Cecília Coelho

Ph.D in Mathematics

Postdoctoral Researcher at HSU-AI Institute for Artificial Intelligence, Faculty of Mechanical Engineering and Civil Engineering, Helmut-Schmidt University Hamburg, Germany
Invited Assistant Professor at Polytechnic Institute of Viana do Castelo, Portugal
Integrated Member at Centre of Mathematics, University of Minho (CMAT), Portugal

Citation Name: C. Coelho

SYNOPSIS

The present document reports the scientific and pedagogical activities carried out by me as a student, researcher, invited researcher, invited lecturer, invited assistant Professor and postdoctoral researcher at: the Department of Physics of University of Minho (UM); the Department of Mathematics of University of Minho (CMAT-UM); the HSU-AI Institute for Artificial Intelligence, Faculty of Mechanical Engineering and Civil Engineering, Helmut-Schmidt University Hamburg, Germany; the Department of Mathematics at the Polytechnic Institute of Viana do Castelo (IPVC).

I received my Ph.D in Mathematics from the University of Minho on the 16th January 2025. The scientific output deliveries in this period were: 6 papers in international peer-reviewed journals (all in Q1 and Q2 SCImago Journal Rank), 10 preprints, 11 full papers in peer-reviewed conference proceedings, 4 book chapters (where 3 of these 4 chapters are Lecture Notes), 20 invited talks, and +30 posters, abstracts and extended abstracts (and presentations) in workshops, national and international conferences proceedings. Furthermore, I am the author of +10 code repositories on *GitHub* and 5 datasets, publicly available on the *Kaggle* platform.
I successfully acquired funding for 4 research projects (where in 3 of these 4 research projects, I am the Principal Investigator) - in the field of Artificial Intelligence and Applied Mathematics - totalling a budget of ≈386 968€ (from the Portuguese Foundation for Science and Technology (FCT), Google and "la Caixa" Foundation | BPI).
My research has been positively received in the research community: the paper C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Neural Fractional Differential Equations: Optimising the Order of the Fractional Derivative." In: *Fractal and Fractional* 8.9 (2024), p. 529. DOI: 10.3390/fractalfract8090529 was selected as the Journal Issue Cover of Volume 8, Issue 9 (September 2024); the paper C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Enhancing continuous time series modelling with a latent ODE-LSTM approach." In: *Applied Mathematics and Computation* 475 (2024), p. 128727. URL: https://www.sciencedirect.com/science/article/pii/S0096300324001991 was selected as 1 of 4 highlighted papers (out of 68) in the Centre of Mathematics (CMAT) 2024 Annual Report; my project Artificial Intelligence for Optimising the Irrigation of Olive Orchards Resilient to Climate Change" was highlighted in the news section of the Portuguese Foundation for Science and Technology (FCT) website; my project proposal to Concurso Promove. O futuro do interior - Projetos Piloto 2024, Fundação "la Caixa" and FCT "Artificial Intelligence for Optimising the Irrigation of Olive Orchards Resilient to Climate Change" was positively evaluated and endorsed with a letter of support by the International Federation for Information Processing (IFIP) Technical Committee 12 (AI).

I supervised (or am currently supervising) 1 M.Sc. thesis in Mathematics and Computation (Department of Mathematics of the University of Minho) and 7 researchers, in the fields of Artificial Intelligence and Applied Mathematics.
I have taught 3 courses in Mathematics (in which in 2 of these I am the Coordinator of the Curricular Unit) and 2 invited lectures in Mathematics and Artificial Intelligence at university level. Additionally, I have taught 2 expert courses in Artificial Intelligence and

Numerical Methods (in which 1 of these was held at a top tier AI venue). From these, in total, I have developed 5 lecture materials and 2 online resources.

I have 2 published papers in journals ranked in the first two ranking quartiles of Journal Citation Reports (JCR):

- C. Coelho, M. Fernanda P. Costa, and L. L. Ferrás. "Neural Chronos ODE: Modelling bidirectional temporal patterns in time-series data." In: *Expert Systems with Applications* 273 (2025), p. 126784. ISSN: 0957-4174. DOI: https://doi.org/10.1016/j.eswa.2025.126784. URL: https://www.sciencedirect.com/science/article/pii/S0957417425004063
(JCR: 7.5 Q1: Computer Science, Artificial Intelligence) (CiteScore: 13.8) (SJR: 1.88, Q1: Computer Science, Artificial Intelligence; Computer Science; Computer Science, Applications)
(Citations: ISI WoS=0, Scopus=0, Google Scholar=1)
PDF
- C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Fractional Calculus Meets Neural Networks for Computer Vision: A Survey." In: *AI* 5.3 (2024), pp. 1391–1426. ISSN: 2673-2688. DOI: 10.3390/ai5030067
Indexing: Web of Science, SCOPUS (JCR: 3.1 Q2: Computer Science, Artificial Intelligence; Computer Science, Interdisciplinary Applications) (CiteScore: 7.2) (SJR: 0.76)
(Citations: ISI WoS=1, Scopus=1, Google Scholar=4)
PDF

EDUCATION

May 2022–Jan 2025

Ph.D. in Mathematics at University of Minho, Portugal
Thesis: "Neural Networks based on Differential Equations for Modelling Real Systems" under supervision of Professors Fernanda Costa (Associate Professor at the Department of Mathematics, University of Minho and Centre of Mathematics (CMAT), University of Minho) and Luís Ferrás (Assistant Professor at the Department of Mechanical Engineering, Section of Mathematics - FEUP, University of Porto and Centre of Mathematics (CMAT), University of Minho)
PDF

Jul 2020–Jan 2021

Specialised Studies Programme in Optimization Applied to Sciences and Engineering at University of Minho, Portugal Proof.

Sep 2018–Oct 2020

M.Sc in Mathematics and Computation at University of Minho, Portugal
Dissertation: "Machine Learning and Image Processing" under supervision of Professors Fernanda Costa (Associate Professor at the Department of Mathematics, University of Minho and Centre of Mathematics (CMAT), University of Minho) and Luís Ferrás (Assistant Professor at the Department of Mechanical Engineering, Section of Mathematics - FEUP, University of Porto and Centre of Mathematics (CMAT), University of Minho) PDF
https://hdl.handle.net/1822/73671 Proof.

Sep 2015–Jul 2018

B.Sc. in Physics at University of Minho, Portugal
Final Projetct: "Determining the Optical Properties of the Cornea" (original title in portuguese: "Determinação das Propriedades Óticas da Córnea") under supervision of Professor Sandra Franco (Assistant Professor at the Department of Physics, Univeristy of Minho and Centre of Physics of Minho and Porto Universities (CF-UM-UP)) PDF
Proof.

TEACHING POSITIONS

Mar 2025–current

Lecturer at Professorship of Computer Science in Mechanical Engineering in the Institute of Automation Technology, Faculty of Mechanical Engineering and Civil Engineering, Helmut-Schmidt University / Universität der Bundeswehr (University of the Federal Armed Forces) Hamburg, Germany (3h/week) Proof.
Subjects: Optimisation for Engineering (starts April 2025).

Sep 2024–current

Invited Assistant Professor at the Mathematics Department at the Polytechnic Institute of Viana do Castelo, Portugal Proof.
Subjects taught: Mathematics (program summary: introduction to mathematical language and logics, real-valued functions, derivatives, primitives, probability theory), Topics in Mathematics (program summary: probability theory and combinatorics, real-valued functions, derivatives, successions).

Sep 2024-Dec 2024

Invited Lecturer at the Mathematics Department at the University of Minho, Braga, Portugal Proof.
2h/week of exercises class of "Linear Algebra for Engineering" of the Bachelor's in Polymer Engineering, Bachelor's in Material Engineering and Bachelor's in Textile Engineering (program summary: matrices; systems of linear equations; determinants; vector spaces $\mathbb{R}^n$; eigenvalues and eigenvectors of a matrix; linear mappings from $\mathbb{R}^n$ to $\mathbb{R}^m$).

RESEARCH POSITIONS

Mar 2025–current

Postdoctoral Researcher at the HSU-AI Institute for Artificial Intelligence, Faculty of Mechanical Engineering and Civil Engineering, Helmut-Schmidt University / Universität der Bundeswehr (University of the Federal Armed Forces) Hamburg, Germany Proof.
Duties: research focused on Scientific-Machine Learning, Time-Series and Explainability for applications in real-world problems in engineering, science and finance. Teaching Mathematics, Computer Science and Artificial Intelligence related subjects. Applying for research projects funding from German funding agencies.

May 2022–Jan 2025

PhD Scholarship grant with reference 2021.05201.BD from the Foundation for Science and Technology (FCT), Portugal at the Centre of Mathematics (CMAT), University of Minho Proof.
Duties: teaching and research.
Work Developed: new neural network architectures for modelling differential equations to data, namely endpoint differential equations and fractional differential equations. Study of the existence and uniqueness of solutions for the differential equations modelled by the newly developed neural network architectures. New algorithms for incorporating constraints explicitly into neural networks for modelling real-world systems given by time-series data. Development of frameworks to incorporate expert-knowledge by combining classical optimisation algorithms and neural networks for climate change applications (climate AI). Supervision of under-graduate students (some of the supervised works were: using machine learning to solve the Navier-Stokes equations for modelling the blood flow in arteries; neural networks for the ethical optimisation of an hydroelectric central). Teaching 2h/week of exercises class of "Linear Algebra for Engineering" (program summary: matrices; systems of linear

equations; determinants; vector spaces $\mathbb{R}^n$; eigenvalues and eigenvectors of a matrix; linear mappings from $\mathbb{R}^n$ to $\mathbb{R}^m$).

Dec 2021–Apr 2022

Contracted Researcher at Tecminho and Centre of Mathematics (CMAT), University of Minho, Portugal
Project description: VALORAGUA - modernize, update and adapt a management software for the optimization of the hydrothermal electric power system, to the new current and future challenges. Development of a Graphical User Interface to ease the user's experience (developed using Flutter).
`https://cmat.uminho.pt/projects/valoragua` Proof.
Duties: research.
Work Developed: optimisation of the energy distribution system in Portugal (REN) - new optimisation and numerical procedures that take into account green energy (solar and wind), thermo-electric and hidro-electric energies. Code translation and optimization from Fortran 86 to Golang. Algorithm update to incorporate renewable energies and optimizing daily. Development of a cross-platform user interface in Flutter.

Nov 2020–Nov 2021 **Research fellowship** at Tecminho and Centre of Mathematics (CMAT), University of Minho, Portugal
Project description: VALORAGUA - modernize, update and adapt a management software for the optimization of the hydrothermal electric power system, to the new current and future challenges. Development of a Graphical User Interface to ease the user's experience (developed using Flutter).
`https://cmat.uminho.pt/projects/valoragua` Proof.
Duties: research.
Work Developed: optimisation of the energy distribution system in Portugal (REN) - new optimisation and numerical procedures that take into account green energy (solar and wind), thermo-electric and hidro-electric energies. Code implementation in Python of templates to input data of energy, granularity and prices information.

Nov 2019–Jul 2020

Research Internship in Machine Learning, Accenture Portugal, Braga
Master's dissertation entitled "Machine Learning and Image Processing" with the goal of detecting illegal swimming pools in satellite images using Artificial Intelligence using Machine Learning and Deep Learning methods. The final, delivered, product is a Deep Learning model (written in Python) specialized in the detection of swimming pools, along with a Graphical User Interface to ease the user's experience (developed using the Electron framework).
`https://hdl.handle.net/1822/73671` Proof.
Duties: research.
Work Developed: a Deep Learning model (written in Python) specialized in the detection of swimming pools, along with a Graphical User Interface to ease the user's experience (developed using the Electron framework).

RESEARCH VISITS

Feb–Mar 2024

Invited Researcher at the Institute of Automation Technology, Faculty of Mechanical Engineering and Civil Engineering, Helmut-Schmidt University / Universität der Bundeswehr (University of the Federal Armed Forces) Hamburg, Germany (hosts: Professor Oliver Niggemann and Bernd Zimmering) Invitation Letter
Duties: research and invited lecturer.
Work Developed: optimised implementation of a Fractional Differentials Equation solver in Pytorch, applications of Neural ODEs to cyber-physical systems. Invited lecture on ordinary/partial differential equations, numerical methods, fractional differential equations and Scientific-Machine Learning (Physics-Informed Neural Networks and Neural ODEs).

