communities.

Keywords: *Military Tourism, Templar product, Network, Innovation.*

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Como a ligação dos residentes ao território se repercute na experiência turística? O caso da Fórmula 1, O Grande Prémio de Itália, Monza.

Gabriela Oriol[†,⋆,1], Zélia Breda[2], Maria João Carneiro[3]

1.
2. UA - DEGEI -Campus Universitário de Santiago, 3810-193 Aveiro, Portugal
3. Research Unit on Governance, Competitiveness and Public Policies (GOVCOPP)

⋆ Corresponding author; oriol@ua.pt; † Presenting author; Tourism.

Abstract. É indiscutível que as experiências turísticas são afeitadas pelas interações sociais que se geram entre residentes e turistas (Cohen, 1972), razão pela qual é essencial compreender estas relações para garantir o desenvolvimento sustentável e o sucesso de um destino turístico (Gretzel, 2011), uma vez que podem ter um impacto, tanto positivo como negativo, na experiência do visitante (Pulido & Navarro, 2014).
Do ponto de vista do turismo desportivo, é de vital importância gerir as relações entre a comunidade local, os gestores de eventos e as autoridades governamentais locais com os adeptos que frequentam o destino, a fim de garantir experiências sustentáveis e positivas (Gursoy & Rutherford, 2004).

Tendo isto em conta e tomando como estudo de caso a corrida de Fórmula 1: Grande Prémio de Itália, realizada na cidade de Monza, Itália, a investigação que se segue pretende responder à seguinte questão:
£Como é que o apego ao território que os residentes têm manifestado em atitudes, se repercute na experiência do turista no momento em que se dão as inter-relações sociais entre estes?
Em termos de objetivos: 1.- Procura-se identificar de que forma as inter-relações sociais entre residente e turista; neste caso adepto de desporto, podem representar um atrativo deste destino turístico, como fator que influencia a visita do território e na gestão sustentável do destino para alcançar o seu sucesso.
2.- Validar-se a relação entre o residente e o turista, ligada à qualidade da experiência e à sua satisfação, através do desenvolvimento de um modelo que permita a avaliação destas variáveis ao mesmo tempo que o turista se encontra no território e não posteriormente.

Keywords: *place attachment, local community, tourist experience, social interaction, sport tourism*

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Acknowledgements. As minhas orientadoras pelo inestimável apoio nesta pesquisa, à minha família, parceiros e amigos que do Chile puderam me inspirar a alcançar este desafio profissional.

Translation and terminology

Transcreation in advertising translation: quality evaluation in the age of human-centered AI

Ana L. Mouro[†,⋆,1], Katrin Herget[1]

1. University of Aveiro, Capus Universitário de Santiago, 3810-193, Aveiro, Portugal

⋆ Corresponding author; anamouro@ua.pt; † Presenting author; Translation and terminology.

Abstract. This study aims to investigate the transcreation of product brochures in the German-Portuguese language pair, with a focus on developing cross-cultural marketing communication strategies. Transcreation is broadly defined as "a translation-related activity that combines processes of linguistic translation, cultural adaptation and (re-)creation or creative re-interpretation of certain parts of a text."(Diaz-Millon & Olvera-Lobo, 2021, p. 347). Ongoing scholarly debates, as highlighted by Jimenez-Crespo (2024), discuss its role: while some regard transcreation as transformative and mediating, others argue that creativity is inherent to all translation, potentially diminishing transcreation's distinctiveness. Nonetheless, Jimenez-Crespo (2024) advocates for ongoing discourse due to transcreation's evolving nature, increasingly recognized as a form of "translation plus"in standards such as ISO:17100 (https://www.iso.org/standard/59149.html).
The methodology of this study comprises the compilation of a representative corpus of recent product brochures across diverse industries. These materials are carefully sourced from company websites, marketing departments of large corporations, among others. The corpus is then annotated using CATMA, an annotation tool selected for its efficiency in managing and organizing annotations.
The analysis phase involves both quantitative and qualitative approaches.
Quantitative assessment focuses on quantifying the frequency of transcreation strategies used for the text production in brochures and measuring textual modifications between the original German versions and their Portuguese transcreations. Qualitative analysis complements this by examining specific examples to identify the reasoning behind selected transcreation techniques.
Additionally, the study evaluates the role of artificial intelligence (AI) in the transcreation process, comparing AI-generated translations with human-transcreated texts to assess its impact on usability and compliance with pertinent quality standards.