CURRENT RESEARCH INTERESTS

Machine Learning; Deep Learning; Optimisation for Machine Learning; Scientific-Machine Learning; Time-series; Knowledge Extraction; eXplainable AI; Climate AI; Differential Equations; Numerical Analysis; Numerical Methods; Applied Mathematics; Fractional Differential Equations; Mathematical Modelling; Constrained Optimisation

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Contents

Scientific Merit Dimension

VMC1 - SCIENTIFIC PRODUCTION

THESIS

2025

Ph.D. Thesis in Mathematics, University of Minho, Portugal: *Neural Networks based on Differential Equations for Modelling Real Systems* PDF

2020

Master Thesis in Mathematics and Computation, University of Minho, Portugal: *Machine Learning and Image Processing* PDF
`https://hdl.handle.net/1822/73671`

BOOKS

2025

2. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás. *The Symbiosis of Neural Networks and Differential Equations*, Springer Nature (in preparation)

2024

1. (Edited Book) C. Coelho, B. Zimmering, M. Fernanda P. Costa, L.L. Ferrás, O. Niggemann. *Proceedings of the 1st ECAI Workshop on "Machine Learning Meets Differential Equations: From Theory to Applications"*, Proceedings of Machine Learning Research Volume 255, PMLR
Found here.

PUBLICATIONS

Articles in International Journals (with referee):

2025

6. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "A Two-Stage Training Method for Modeling Constrained Systems With Neural Networks." In: *Accepted to Journal of Forecasting* (2024)
(JCR: 3.4 Q1: Economics; Management; Planning and Development) (CiteScore: 5.4) (SJR: 0.89, Q1: Mathematics, Modelling and Simulation Q2: Computer Science, Computer

Science Applications; Decision Sciences, Management Science and Operations; Decision Sciences, Research; Decision Sciences, Statistics, Probability and Uncertainty; Business Management and Accounting, Strategy and Management; Economics Econometrics and Finance, Economics and Econometrics)
(Citations: ISI WoS=0, Scopus=0, Google Scholar=0)

5. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Neural Fractional Differential Equations." In: *Accepted to Applied Mathematical Modelling* (2024)
(JCR: 4.4 Q1: Engineering, Multidisciplinary; Mathematics, Interdisciplinary; Mechanics) (CiteScore: 9.8) (SJR: 1, Q1: Mathematics, Applied Mathematics; Mathematics, Modelling and Simulation)

4. C. Coelho, M. Fernanda P. Costa, and L. L. Ferrás. "Neural Chronos ODE: Modelling bidirectional temporal patterns in time-series data." In: *Expert Systems with Applications* 273 (2025), p. 126784. ISSN: 0957-4174. DOI: https://doi.org/10.1016/j.eswa.2025.126784. URL: https://www.sciencedirect.com/science/article/pii/S0957417425004063
(JCR: 7.5 Q1: Computer Science, Artificial Intelligence; Engineering, Electrical and Electronic; Operations Research and Management Science) (CiteScore: 13.8) (SJR: 1.88, Q1: Computer Science, Artificial Intelligence; Computer Science; Computer Science, Applications; Engineering (miscellaneous))
(Citations: ISI WoS=0, Scopus=0, Google Scholar=1)
PDF

2024

3. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Fractional Calculus Meets Neural Networks for Computer Vision: A Survey." In: *AI* 5.3 (2024), pp. 1391–1426. ISSN: 2673-2688. DOI: 10.3390/ai5030067
Indexing: Web of Science, SCOPUS (JCR: 3.1 Q2: Computer Science, Artificial Intelligence; Computer Science, Interdisciplinary Applications) (CiteScore: 7.2) (SJR: 0.76, Q2: Computer Science, Artificial Intelligence)
(Citations: ISI WoS=1, Scopus=1, Google Scholar=4)
PDF

2. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Enhancing continuous time series modelling with a latent ODE-LSTM approach." In: *Applied Mathematics and Computation* 475 (2024), p. 128727. URL: https://www.sciencedirect.com/science/article/pii/S0096300324001991
Indexing: Zentralblatt MATH, Web of Science, SCOPUS, Mechanics, Applied Mechanics Reviews, MathSciNet (JCR: 3.5 Q1: Mathematics, Applied) (CiteScore: 7.9) (SJR: 1.03, Q1: Mathematics, Applied Mathematics; Mathematics, Computational Mathematics)
(Citations: ISI WoS=5, Scopus=7, Google Scholar=11)
PDF

1. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Neural Fractional Differential Equations: Optimising the Order of the Fractional Derivative."

In: *Fractal and Fractional* 8.9 (2024), p. 529. DOI: 10.3390/fractalfract8090529
Indexing: Zentralblatt MATH, Web of Science, SCOPUS (JCR: 3.6 Q1: Mathematics, Interdisciplinary Applications) (CiteScore: 4.6) (SJR: 0.65, Q2: Mathematics, Analysis; Mathematics, Statistics and Probability; Physics and Astronomy, Statistical and Nonlinear; Physics and Astronomy, Physics)
(Citations: ISI WoS=0, Scopus=0, Google Scholar=0)
PDF

Articles Submitted and Preprints - International Journals (with referee):

2024

10. C. Coelho, M. Fernanda P. Costa, and L. L. Ferrás. "Back to the Roots: A Suite of Xai Techniques for Understanding Neural Ordinary Differential Equations." In: *Submitted to IEEE Transactions on Visualization and Computer Graphics* (2024). DOI: 10.2139/ssrn.4691417 **(JCR: 4.7 Q1: Computer Science, Software Engineering; Computer Science, Software and Graphics Programming; Engineering, Electrical and Electronical) (SJR: 2.06 Q1: Computer Science, Software; Computer Science, Computer Graphics and Computer-Aided Design; Computer Science, Computer Vision and Pattern Recognition Signal Processing)**
(Citations: ISI WoS=0, Scopus=0, Google Scholar=0)

9. C. Coelho, M. Fernanda P. Costa, and L. L. Ferrás. "A Self-Adaptive Penalty Method for Integrating Prior Knowledge Constraints into Neural ODEs." In: *Submitted Applied Mathematics and Optimization* (2024). DOI: 10.48550/arXiv.2307.14940 **(JCR: 1.6 Q2: Mathematics, Applied) (CiteScore: 3.3) (SJR: 2.06 Q1: Mathematics, Applied Mathematics; Mathematics, Control and Optimization)**
(Citations: ISI WoS=0, Scopus=0, Google Scholar=0)

8. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Fractional Calculus Meets Neural Networks For Computer Vision: A Survey." In: *Preprints* (July 2024). DOI: 10.20944/preprints202407.0399.v1. URL: https://doi.org/10.20944/preprints202407.0399.v1

7. C. Coelho, M. Jing, M. Fernanda P. Costa, and L.L. Ferrás. "An Adaptive Hydropower Management Approach for Downstream Ecosystem Preservation." In: *arXiv preprint arXiv:2403.02821* (2024). URL: https://arxiv.org/pdf/2403.02821
(Citations: ISI WoS=0, Scopus=0, Google Scholar=1)

6. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Neural Fractional Differential Equations." In: *arXiv preprint arXiv:2403.02737* (2024). URL: https://arxiv.org/pdf/2403.02737
(Citations: ISI WoS=0, Scopus=0, Google Scholar=4)

5. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "A Two-Stage Training Method for Modeling Constrained Systems With Neural Networks." In: *arXiv preprint arXiv:2403.02730* (2024). URL: https://arxiv.org/pdf/2403.02730

(Citations: ISI WoS=0, Scopus=0, Google Scholar=0)

2023

4. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "The Influence of Neural Networks on Hydropower Plant Management in Agriculture: Addressing Challenges and Exploring Untapped Opportunities." In: *arXiv preprint arXiv:2311.13293* (2023). DOI: 10.48550/arXiv.2311.13293. URL: https://arxiv.org/pdf/2311.13293
3. C. Coelho, M. Fernanda P. Costa, and Luis L. Ferrás. "Enhancing Continuous Time Series Modelling with a Latent ODE-LSTM Approach." In: *CoRR* abs/2307.05126 (2023). DOI: 10.48550/arXiv.2307.05126. arXiv: 2307.05126. URL: https://arxiv.org/pdf/2307.05126
2. C. Coelho, M. Fernanda P. Costa, and Luis L. Ferrás. "Neural Chronos ODE: Unveiling Temporal Patterns and Forecasting Future and Past Trends in Time Series Data." In: *CoRR* abs/2307.01023 (2023). DOI: 10.48550/arXiv.2307.01023. arXiv: 2307.01023. URL: https://arxiv.org/pdf/2307.01023
1. C. Coelho, M. Fernanda P. Costa, and Luis L. Ferrás. "A Self-Adaptive Penalty Method for Integrating Prior Knowledge Constraints into Neural ODEs." In: *CoRR* abs/2307.14940 (2023). DOI: 10.48550/arXiv.2307.14940. arXiv: 2307.14940. URL: https://arxiv.org/pdf/2307.14940 v

Conference Proceedings (with referee):

2024

11. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Optimal Control of a Coastal Ecosystem Through Neural Ordinary Differential Equations." In: *Proceedings of the 1st ECAI Workshop on "Machine Learning Meets Differential Equations: From Theory to Applications"*. Ed. by Cecília Coelho, Bernd Zimmering, M. Fernanda P. Costa, Luís L. Ferrás, and Oliver Niggemann. Vol. 255. Proceedings of Machine Learning Research. PMLR, Oct. 2024, pp. 1–9. URL: https://proceedings.mlr.press/v255/coelho24a.html
(Citations: Google Scholar=0)
PDF
10. B. Zimmering, C. Coelho, and O. Niggemann. "Optimising Neural Fractional Differential Equations for Performance and Efficiency." In: *Proceedings of the 1st ECAI Workshop on "Machine Learning Meets Differential Equations: From Theory to Applications"*. Ed. by Cecília Coelho, Bernd Zimmering, M. Fernanda P. Costa, Luís L. Ferrás, and Oliver Niggemann. Vol. 255. Proceedings of Machine Learning Research. PMLR, Oct. 2024, pp. 1–22. URL: https://proceedings.mlr.press/v255/zimmering24a.html
PDF
9. C Coelho, M Fernanda, P Costa, and LL Ferrás. "The role of adaptive activation functions in fractional physics-informed neural networks." In: 3094.1 (2024). DOI: https://doi.org/10.1063/5.0210505
(Citations: Google Scholar=0)
PDF

8. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Consistency Matters: Neural ODE Parameters are Dependent on the Training Numerical Method." In: (2024). URL: https://openreview.net/forum?id=tPDA7Zt1bf
(Citations: Google Scholar=0)
PDF

7. C. Coelho, M Jing, M. Fernanda P. Costa, and L.L. Ferrás. "An Adaptive Hydropower Management Approach for Downstream Ecosystem Preservation." In: *ICLR 2024 Workshop: Tackling Climate Change with Machine Learning* (2024)
(Citations: Google Scholar=1)
PDF

6. C. Coelho, M. Fernanda P. Costa, and Luis L. Ferrás. "Tracing Footprints: Neural Networks Meet Non-integer Order Differential Equations For Modelling Systems with Memory." In: *Accepted to Tiny Papers @ ICLR 2024*. OpenReview.net, 2024. URL: https://openreview.net/forum?id=8518dcW4hc&noteId=xO6MHGD3s4
(Citations: Google Scholar=2)
PDF

2023

5. C Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "The influence of the optimization algorithm in the solution of the fractional Laplacian equation by neural networks." In: *AIP Conference Proceedings*. Vol. 2849. 1. AIP Publishing. 2023. DOI: 10.1063/5.0162230. URL: https://pubs.aip.org/aip/acp/article-abstract/2849/1/220002/2909119/The-influence-of-the-optimization-algorithm-in-the?redirectedFrom=fulltext
(Citations: Scopus=0 Google Scholar=1)
PDF