Keywords: *Transcreation, Human-Centered AI, AI-generated translations, Advertising translation, Translation quality evaluation*

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A pilot test to assess the comprehension of subtitles for science dissemination films - methodological reflection

Claudia Ferreira[†,1], Teresa Alegre[⋆,1], Cláudia Martins[2]

1. Languages, Literatures and Cultures Research Centre (CLLC)
2. Research Centre in Basic Education (CIEB) and Languages, Literatures and Cultures Research Centre (CLLC)

⋆ Corresponding author; teresaalegre@ua.pt; † Presenting author; Translation and terminology.

Abstract. This proposal stems from an ongoing, exploratory research in the field of Audiovisual Translation (AVT) and its intersection with other areas of knowledge, namely Reception Studies and Science Communication (Di Giovanni, Orero & Agost, 2012, p.12).
Its relevance derives directly from this interdisciplinarity, which is still little studied in the Portuguese context, as well as from the need to improve scientific literacy in the country (PISA reports until 2022).
Methodologically, we therefore set out to reflect on how we can assess the perception and understanding of subtitles in science dissemination (SD) films.
In order to design a pilot test to be carried out with a random group of respondents, we selected a corpus of short film extracts in a foreign language (mainly Italian but also German, both being less familiar foreign languages in Portugal) and subtitled in Portuguese. We then created an alternative subtitle file for each of the extracts, based on current criteria regarding, on the one hand, rules for optimizing the reading of subtitles and, on the other, issues inherent to the film genre (SD documentary) and its discourse. Finally, we designed a questionnaire to assess the perception and comprehension of the corpus.
The results were two-fold: they revealed clear interference from subtitling in the perception and comprehension of these SD films and gave clues as to possible improvements, while indicating some methodological problems or inconsistencies.
With this reflection, we hope to understand the reasons behind these difficulties and to be able to look for a new methodological approach capable of evaluating the understanding of subtitling of audiovisual SD products in a more refined and scientifically sound manner.

Keywords: *Audiovisual translation, Interlingual subtitling, Reception studies, Science dissemination; Research methodology in translation studies and social sciences*

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European Portuguese and Cross-Linguistic Register Variation

Pedro Augusto Ferreira†,1

1. DLC

⋆ Corresponding author; † Presenting author; Translation and terminology.

Abstract. This presentation is based on a larger quantitative corpora study exploring the impact of register on cross-linguistic contrasts and properties of translations, i.e. variation, regarding Portuguese translations (and also German) of English registers. Against the backdrop of SFL situational context Field, the hypotheses consider: language-internal variation in originals; cross-linguistic variation in originals; variation between originals and translations. The amount of observations and the data sizes for comparable and reference components of the compiled corpus contain an average of 10 texts and 30,000 tokens for each subcorpora. Summarization of queried data (noun vs. verbal POS distribution per register; lexical variation between originals and translations, lexical item freq. ratio) is undertaken through measures of central tendency and statistical dispersion, as well as significance testing and hierarchical cluster analysis. The multivariate descriptive method of Correspondence Analysis is also included, for visualization matters. Some preliminary results for the variable Field and the register Fiction show that Portuguese translations seem to be more nominal and verbal than all other subcorpora, pointing to variation, also hinted at by the most frequent lexical items; more proximity among Portuguese than English and German clusters of lexical item frequency ratios, pointing to a less registerial and more cross-linguistic variation.

Keywords: *The field of fiction: preliminary results of a study on register variation of portuguese*

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Acknowledgements. Supported by FCT, Foundation for Science and Technology, under grant SFRH/BD/146578/2019.