4. L Albuquerque, C Coelho, M. Fernanda P. Costa, L.L. Ferrás, and AJ Soares. "Improving public parking by using artificial intelligence." In: *AIP Conference Proceedings*. Vol. 2849. 1. AIP Publishing. 2023. DOI: 10.1063/5.0162231. URL: https://pubs.aip.org/aip/acp/article-abstract/2849/1/220003/2909120/Improving-public-parking-by-using-artificial?redirectedFrom=fulltext
(Citations: Scopus=1 Google Scholar=1)
PDF

3. DS Carrilho, C Coelho, M. Fernanda P. Costa, L.L. Ferrás, and AJ Soares. "Optimization of traffic lights using supervised learning." In: *AIP Conference Proceedings*. Vol. 2849. 1. AIP Publishing. 2023. DOI: 10.1063/5.0162229. URL: https://pubs.aip.org/aip/acp/article-abstract/2849/1/220001/2909118/Optimization-of-traffic-lights-using-supervised?redirectedFrom=PDF
(Citations: Scopus=0 Google Scholar=0)
PDF

2. C. Coelho, M. Fernanda P. Costa, and Luis L. Ferrás. "Prior knowledge meets Neural ODEs: a two-stage training method for improved explainability." In: *The First Tiny Papers Track at ICLR 2023, Tiny Papers*

@ ICLR 2023, Kigali, Rwanda, May 5, 2023. Ed. by Krystal Maughan, Rosanne Liu, and Thomas F. Burns. OpenReview.net, 2023. URL: https://openreview.net/pdf?id=p7sHcNt%5C_tqo
(Citations: Google Scholar=4)
PDF

2021

1. C. Coelho, M. Fernanda P. Costa, Luis L. Ferrás, and Ana Jacinta Soares. "Development of a machine learning model and a user interface to detect illegal swimming pools." In: *Proceedings of the 5th International Conference on Numerical and Symbolic Computing: Developments and Applications*. European Community on Computational Methods in Applied Sciences ECCOMAS. 2021. URL: https://hdl.handle.net/1822/75102
PDF

Book Chapters and Lecture Notes (with referee):

2024

4. C. Coelho, M. Fernanda P. Costa, and L. L. Ferrás. "The Influence of Neural Networks on Hydropower Plant Management in Agriculture: Addressing Challenges and Exploring Untapped Opportunities." In: *Artificial Intelligence for Knowledge Management, Energy and Sustainability*. Ed. by Eunika Mercier-Laurent, Gülgün Kayakutlu, Mieczyslaw Lech Owoc, Abdul Wahid, and Karl Mason. Cham: Springer Nature Switzerland, 2024, pp. 150–160. ISBN: 978-3-031-61069-1. URL: https://link.springer.com/chapter/10.1007/978-3-031-61069-1_11#citeas
Indexing: SCOPUS
(Citations: ISI WoS=0, Scopus=0, Google Scholar=1)
PDF

2023

3. C. Coelho, M. Fernanda P. Costa, and Luis L. Ferrás. "A Filter-Based Neural ODE Approach for Modelling Natural Systems with Prior Knowledge Constraints." In: *Machine Learning and Principles and Practice of Knowledge Discovery in Databases*. Ed. by Rosa Meo and Fabrizio Silvestri. Cham: Springer Nature Switzerland, 2025, pp. 349–360. ISBN: 978-3-031-74633-8
Indexing: SCOPUS (CiteScore: 1.1) (SJR: 0.203, Q3: General Mathematics Q4: General Computer Science)
(Citations: ISI WoS=0, Scopus=0, Google Scholar=0)
PDF

2021

2. M. Fernanda P. Costa, C. Coelho, and Luis L. Ferrás. "Optimisation Approach for Parameter Estimation of the Generalised PTT Viscoelastic Model." In: *Computational Science and Its Applications - ICCSA 2021 - 21st International Conference, Cagliari, Italy, September 13-16, 2021, Proceedings, Part IV*. ed. by Osvaldo Gervasi, Beniamino Murgante, Sanjay Misra, et al. Vol. 12952. Lecture Notes in Computer Science.

Springer, 2021, pp. 481–494. DOI: 10.1007/978-3-030-86973-1. URL: https://link.springer.com/chapter/10.1007/978-3-030-86973-1_34
Indexing: SCOPUS (JCR: 0.40 Q4: Computer Science, Theory and Methods) (SJR: 0.61, Q2: Computer Science (miscellaneous); Theoretical Computer Science)
(Citations: ISI WoS=5, Scopus=1, Google Scholar=2)
PDF

1. C. Coelho, M. Fernanda P. Costa, Luis L. Ferrás, and Ana Jacinta Soares. "Object Detection with RetinaNet on Aerial Imagery: The Algarve Landscape." In: *Computational Science and Its Applications - ICCSA 2021 - 21st International Conference, Cagliari, Italy, September 13-16, 2021, Proceedings, Part II*. ed. by Osvaldo Gervasi, Beniamino Murgante, Sanjay Misra, et al. Vol. 12950. Lecture Notes in Computer Science. Springer, 2021, pp. 501–516. DOI: 10.1007/978-3-030-86960-1. URL: https://link.springer.com/chapter/10.1007/978-3-030-86960-1_35
Indexing: SCOPUS (JCR: 0.40 Q4: Computer Science, Theory and Methods) (SJR: 0.61, Q2: Computer Science (miscellaneous); Theoretical Computer Science)
(Citations: ISI WoS=5, Scopus=4, Google Scholar=7)
PDF

Articles in Preparation - International Journals/Conferences (with referee):

4. B. Zimmering[12], C. Coelho[12*] , V. Gupta[13], M. Maleshkova[13], O. Niggemann[12]
Keywords: Forced Dynamical Systems; Laplace Transformation; Neural Networks; Scientific-Machine Learning
Targetted venue: European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases - ECML PKDD 2025
[1]HSU-AI Institute for Artificial Intelligence, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany
[2]Faculty of Mechanical Engineering and Civil Engineering, Chair of Automation Technology, Helmut-Schmidt-University
[3]Faculty of Electrical Engineering, Chair of Data Engineering, Helmut-Schmidt-University
*Centre of Mathematics of University of Minho (CMAT)

3. C. Coelho[123], M. Fernanda P. Costa[3], L.L. Ferrás[3]
Keywords: Optimal Control; Neural Networks; Scientific-Machine Learning
Targetted venue: Expert Systems with Applications
[1]HSU-AI Institute for Artificial Intelligence, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany
[2]Faculty of Mechanical Engineering and Civil Engineering, Chair of Automation Technology, Helmut-Schmidt-University
[3]Centre of Mathematics of University of Minho (CMAT)
Transport Phenomena Research Center (CEFT), Faculty of Engineering, University of Porto
ALiCE, Faculty of Engineering, University of Porto

2. C. Coelho[12] , O. Niggemann[12]

Keywords: Scientific-Machine Learning; Support Vector Machine
Targetted venue: Machine Learning
[1]HSU-AI Institute for Artificial Intelligence, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany
[2]Faculty of Mechanical Engineering and Civil Engineering, Chair of Automation Technology, Helmut-Schmidt-University
[3]Faculty of Electrical Engineering, Chair of Data Engineering, Helmut-Schmidt-University
Centre of Mathematics of University of Minho (CMAT)

1. V. Loureiro C. Coelho[123], M. Fernanda P. Costa[3], S. Faria[3], C. Ribeiro[3]
Keywords: Time-series; Knowledge Extraction; Climate AI; Deep Learning
Targetted venue: Workshop at the European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases - ECML PKDD 2025
[1]HSU-AI Institute for Artificial Intelligence, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany
[2]Faculty of Mechanical Engineering and Civil Engineering, Chair of Automation Technology, Helmut-Schmidt-University
[3]Centre of Mathematics of University of Minho (CMAT)

TALKS AND POSTERS

Invited Talks:

2024

20. "Descobrindo a Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *4º ano da Escola EB1 de Frossos, Conversar com um cientista, Centro de Ciência Viva de Guimarães, Guimarães, Portugal, 25th November* (2024) Proof.
19. "Descobrindo a Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *4º ano da Escola EB1 de Frossos, Conversar com um cientista, Centro de Ciência Viva de Guimarães, Guimarães, Portugal, 18th November* (2024) Proof.
18. "Descobrindo a Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *4º ano da Escola EB1 de Carrascal, Conversar com um cientista, Centro de Ciência Viva de Guimarães, Guimarães, Portugal, 4th November* (2024) Proof.
17. "Modelling Data with Fractional Differential Equations Using Neural Networks" In: *Workshop on Statistics and Data Science, University of Minho, Guimarães, Portugal, 24-25th October* (2024) Proof.
16. "Symposium on Navigating the 3rd Hype of AI: Empowering Humans - A Crucial Discussion for Our Future", NOVA University, Lisbon, Portugal (2024) Proof.
15. "Learning Fractional Differential Equations From Data" In: *Machine Learning in Infinite Dimensions Workshop, Bath, United Kingdom* (2024) Proof.

14. "Desvendando a Magia da Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *4º ano da EB1 de Merelim S. Pedro, Conversar com um cientista, Centro de Ciência Viva de Braga, Braga, Portugal* (2024) Proof.

13. "Desvendando a Magia da Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *2º/3º anos da EB1 Motelo, Conversar com um cientista, Centro de Ciência Viva de Guimarães, Guimarães, Portugal* (2024) Proof.

12. "Desvendando a Magia da Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *3º ano da Escola Básica N^a S^a Conceição, Conversar com um cientista, Centro de Ciência Viva de Guimarães, Guimarães, Portugal* (2024) Proof.

2023

11. "IA é Matemática. Redes Neuronais para a Modelação de Sistemas Reais." In: *VEM - Vamos Experimentar a UMinho, Department of Mathematics, University of Minho, Braga, Portugal* (2023) Proof.

10. "IA é Matemática. Redes Neuronais para a Modelação de Sistemas Reais." In: *For the 11th grade students of the St. Peter's International School at the Department of Mathematics, University of Minho, Azurém, Portugal* (2023) Proof.

9. "Neural Networks Meet Differential Equations for Real Systems Modelling" In: *Inserted in a course of the 3rd year Bachelor's in Applied Mathematics and Data Science, University of Trás-os-Montes e Alto Douro, Vila Real, Portugal* (2023) Proof.

8. "Video: Benefits of studying mathematics and real-life applications of mathematics. From mathematics to the world." In: *Mathematics International Day, University of Trás-os-Montes e Alto Douro, Vila Real, Portugal* (2023) Proof.

7. "Investigação em Matemática: testemunhos de alunos de doutoramento." In: *Centre of Mathematics (CMAT) Labs Fest, University of Minho, Braga, Portugal* (2023) Proof.

6. "Inteligência Artificial explicada às crianças: Como ensinar um computador a detetar a nossa face." In: *Conversar com um cientista, Centro de Ciência Viva, Braga, Portugal* (2023) Proof.

5. "Aplicações da Inteligência Artificial: sistemas de recomendação (redes sociais, plataformas de streaming, comércio eletrónico), classificação/deteção de objetos em imagem/vídeo e geração de conteúdo artificial/falso." In: *Investigadores voltam à escola, Escola Secundária de Caldas das Taipas, Braga, Portugal* (2023) Proof.

2022

4. "Round Table: À conversa com bolseiros." In: *Centre of Mathematics (CMAT) Labs Fest, University of Minho, Braga, Portugal* (2022) Proof.

2021

3. "Aplicações da Inteligência Artificial no processamento de imagem: condução autónoma e classificação/deteção de objetos em imagens." In: *Investigadores voltam à escola, Escola Secundária das Taipas, Braga, Portugal* (2021) Proof.

2. "Aplicações da Inteligência Artificial no processamento de imagem: condução autónoma e classificação/deteção de objetos em imagens." In: *Investigadores voltam à escola, Colégio La Salle, Barcelos, Portugal* (2021) Proof.

1. "A Successful Cooperation between Academia and Industry." In: *Encontro Nacional Sociedade Portuguesa de Matemática, Sociedade Portuguesa de Matemática, online* (2021) Proof.

Talks at International Conferences (presenter's name is underlined):

2024

15. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás "Tracing Footprints: Neural Networks Meet Non-integer Order Differential Equations For Modelling Systems with Memory". In: *ML-DE Workshop on "Machine Learning Meets Differential Equations: From Theory to Applications", co-located with ECAI 2024, Santiago de Compostela, Spain* (2024)

14. C. Coelho "Incorporating Prior Knowledge Into Neural Networks." In: *International Mentoring Foundation for the Advancement of Higher Education IMFAHE´s International Conference, online* (2024)

13. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás "Tracing Footprints: Neural Networks Meet Non-integer Order Differential Equations For Modelling Systems with Memory." In: *Tiny Papers @ International Conference on Learning Representations ICLR, Vienna, Austria* (2024)

12. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás "Consistency Matters: Neural ODE Parameters are Dependent on the Training Numerical Method" In: *Workshop AI4DifferentialEquations In Science @ International Conference on Learning Representations ICLR, Vienna, Austria* (2024)

11. C. Coelho, M. Jing, M. Fernanda P. Costa, L.L. Ferrás "An Adaptive Hydropower Management Approach for Downstream Ecosystem Preservation" In: *Workshop Tackling Climate Change with Machine Learning: Fostering the Maturity of ML Applications for Climate Change @ International Conference on Learning Representations ICLR, Vienna, Austria* (2024)

2023

10. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás "Not All Roses: The Impact of Neural Networks for Hydropower Plant Management in Agriculture." In: *Artificial Intelligence for Sustainability (AI4S) Workshop at the European Conference on Artificial Intelligence ECAI, Krakow, Poland* (2023)

9. C. Coelho "Neural Networks Based on Differential Equations for Modelling Real Systems." In: *Doctoral Consortium at the European Conference on Artificial Intelligence ECAI, Krakow, Poland* (2023)

8. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás "Prior Knowledge Meets Neural ODEs: A Two-stage Training Method for Improved Explainability."

In: *European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases ECML PKDD, Turim, Italy* (2023)

7. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás "A Filter-based Neural ODE Approach for Modelling Natural Systems with Prior Knowledge Constraints." In: *European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases ECML PKDD, Turim, Italy* (2023)
6. C. Coelho "Improving Neural ODEs Explainability: A Two-stage Training Method for Modeling Constrained Natural Systems." In: *PhD Forum at the European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases ECML PKDD, Turim, Italy* (2023)
5. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás "A Study on Adaptive Penalty Functions in Neural ODEs for Real Systems Modeling." In: *21st International Conference of Numerical Analysis and Applied Mathematics ICNAAM, Crete, Greece* (2023)

2022

4. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás "The role of adaptive activation functions in Fractional Physics-Informed Neural Networks." In: *20th International Conference of Numerical Analysis and Applied Mathematics ICNAAM, Crete, Greece* (2022)

2021

3. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás "The Influence of the Optimization Algorithm in the Solution of the Fractional Laplacian Equation by Neural Networks." In: *19th International Conference of Numerical Analysis and Applied Mathematics ICNAAM, Rhodes, Greece* (2021)
2. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás, A.J. Soares "Object Detection with RetinaNet on Aerial Imagery: the Algarve's Landscape." In: *21st International Conference on Computational Science and its Applications ICCSA, Cagliari, Italy* (2021)

Talks at National Conferences (presenter's name is underlined):

2021

1. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás, A.J. Soares "Development of a Machine Learning Model and a User Interface to Detect Illegal Swimming Pools." In: *5th International Conference on Numerical and Symbolic Computation Developments and Applications SYMCOMP, Évora, Portugal* (2021)

Posters:

2024

14. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Neural Networks Meet Fractional Differential Equations: A Learn-then-Discretise Approach to Complex Dynamics." In: *Machine Learning in Infinite Dimensions Workshop, Bath, United Kingdom* (2024). URL: `http://dx.doi.org/10.13140/RG.2.2.18965.54242`

13. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Neural Networks Meet Non-integer Order Differential Equations For Modelling Systems with Memory." In: *European Conference on Artificial Intelligence, Workshop on Machine Learning Meets Differential Equations, Santiago de Compostela* (2024)
12. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Optimal Control of a Coastal Ecosystem Through Neural Ordinary Differential Equations." In: *European Conference on Artificial Intelligence, Workshop on Machine Learning Meets Differential Equations, Santiago de Compostela* (2024). URL: http://dx.doi.org/10.13140/RG.2.2.14316.99201
11. E. Villar, C. Coelho, M. Fernanda P. Costa, and L. L. Ferrás. "Predicting Miranda's Hydropower Plant Inflow with Neural Networks." In: *Open Day of the Centre of Mathematics (CMAT) of University of Minho* (2024). DOI: 10.13140/RG.2.2.31094.20809. URL: http://dx.doi.org/10.13140/RG.2.2.31094.20809
10. C. Coelho, M. Fernanda P. Costa, and Luis L. Ferrás. "Not All Roses: The Impact of Neural Networks for Hydropower Plant Management in Agriculture." In: *SCI - Semana da Ciência e Inovação* (2024). DOI: 10.13140/RG.2.2.33648.67847
9. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Consistency Matters: Neural ODE Parameters are Dependent on the Training Numerical Method." In: *ICLR 2024 Workshop on AI4DifferentialEquations In Science* (2024). URL: http://dx.doi.org/10.13140/RG.2.2.13990.33602
8. C. Coelho, M Jing, M. Fernanda P. Costa, and L.L. Ferrás. "An Adaptive Hydropower Management Approach for Downstream Ecosystem Preservation." In: *ICLR 2024 Workshop: Tackling Climate Change with Machine Learning* (2024). DOI: 10.13140/RG.2.2.13111.33445. URL: http://dx.doi.org/10.13140/RG.2.2.13111.33445
7. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Tracing Footprints: Neural Networks Meet Non-integer Order Differential Equations For Modelling Systems with Memory." In: *Tiny Papers @ ICLR 2024* (2024). URL: http://dx.doi.org/10.13140/RG.2.2.35712.24327

2023

6. C. Coelho. "Neural Networks Based on Differential Equations for Modelling Real Systems." In: *26th European Conference on Artificial Intelligence ECAI 2023, Doctoral Consortium* (2023). DOI: 10.13140/RG.2.2.34018.71363/1. URL: http://dx.doi.org/10.13140/RG.2.2.33648.67847
5. C. Coelho, M. Fernanda P. Costa, and L. L. Ferrás. "Improving Neural ODEs Explainability: A Two-Stage Training Method for Modeling Constrained Natural Systems." In: *European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML PKDD), PhD Forum* (2023). DOI: 10.13140/RG.2.2.23911.42400. URL: http://dx.doi.org/10.13140/RG.2.2.23911.42400

2022

4. C. Coelho, M. Fernanda P. Costa, and L. L. Ferrás. "Fractional Physics Informed Neural Networks with adaptive activation functions: a numerical

study." In: *International Conference on Challenges in Numerical Analysis and Scientific Computing CNASC* (2022)

2021

3. C. Coelho, M. Fernanda P. Costa, and L. L. Ferrás. "Neural Networks and Fractional Differential Equations." In: *Open Day of the Centre of Mathematics (CMAT) of University of Minho* (2021). DOI: 10.13140/RG.2.2.26286.43843. URL: http://dx.doi.org/10.13140/RG.2.2.26286.43843
2. M. Fernanda P. Costa, C. Coelho, and L. L. Ferrás. "Parameter Estimation for Constitutive Differential Equations: An Optimization Approach." In: *Open Day of the Centre of Mathematics (CMAT) of University of Minho* (2021). DOI: 10.13140/RG.2.2.36352.76806. URL: http://dx.doi.org/10.13140/RG.2.2.36352.76806
1. C. Coelho, M. Fernanda P. Costa, L. L. Ferrás, and A. J. Soares. "Implementation of a Deep Learning model capable of detecting objects from satellite images." In: *Open Day of the Centre of Mathematics (CMAT) of University of Minho* (2021). DOI: 10.13140/RG.2.2.22930.99525. URL: http://dx.doi.org/10.13140/RG.2.2.22930.99525

ADVANCED TRAINING

Scientific Training Activities:

2024 "Quarter Course on Innovation, Entrepreneurship and Leadership" By: *International Mentoring Foundation For The Advancement Of Higher Education (IMFAHE)* Proof.

2023 "Workshop: Climate Change AI Summer School 2023." By: *Climate Change AI, online* (2023)

2021 "Workshop: EUROPT Summer School 2021." By: *International Centre for Mathematical Sciences UK, online* Proof.

2021 "Workshop: Qiskit Global Summer School on Quantum Machine Learning." By: *IBM Research, United States, online*

2021 "Workshop: HelloAI RIS Online Program - AI in Healthcare." By: *KTH Royal Institute of Technology Centre for Autonomous Systems and Leitat and Universiteit Maastricht and Debreceni Egyetem, online*

2021 "Seminar: Artificial Intelligence in Retail" By: *I2AI (International Association of Artificial Intelligence), Brasil, online*

2020 "Symposium: I2AI Artificial Intelligence Marathon - Portugal" By: *International Association of Artificial Intelligence), Brasil, online*

2019 "Seminar: Q Days 2019 - QuantaLab Workshop in Quantum Computation" By: *Centre of Mathematics (CMAT), University of Minho, Portugal*

2019 "Symposium: Data Science - Bridging Fundamental Research and Industry" By: *Laboratório de Instrumentação e Física Experimental de Partículas (LIP), University of Minho, Portugal* (2019)

2016 "Seminar: LightTalks - Careers in Photonics" By: *International Iberian Nanotechnology Laboratory, Portugal* (2016)

ONLINE MATERIAL

Datasets and Code Repositories:

2024

4. B. Zimmering, C. Coelho, and O. Niggemann. *FDE-CPS*. `https://github.com/zimmer-ing/FDE-CPS`. 2024
3. B. Zimmering, C. Coelho, and O. Niggemann. *FDEint*. `https://github.com/zimmer-ing/FDEint`. 2024
2. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. *NeuralFDE*. `https://github.com/CeciliaCoelho/neuralFDE`. 2024
1. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. *XNODE*. `https://github.com/CeciliaCoelho/XNODE`. 2024

2023

10. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. *NeuralChronosODE*. `https://github.com/CeciliaCoelho/NeuralChronosODE`. 2023
9. C. Coelho. *Code repository of "A Study on Adaptive Penalty Functions in Neural ODEs for Real Systems Modeling" paper*. `https://github.com/CeciliaCoelho/PriorKnowledgeNeuralODE`. 2023
8. C. Coelho. *Code repository of "Enhancing Continuous Time Series Modelling with a Latent ODE-LSTM Approach" paper*. `https://github.com/CeciliaCoelho/LatentODELSTM`. 2023
7. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. *Dataset: Damped Harmonic Oscillator Dataset*. `https://www.kaggle.com/ds/3147798`. 2023. DOI: `10.34740/KAGGLE/DS/3147798`
6. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. *Dataset: Synthetic Chemical Reaction*. `https://www.kaggle.com/ds/3010478`. 2023. DOI: `10.34740/KAGGLE/DS/3010478`
5. C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. *Dataset: World Population Growth*. `https://www.kaggle.com/ds/3010437`. 2023. DOI: `10.34740/KAGGLE/DS/3010437`

2022

4. C. Coelho, M. Fernanda P. Costa, and L. L. Ferrás. *Code repository of "The role of adaptive activation functions in Fractional Physics-Informed Neural Networks"*. `https://github.com/CeciliaCoelho/icnaam2022`. 2022

2021

3. C. Coelho. *Code repository of a Hydropower Optimization Project ("Otimização de Centrais Hidroelétricas" document in portuguese)*. `https://github.com/CeciliaCoelho/Hydropower-Optimization-Project`. 2020

2. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás, and A. J. Soares. *Dataset: Swimming Pool detection - Algarve's Landscape*. 2021. DOI: 10.34740/KAGGLE/DSV/2088783. URL: https://www.kaggle.com/dsv/2088783

1. C. Coelho, M. Fernanda P. Costa, L.L. Ferrás, and A. J. Soares. *Dataset: Swimming Pool Detection in Satellite Images*. 2021. DOI: 10.34740/KAGGLE/DSV/2080963. URL: https://www.kaggle.com/dsv/2080963

2020

1. C. Coelho. *Code repository with utility scripts for Machine Learning Datasets* https://github.com/CeciliaCoelho/Deep_Learning. 2020

Code Tutorials:

2024

4. C. Coelho, L.L. Ferrás. Jupyter notebook with a tutorial to solving differential equations in Python, coding Physics-Informed Neural Networks and coding Neural Ordinary Differential Equations (2024).
Find it here.

2020

3. C. Coelho. Practise coding exercises in Fortran (2020).
Find it here.

2. C. Coelho. Practise Machine Learning exercises with the Iris dataset (2020).
Find it here.

1. C. Coelho. Practise coding exercises of data structures and algorithms in Python (2020).
Find it here.

Other Online Resources:

- My research website, where I provide research and teaching material.
https://ceciliacoelho.github.io/

- My GitHub, where I provide code practise exercises and code implementations of my research papers.
https://github.com/CeciliaCoelho

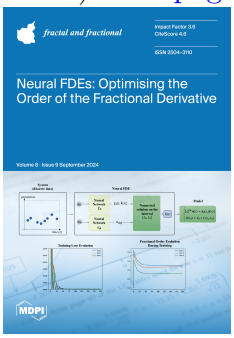
- My DEV page, where I share tutorials on Raspberry Pi and web scrapping.
https://dev.to/ceciliacoelho

AWARDS/SELECTIVE PROGRAMS

2024

9. The paper C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Enhancing continuous time series modelling with a latent ODE-LSTM approach." In: *Applied Mathematics and Computation* 475 (2024), p. 128727. URL: https://www.sciencedirect.com/science/article/pii/S0096300324001991 was selected as 1 of 4 highlighted papers (out of 68) in the Centre of Mathematics (CMAT) 2024 Annual Report PDF

8. The paper C. Coelho, M. Fernanda P. Costa, and L.L. Ferrás. "Neural Fractional Differential Equations: Optimising the Order of the Fractional Derivative." In: *Fractal and Fractional* 8.9 (2024), p. 529. DOI: 10.3390/fractalfract8090529 was selected as the Journal Issue Cover of Volume 8, Issue 9 (September 2024). Webpage



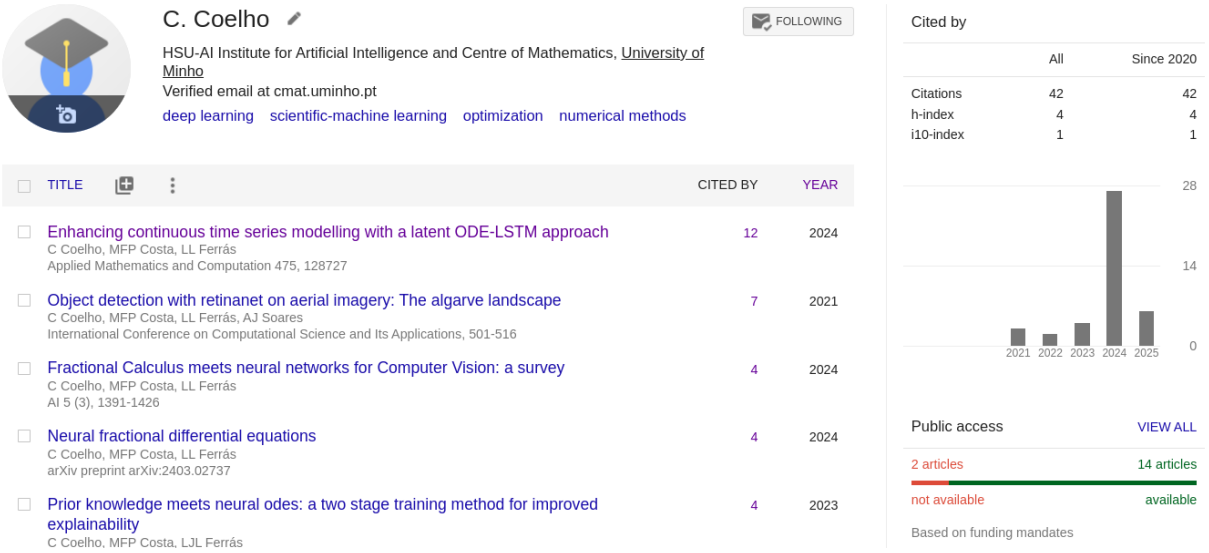
7. My project "Artificial Intelligence for Optimising the Irrigation of Olive Orchards Resilient to Climate Change" was highlighted in the news section of the Portuguese Foundation for Science and Technology (FCT) website. See the news article.
6. "Full grant for participation in the Machine Learning in Infinite Dimensions Workshop, Bath, United Kingdom, 5-9 August 2024"
5. My project proposal to *Concurso Promove. O futuro do interior - Projetos Piloto 2024, Fundação "la Caixa" and FCT* "Artificial Intelligence for Optimising the Irrigation of Olive Orchards Resilient to Climate Change" was positively evaluated and endorsed with a letter of support by the International Federation for Information Processing (IFIP) Technical Committee 12 (AI) Proof
4. "Finalist team of the IMFAHE's Idea Competition-Nodal Award/Shark Tank Edition 2024", By: IMFAHE Foundation Proof.
3. "Mentorship program." By: *ICLR 2024 "Tackling Climate Change with Machine Learning" workshop*, Mentorship by: Ming Jin, Assistant Professor at the Bradley Department of Electrical and Computer Engineering at Virginia Tech, United States of America Proof.
2. "International Mentoring Programme 2024" By: *International Mentoring Foundation for the Advancement of Higher Education (IMFAHE)*, Mentorship by: Raquel Martínez Farreres, Energy Analist, Repsol, Spain Proof.

2021

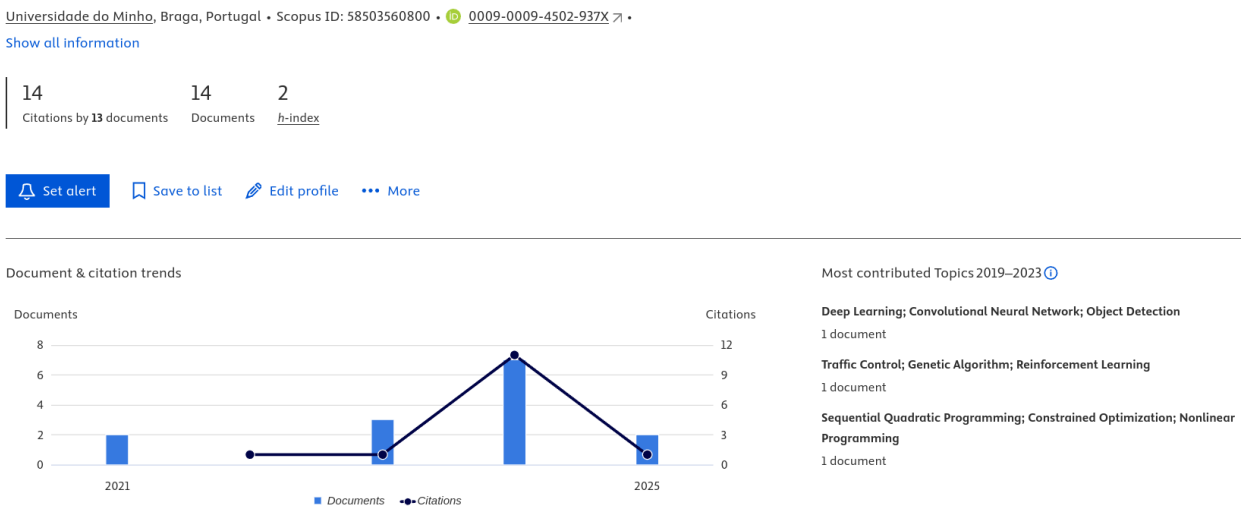
1. "Full scholarship for the HelloAI RIS Online Program." By: *HelloAI RIS* Proof.

RESEARCH METERS

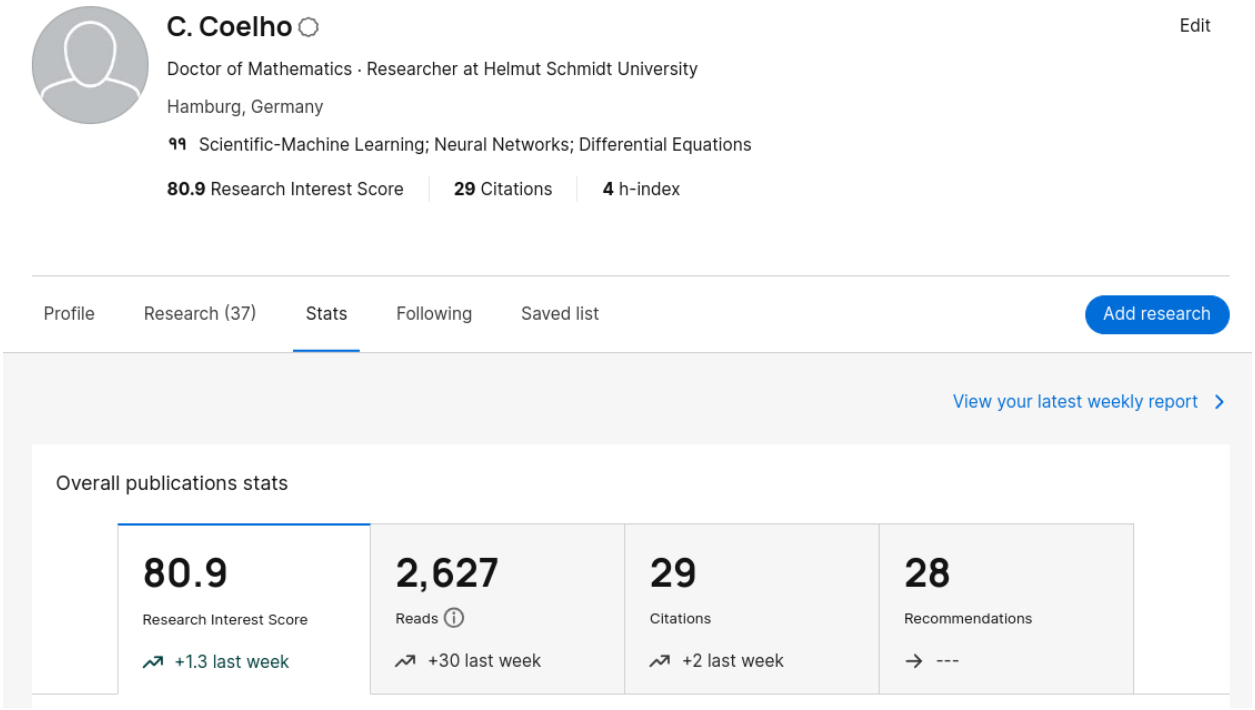
Google Scholar - updated and reviewed



Scopus - not updated (updates depend on the tracking algorithm)



Research Gate - not updated (updates depend on the tracking algorithm)



VMC2 - COORDINATION AND IMPLEMENTATION OF RESEARCH PROJECTS

RESEARCH FUNDING AND GRANTS

Research Projects:

Sep 2024–current

Principal Investigator: IA-Olivais-"Artificial Intelligence for Optimising the Irrigation of Olive Orchards Resilient to Climate Change" (original title in portuguese: "Inteligência Artificial na Otimização da Rega para Olivais Resilientes às Alterações Climáticas.") By: *Concurso Promove. O futuro do interior - Projetos Piloto 2024, Fundação "la Caixa" and Foundation for Science and Technology (FCT)*
Project description: This project proposes an Artificial Intelligence system to predict and monitor water needs by forecasting atmospheric and soil conditions. It will be integrated into drip irrigation systems to intelligently control the amount of water released. As nutrients are essential for plant growth and development and are related to the ability to tolerate periods of drought, an AI system will also be developed to optimise and recommend their application.
Entities: University of Minho (CMAT), University of Trás-os-Montes e Alto Douro (CITAB), Associação de Agricultores do Vale da Vilariça, Sementinteligente Unipessoal Lda.
Budget: 281 643€ (3 years) webpage

Dec 2024–current

COST Member CA23108 - Seasonal-to-decadal climate predictability in the Mediterranean: process understanding and services (MEDUSSE), Working Groups 2 and 3.
Action keyworkds: climate variability - climate predictability - climate prediction - climate services Proof

Oct 2024–current

Principal Investigator: "OptXAI: Constrained Optimization in NNs for Explainable, Ethical and Greener AI" Reference: 2024.00191.CPCA.A1 By: *Call Advanced Computing Projects (4th ed): A1 Development Access (round C)*
Budget: 2 880 GPU.hours + 23 040 CPU core.hours (computational time) (1 year) Proof

Nov 2023-Nov 2024

Principal Investigator: "HydroEthiX - Integrating Constraints for Sustainable Management of Hydropower Plants: A Transparent and Ethical AI Approach." Reference: CPCA-IAC/AV/589164/2023 By: *"Call on Advanced Computing Projects: Artificial Intelligence in Cloud (2nd edition)" Foundation for Science and Technology (FCT), Portugal and Google*
Project description: Hydropower plants play a crucial role in renewable energy production and water resource usage. Current models primarily prioritise energy production and revenue generation, neglecting environmental consequences and the importance of water for agricultural needs. Furthermore, the black-box nature of Neural Networks complicates the interpretability of the generated models, hindering our understanding of the underlying decision-making process. This lack of transparency raises concerns about accurately representing the constraints and may lead to unethical choices that harm ecosystems or strain farmers' food supplies In this project, we propose a model to prevent the destruction of the ecosystem where the hydropower plants are and avoid strain to the world food supply during the dry seasons. The research team was composed by Cecília Coelho, Fernanda Costa and Luís Ferrás. Additionally we supported a research initiation fellowship for Emmanuela Villar, Bachelor's student in Data Science at University of Minho under the theme "Artificial Intelligence for the Ethical Management Optimisation of Hydroelectric Centrals".
Entity: CMAT
Budget: 88 806 USD (1 year) Proof
Outcomes: +10 papers, conference abstracts and poster, on incorporating constraints into neural networks in which 2 are applied to hydropower plant management.

Nov 2023-Nov 2024 **Co-Principal Investigator:** "Enhancing Industrial and Environmental Modelling with Non-Local Operators in Neural Ordinary Differential Equations." Reference: CPCA-IAC/AF/589140/2023 By: *"Call on Advanced Computing Projects: Artificial Intelligence in Cloud (2nd edition)" Foundation for Science and Technology (FCT), Portugal and Google* (Principal Investigator: Luís Ferrás)

Fundação para a Ciência e a Tecnologia

Project description: Mathematical modelling plays a crucial role in understanding real systems across multiple disciplines. It allows us to describe the behavior of these systems over time, gain valuable insights, and explore scenarios without the need for expensive experiments. Neural Ordinary Differential Equations (Neural ODEs) are a Neural Network (NN) architecture that adapts a continuous-depth NN (ODE) to accurately model system dynamics. ODEs are the simplest type of DEs and provide a powerful framework for studying the relationships between a function and its derivatives, their simplicity can become a drawback when dealing with complex systems that exhibit intricate interdependencies and nonlinear behaviour. In this project, our goal is to enhance the modelling capabilities of Neural ODEs to improve the performance of modelling real systems, thereby providing more accurate and realistic simulations and predictions. The research team was composed by Luís Ferrás, Cecília Coelho and Fernanda Costa. Additionally we supported a research initiation fellowship for Carlos Fernandes, Bachelor's student in Computer Science at University of Minho under the theme "Machine Learning and the Navier-Stokes Equations for Modelling the Blood Flow in Arteries".
Entity: CMAT
Budget: 25 000 USD (1 year) Proof
Outcomes: +10 papers, conference abstracts and poster, on incorporating modelling differential equations with neural networks in which 1 is applied to ecosystems modelling and 7 are applied to engineering problems.

2022–current **Researcher:** "Strategic Project with Public Interest promoted by Associated Laboratories and R & D Units.2019-COMPETE" References: UID/MAT/00013. Main research area: Mathematics.

Fundação para a Ciência e a Tecnologia

Entity: CMAT

2022–current **Researcher:** "Strategic Project with Public Interest promoted by Associated Laboratories and R & D Units.2019-COMPETE" References: UIDB/00013/2020, UIDP/00013/2020. Main research area: Mathematics.

Fundação para a Ciência e a Tecnologia

Entity: CMAT
Budget: 900 000€

Projects with Industry:

Nov 2020-May 2022 **Researcher:** "VALORAGUA" an industrial project involving REN – Redes Energéticas Nacionais, SGPS, S.A. and Centre of Mathematics (CMAT-UM)

Project description: REN is a Portuguese energy sector company which is the current concession holder of the country's two main energy infrastructure networks: the National Electricity Transmission Grid (RNT) and the National Natural Gas Transportation Grid (RNTGN). This project started on 2020-01-11 and aims the optimization of the water, solar and wind networks taking into account the cost to produce energy. The duration of the project was 16 months. The research team from CMAT was composed by Ana Jacinta Soares, Fernando Miranda, Fernanda Costa, Luís Ferrás (internal members) and the researchers Andreia Costa and Cecília Coelho. The team, composed by the internal members, submitted a proposal and won the national public tender by REN.
Entities: CMAT and REN
Budget: 130 000€ webpage
Outcomes: Code implementation in Python of templates to input data of energy, granularity and prices information. Code translation and optimization from Fortran 86 to Golang. Algorithm update to incorporate renewable energies and optimizing daily. Development of a cross-platform user interface in Flutter.

International Research Teams Participation:

Aug 2024–current

School of Sciences of University of Minho (ECUM/UMinho) Team at "Climate Change and Sustainable Development" Cluster of the Arqus Alliance (University of Minho, University of Padua, Vilnius University, University of Wroclaw, University of Granada, University of Graz, Leipzig University and Université Claude Bernard Lyon 1) Proof

Grants:

2024

2. Travel grant to attend the Machine Learning in Infinite Dimensions Workshop (£300 + accommodation)

2023

1. Grant to attend the Eleventh International Conference on Learning Representations (ICLR) 2023 Virtually (100 USD)

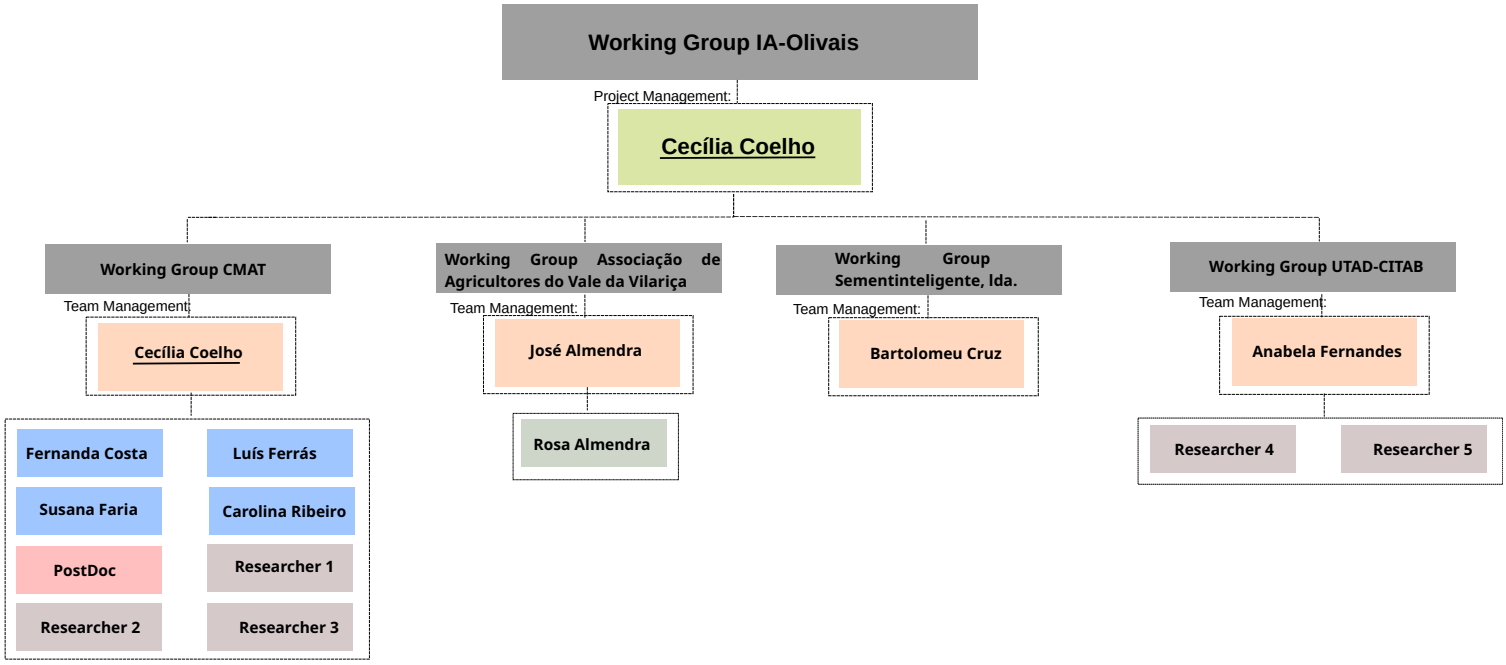
Scholarships:

Portuguese Foundation for Science and Technology (FCT) Ph.D. 2021.05201.BD. ≈ 53 597€ Proof.

Research Funding and Grants - in Preparation:

Submission June 2025

Deutsche Forschungsgemeinschaft (DFG)
Principal Investigator: Cecília Coelho
Team: Cecília Coelho, Michael Hohmannm, Oliver Niggemann
Keywords: Scientific-Machine Learning; Differential Equations; Material Design
Entities: HSU-AI Institute for Artificial Intelligence, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany



PROJECT MANAGEMENT

IA-Olivais

In the project "Artificial Intelligence for Optimising the Irrigation of Olive Orchards Resilient to Climate Change", funded by Fundação "la Caixa" and FCT, I play the role of project manager and group leader of the CMAT members. The management structure is shown below:

VMC3 - CREATION OF RESEARCH TEAMS

SUPERVISION AND CONSTITUTION OF SCIENTIFIC TEAMS

Supervision of Researchers and Post-Docs:

2025

Apr 2025-Jul 2025

Initiation to Scientific Research "Scientific Validation of Neural Networks based on Ordinary Differential Equations" (original title in portuguese: "Validação de Redes Neuronais Baseadas em Equações Diferenciais Ordinárias.") In: *Prémio UMinho de Iniciação à Investigação Científica 2025* By: *Centre of Mathematics (CMAT), University of Minho*
Elisa Oliveira - 3rd year Bachelor's in Data Science, University of Minho.
Keywords: Deep Learning; Time-series; Ordinary Differential Equations; Numerical Methods
Responsible Investigator and Supervision shared: Cecília Coelho, Fernanda Costa (Department of Mathematics, University of Minho) and Luís Ferrás (FEUP, University of Porto) Proof.

Initiation to Scientific Research "A Method Based on Neural Networks for Optimal Control Problems" (original title in portuguese: "Um Método Baseado em Redes Neuronais para Problemas de Controlo Ótimo.") In: *Prémio UMinho de*

Iniciação à Investigação Científica 2025 By: *Centre of Mathematics (CMAT), University of Minho*
Emmanuella Villar - 3rd year Bachelor's in Data Science, University of Minho.
Keywords: Deep Learning; Time-series; Differential Equations; Optimal Control; Mathematical Modelling
Responsible Investigator and Supervision shared: Cecília Coelho, Fernanda Costa (Department of Mathematics, University of Minho) and Luís Ferrás (FEUP, University of Porto) Proof.

Mar 2025-current

Research Fellowship "Predicting Olive Orchards Irrigation Needs with Neural Networks" (original title in portuguese: "Previsão da Irrigação de Oliveiras com Redes Neuronais.") In: *IA-Olivais R&D project "Inteligência Artificial na Otimização da Rega para Olivais Resilientes às Alterações Climáticas" with reference PL24-00057* Ref: 40/ECUM/CMAT/2024 - IA-Olivais By: *Centre of Mathematics (CMAT), University of Minho*
José Virgílio Loureiro
Keywords: Deep Learning; Knowledge Extraction; Explainable AI; Climate AI; Optimization; Time-series
Scientific Supervision: Cecília Coelho Proof.

2024

Oct 2024-Dec 2024

Research Initiation Fellowship "Artificial Intelligence for the Ethical Management Optimisation of Hydroelectric Centrals" (original title in portuguese: "Inteligência Artificial na Otimização Ética da Gestão de Centrais Hidroelétricas.") Ref: 17/ECUM/CMAT/2024–UIDB/00013/2020 By: *Centre of Mathematics (CMAT), University of Minho*
Emmanuela Villar, undergraduate student of Bachelor's in Data Science, University of Minho.
Keywords: Deep Learning; Constrained Optimization; Climate AI; Time-series.
Supervision shared: Fernanda Costa (Department of Mathematics, University of Minho) and Cecília Coelho Proof.

Oct 2024-Dec 2024

Research Initiation Fellowship "Machine Learning and the Navier-Stokes Equations for Modelling the Blood Flow in Arteries" (original title in portuguese: "Machine Learning e as Equações de Navier-Stokes na Modelação do Escoamento de Sangue em Artérias.") Ref: 17/ECUM/CMAT/2024–UIDB/00013/2020 By: *Centre of Mathematics (CMAT), University of Minho*
Carlos Fernandes - 2nd year Bachelor's in Computer Science, University of Minho.
Keywords: Deep Learning; Differential Equations; Numerical Methods; Physics-informed Neural Networks; Fluid Mechanics. Supervision shared: Luís Ferrás (FEUP, University of Porto) and Cecília Coelho Proof.

Apr 2024-Sep 2024

Initiation to Scientific Research "Artificial Intelligence for the Ethical Management Optimisation of Hydroelectric Centrals" (original title in portuguese: "Inteligência Artificial na Otimização Ética da Gestão de Centrais Hidroelétricas.") In: *Prémio UMinho de Iniciação à Investigação Científica 2024* By: *Centre of Mathematics (CMAT), University of Minho*

Emmanuela Villar - 2nd year Bachelor's in Data Science, University of Minho. Keywords: Deep Learning; Constrained Optimization; Climate AI; Time-series. Supervision shared: Fernanda Costa (Department of Mathematics, University of Minho) and Cecília Coelho Proof.

Apr 2024-Sep 2024

Initiation to Scientific Research "Machine Learning and the Navier-Stokes Equations for Modelling the Blood Flow in Arteries" (original title in portuguese: "Machine Learning e as Equações de Navier-Stokes na Modelação do Escoamento de Sangue em Artérias.") In: *Prémio UMinho de Iniciação à Investigação Científica 2024* By: *Centre of Mathematics (CMAT), University of Minho* Carlos Fernandes - 2nd year Bachelor's in Computer Science, University of Minho. Keywords: Deep Learning; Differential Equations; Numerical Methods; Physics-informed Neural Networks; Fluid Mechanics. Supervision shared: Luís Ferrás (FEUP, University of Porto) and Cecília Coelho Proof.

Supervision of Master Students:

Sep 2024–current

Master's in Mathematics and Computation "Irrigation Optimization of Olive Orchards Using Deep Learning". Keywords: Deep Learning; Knowledge Extraction; Explainable AI; Climate AI; Optimization; Time-series;
José Virgílio Silva Loureiro, master's student in Mathematics and Computation, University of Minho, Braga, Portugal.
Supervision shared: Fernanda Costa (Department of Mathematics, University of Minho) and Cecília Coelho

VMC4 - INVOLVEMENT IN THE SCIENTIFIC AND PROFESSIONAL COMMUNITIES

EDITORIAL BOARD

Journal Editor: Editor of Special Issues/Board Member (peer-reviewed Journals):

2025

1. Fractal and Fractional (to start in 2025) **IF: 3.6** - Special Issue - "Computational and Analytical Approaches in Fractional Calculus for Digital Twins."
   Editors: Cecília Coelho, M. Fernanda P. Costa, Luís L. Ferrás.

Proceedings Editor (peer-reviewed Proceedings)

2024

1. C. Coelho, B. Zimmering, M. Fernanda P. Costa, L.L. Ferrás, O. Niggemann. *Proceedings of the 1st ECAI Workshop on "Machine Learning Meets Differential Equations: From Theory to Applications"*, Proceedings of Machine Learning Research Volume 255, PMLR
   Found here.

Invited Referee for Scientific Journals

2024

6. "Fractional Calculus and Applied Analysis, Springer.", ISSN: 1311-0454 **IF: 2.5** (2024 - current): 1 review
5. "Applied Mathematical Modelling, Elsevier.", ISSN: 1872-8480 **IF: 4.4** (2024 - current): 1 review
4. "Mathematics, MDPI.", ISSN: 2227-7390 **IF: 2.3** (2024 - current): 1 review
3. "Computers & Electrical Engineering, Elsevier.", ISSN: 1879-0755 **IF: 4.3** (2024 - current): 4 reviews
2. "Engineering Applications of Artificial Intelligence, Elsevier.", ISSN: 1873-6769 **IF: 8** (2024 - current): 3 reviews

2023

1. "Journal of Open Source Software (JOSS).", ISSN: 2475-9066 (2023 - current): 3 reviews

Invited Referee for Conferences

2025

1. "34th International Joint Conference on Artificial Intelligence (IJCAI)" (2025): 4 reviews

2024

8. "Neural Information Processing Systems (NeurIPS)" (2024): 3 reviews
7. "Machine Learning Meets Differential Equations: From Theory to Applications" (2024): 2 reviews
6. "European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML)" (2024): 2 reviews
5. "European Conference on Computer Vision (ECCV)" (2024): 1 review
4. "International Joint Conference on Artificial Intelligence (IJCAI)" (2024): 6 reviews
3. "International Conference on Learning Representations (ICLR)" (2024): 6 reviews

2023

2. "Neural Information Processing Systems (NeurIPS)" (2023): 4 reviews
1. "European Conference on Artificial Intelligence (ECAI)" (2023): 1 review

PRESENTATION OF LECTURES

Invited Talks:

2024

20. "Descobrindo a Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *4º ano da Escola EB1 de Frossos, Conversar com um cientista, Centro de Ciência Viva de Guimarães, Guimarães, Portugal, 25th November* (2024) Proof.

19. "Descobrindo a Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *4º ano da Escola EB1 de Frossos, Conversar com um cientista, Centro de Ciência Viva de Guimarães, Guimarães, Portugal, 18th November* (2024) Proof.

18. "Descobrindo a Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *4º ano da Escola EB1 de Carrascal, Conversar com um cientista, Centro de Ciência Viva de Guimarães, Guimarães, Portugal, 4th November* (2024) Proof.

17. "Modelling Data with Fractional Differential Equations Using Neural Networks" In: *Workshop on Statistics and Data Science, University of Minho, Guimarães, Portugal, 24-25th October* (2024) Proof.

16. "Symposium on Navigating the 3rd Hype of AI: Empowering Humans - A Crucial Discussion for Our Future", NOVA University, Lisbon, Portugal (2024) Proof.

15. "Learning Fractional Differential Equations From Data" In: *Machine Learning in Infinite Dimensions Workshop, Bath, United Kingdom* (2024) Proof.

14. "Desvendando a Magia da Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *4º ano da EB1 de Merelim S. Pedro, Conversar com um cientista, Centro de Ciência Viva de Braga, Braga, Portugal* (2024) Proof.

13. "Desvendando a Magia da Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *2º/3º anos da EB1 Motelo, Conversar com um cientista, Centro de Ciência Viva de Guimarães, Guimarães, Portugal* (2024) Proof.

12. "Desvendando a Magia da Inteligência Artificial: Vamos ensinar um computador a detetar a nossa cara!" In: *3º ano da Escola Básica Nª Sª Conceição, Conversar com um cientista, Centro de Ciência Viva de Guimarães, Guimarães, Portugal* (2024) Proof.

2023

11. "IA é Matemática. Redes Neuronais para a Modelação de Sistemas Reais." In: *VEM - Vamos Experimentar a UMinho, Department of Mathematics, University of Minho, Braga, Portugal* (2023) Proof.

10. "IA é Matemática. Redes Neuronais para a Modelação de Sistemas Reais." In: *For the 11th grade students of the St. Peter's International School at the Department of Mathematics, University of Minho, Azurém, Portugal* (2023) Proof.

9. "Neural Networks Meet Differential Equations for Real Systems Modelling" In: *Inserted in a course of the 3rd year Bachelor's in Applied Mathematics and Data Science, University of Trás-os-Montes e Alto Douro, Vila Real, Portugal* (2023) Proof.

8. "Video: Benefits of studying mathematics and real-life applications of mathematics. From mathematics to the world." In: *Mathematics International Day, University of Trás-os-Montes e Alto Douro, Vila Real, Portugal* (2023) Proof.
7. "Investigação em Matemática: testemunhos de alunos de doutoramento." In: *Centre of Mathematics (CMAT) Labs Fest, University of Minho, Braga, Portugal* (2023) Proof.
6. "Inteligência Artificial explicada às crianças: Como ensinar um computador a detetar a nossa face." In: *Conversar com um cientista, Centro de Ciência Viva, Braga, Portugal* (2023) Proof.
5. "Aplicações da Inteligência Artificial: sistemas de recomendação (redes sociais, plataformas de streaming, comércio eletrónico), classificação/deteção de objetos em imagem/vídeo e geração de conteúdo artificial/falso." In: *Investigadores voltam à escola, Escola Secundária de Caldas das Taipas, Braga, Portugal* (2023) Proof.

2022

4. "Round Table: À conversa com bolseiros." In: *Centre of Mathematics (CMAT) Labs Fest, University of Minho, Braga, Portugal* (2022) Proof.

2021

3. "Aplicações da Inteligência Artificial no processamento de imagem: condução autónoma e classificação/deteção de objetos em imagens." In: *Investigadores voltam à escola, Escola Secundária das Taipas, Braga, Portugal* (2021) Proof.
2. "Aplicações da Inteligência Artificial no processamento de imagem: condução autónoma e classificação/deteção de objetos em imagens." In: *Investigadores voltam à escola, Colégio La Salle, Barcelos, Portugal* (2021) Proof.
1. "A Successful Cooperation between Academia and Industry." In: *Encontro Nacional Sociedade Portuguesa de Matemática, Sociedade Portuguesa de Matemática, online* (2021) Proof.

Invited Chair:

2025

1. "[ML-DE] Machine Learning Meets Differential Equations 2025." In: *Workshop at the 28th European Conference on Artificial Intelligence (ECAI)*
   Chair: Cecília Coelho
   Upcoming The website is now live!

2024

2. "[ML-DE] Machine Learning Meets Differential Equations 2024." In: *Workshop at the 27th European Conference on Artificial Intelligence (ECAI)*
   Chair: Cecília Coelho
   `https://mlde-ecai-2024.github.io/`
1. "Mini-Colloquia 16 - Integrative approaches in physics: using machine learning to explore magnetism, disordered media, and materials science." In:

Teaching Experience and Pedagogic Merit Dimension

VMP1 - COORDINATION OF PEDAGOGICAL PROJECTS

COORDINATION AND DEVELOPMENT OF CURRICULAR UNITS

2024/2025

2. Coordinator of the Curricular Unit "Tópicos de Matemática" ("Topics in Mathematics") of the Higher Professional Technical Course on Technologies and Programming of Information Systems, Polytechnic Institute of Viana do Castelo Proof
1. Coordinator of the Curricular Unit "Matemática" ("Mathematics") of the Higher Professional Technical Course on Car Mechanics, Polytechnic Institute of Viana do Castelo Proof

VMP2 - PRODUCTION OF TEACHING MATERIALS

DEVELOPED LECTURE MATERIALS

5. Course notes for "Topics in Mathematics" (2024/2025)
4. Compilation of practise exercises for "Topics in Mathematics" (2024/2025)
3. Course notes for "Mathematics" (2024/2025)
2. Compilation of practise exercises for "Mathematics" (2024/2025)
1. Jupyter notebook tutorial on Physics-Informed Neural Networks and numerical methods, for Bachelor's Students in Computer Science (2024)

ONLINE RESOURCES

2. Tutorial slides on differential equations, numerical methods, Physics-Informed Neural Networks and Neural Ordinary Differential Equations (2024) PDF

1. Jupyter notebook tutorial on differential equations, numerical methods, Physics-Informed Neural Networks and Neural Ordinary Differential Equations (2024) Access here.

VMP3 - TEACHING ACTIVITY

TEACHING

University:

2024/2025

Linear Algebra for Engineering (Álgebra Linear para a Engenharia) - TPs
To: 1st year Undergraduate Courses of Polymers Engineering, Materials Engineering and Textile Engineering At: *University of Minho* (2 hours/week)
Program summary: matrices; systems of linear equations; determinants; vector spaces $\mathbb{R}^n$; eigenvalues and eigenvectors of a matrix; linear mappings from $\mathbb{R}^n$ to $\mathbb{R}^m$, Proof

Topics in Mathematics (Tópicos de Matemática - T+TP)
To: 1st year Higher Professional Technical Course on Technologies and Programming of Information Systems: *Polytechnic Institute of Viana do Castelo*
Program summary: probability theory and combinatorics, real-valued functions, derivatives, successions. Proof

Mathematics (Matemática - T+TP)
To: 1st year Higher Professional Technical Course on Car Mechanics: *Polytechnic Institute of Viana do Castelo*
Program summary: introduction to mathematical language and logics, real-valued functions, derivatives, primitives, probability theory. Proof

Invited University Lectures:

2024

14th Mar "Neural Networks meets Differential Equations: From Solving to Modelling" At: *Helmut-Schmidt University / Universität der Bundeswehr (University of the Federal Armed Forces) Hamburg, Germany* (3 hours)
Letter of Appreciation

4. Solving Differential Equations
   Physics-Informed Neural Networks (PINNs)
   PINNs versus Numerical Methods
3. Modelling Differential Equations
   Neural Ordinary Differential Equations (Neural ODEs)
   Numerical Methods in Neural ODEs
2. Fractional Differential Equations
1. Neural FDEs

2023

23rd Oct

Applied Project to Data Science (Projeto Aplicado à Ciência de dados), "Neural Networks Meet Differential Equations for Real Systems Modelling"
To: 3rd Year Undergraduate Course on Applied Mathematics and Data Science At: *University of Trás-os-Montes e Alto Douro* (2 hours)
Proof

4. Basics Machine Learning
   Motivation
   The Perceptron
   The Optimization Process
   Deep Neural Networks
3. Solving Differential Equations with Numerical Methods
2. Physics-Informed Neural Networks (PINNs)
   Introduction
   Solving the Burger's Equation
   PINNs-Inspired Networks
   PINNs vs Numerical Methods
1. Neural Ordinary Differential Equations (Neural ODEs)
   Introduction
   Neural ODEs vs Recurrent Neural Networks
   Learning Spiral Dynamics
   Neural ODE-inspired Networks
   Neural ODE vs Traditional Neural Networks

Tasks of Outreach and Enhancement of Knowledge Dimension

VTC1 - PATENTS, REGISTRATION AND OWNERSHIP OF RIGHTS, DEVELOPMENT OF TECHNICAL STANDARDS AND REGULATIONS

Several software/code implementations were developed along the performed research and are publicly available on GitHub and Kaggle. None of the implementations were registered or patented as I believe the patenting of code leads to less efficient research development.

VTC2 - CONSULTING, STUDY AND DEVELOPMENT CONTRACTS

CONSULTANCY

Consultancy Services:

2019/2020

1. My master thesis was a joint work with the company *Accenture, Portugal* as a research internship.
   Outcomes: several neural network models and a fully functioning user interface to use them to detect illegal swimming pools. PDF

PROFESSIONAL TRAINING

Taught Courses:

2025

3. Will teach a tutorial on Physics-Informed Neural Networks In: *Spring School on Physics Informed Machine Learning for Medical Sciences*
   `https://magnet4cardiac7t.github.io/`

2024

2. Taught the Tutorial "The Symbiosis of Neural Networks and Differential Equations: From Physics-Informed Neural Networks to Neural ODEs." In:

27th European Conference on Artificial Intelligence (ECAI)
`https://symbiosisnn-des.github.io/`
Lecturers: Cecília Coelho (Centre of Mathematics of University of Minho) and Luís Ferrás (Centre of Mathematics of University of Minho; Department of Mechanical Engineering (Section of Mathematics) and CEFT - Centro de Estudos de Fenómenos de Transporte - FEUP, University of Porto) (2024)
Contents: Introduction to Differential Equations; Neural Networks for Solving Differential Equations; Neural Networks for Modelling Differential Equations; Wrap-up Proof.

1. Taught a Deep Learning course for the monitors of the "Centros Ciência Viva" network In: *Casa da Ciência Viva de Braga*
Contents: Neural Network Basics, How to Teach Deep Learning to Children; Fun Activities for Children.)

VTC3 - DISSEMINATION OF SCIENCE AND TECHNOLOGY

ORGANISATION OF SCIENTIFIC MEETINGS

2025

4. **Organiser/Chair** "AI for Climate Change: From Mitigation to Adaption." In: *Workshop at the European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases - ECML PKDD 2025*
Organisers: Cecília Coelho (Centre of Mathematics of University of Minho), Eunika Mercier-Laurent (University of Reims, Champagne-Ardenne), Luís Ferrás (Centre of Mathematics of University of Minho; Department of Mechanical Engineering (Section of Mathematics) and CEFT - Centro de Estudos de Fenómenos de Transporte - FEUP, University of Porto), Fernanda Costa (Centre of Mathematics of University of Minho) and Anna Krause (University of Würzburg) (2025).
Proposal Submitted

3. **Organiser/Lecturer** "Neural Networks and Differential Equations: From Infinite Layers to Continuous Modelling." In: *Tutorial at the 28th European Conference on Artificial Intelligence (ECAI) 2025* Organisers/Lecturers: Cecília Coelho (Centre of Mathematics of University of Minho), Luís Ferrás (Centre of Mathematics of University of Minho; Department of Mechanical Engineering (Section of Mathematics) and CEFT - Centro de Estudos de Fenómenos de Transporte - FEUP, University of Porto , and Bernd Zimmering (Institute for Automation Technology, Helmut-Schmidt-University)) (2025).
Proposal Submitted

2. **Organiser/Chair** "[ML-DE] Machine Learning Meets Differential Equations 2025." In: *Workshop at the 28th European Conference on Artificial Intelligence (ECAI)*
Organisers: Cecília Coelho (Centre of Mathematics of University of Minho), Bernd Zimmering (Institute for Automation Technology, Helmut-Schmidt-University), Luís Ferrás (Centre of Mathematics of

University of Minho; Department of Mechanical Engineering (Section of Mathematics) and CEFT - Centro de Estudos de Fenómenos de Transporte - FEUP, University of Porto), Fernanda Costa (Centre of Mathematics of University of Minho) and Oliver Niggemann (Institute for Automation Technology, Helmut-Schmidt-University) (2025).
Upcoming The website is now live!

1. **Organiser/Lecturer** "The Symbiosis of Neural Networks and Differential Equations: From Physics-Informed Neural Networks to Neural ODEs." In: *Tutorial at the European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases - ECML PKDD 2025*
Organisers/Lecturers: Cecília Coelho (Centre of Mathematics of University of Minho) and Luís Ferrás (Centre of Mathematics of University of Minho; Department of Mechanical Engineering (Section of Mathematics) and CEFT - Centro de Estudos de Fenómenos de Transporte - FEUP, University of Porto (2025).
Proposal Submitted

2024

5. **Program Committee** "Tackling Climate Change with Machine Learning." In: *Climate Change AI's Workshop at the Conference on Neural Information Processing Systems (NeurIPS)*
Organisers: Tejasri Nampally (Indian Institute of Technology Hyderabad), Diego Kiedanski (Tryolabs), Yazid Salahudeen Mikail (Ahmadu Bello University), Amrita Gupta (Microsoft), Arthur Ouaknine (McGill, Mila), Bistra Dilkina (University of Southern California), Yoshua Bengio (UdeM, Mila) (2024)

4. **Organiser/Chair** "[ML-DE] Machine Learning Meets Differential Equations 2024." In: *Workshop at the 27th European Conference on Artificial Intelligence (ECAI)*
Organisers: Cecília Coelho (Centre of Mathematics of University of Minho), Bernd Zimmering (Institute for Automation Technology, Helmut-Schmidt-University), Luís Ferrás (Centre of Mathematics of University of Minho; Department of Mechanical Engineering (Section of Mathematics) and CEFT - Centro de Estudos de Fenómenos de Transporte - FEUP, University of Porto), Fernanda Costa (Centre of Mathematics of University of Minho) and Oliver Niggemann (Institute for Automation Technology, Helmut-Schmidt-University)
`https://mlde-ecai-2024.github.io/` (2024) Proof.

3. **Organiser/Lecturer** "The Symbiosis of Neural Networks and Differential Equations: From Physics-Informed Neural Networks to Neural ODEs." In: *Tutorial at the 27th European Conference on Artificial Intelligence (ECAI)*
`https://symbiosisnn-des.github.io/`
Organisers/Lecturers: Cecília Coelho (Centre of Mathematics of University of Minho) and Luís Ferrás (Centre of Mathematics of University of Minho; Department of Mechanical Engineering (Section of Mathematics) and CEFT - Centro de Estudos de Fenómenos de Transporte - FEUP, University of Porto) (2024) Proof.

2. **Organiser/Chair** "Mini-Colloquia 16 - Integrative approaches in physics: using machine learning to explore magnetism, disordered media, and

materials science." In: *General Conference of the Condensed Matter Division - CMD31, Altice Forum, Braga, Portugal*
`https://cmd31.sci-meet.net/mini-colloquia`
Organisers: Cecília Coelho (Centre of Mathematics of University of Minho), Célio Fernandes (Department of Mechanical Engineering (Section of Mathematics) and CEFT - Centro de Estudos de Fenómenos de Transporte - FEUP, University of Porto) and Luís Ferrás (Centre of Mathematics of University of Minho; Department of Mechanical Engineering (Section of Mathematics) and CEFT - Centro de Estudos de Fenómenos de Transporte - FEUP, University of Porto) (2024) Proof.

2016

1. **Volunteer** "Exhibition celebrating the 30th anniversary of LIP (Laboratory for Instrumentation and Experimental Particle Physics)." In: *University of Minho, Portugal* (2016) Proof.

OUTREACH ACTIVITIES

2024

2. "Activities to promote the Department of Mathematics/ Centre of Mathematics (CMAT) of the School of Sciences of University of Minho (ECUM)." In: *"UPA - UMinho de Portas Abertas", Campus de Gualtar, Braga, Portugal* (2024) Proof.
1. "Masters offered by the Department of Mathematics of University of Minho (Masters in Mathematics and Computation, Masters in Statistics for Data Science)" In: *Feira de Mestrados, Association for Information Systems Student Chapter – UMinho (AIS.SC UMinho), School of Engineering, University of Minho, Azurém, Guimarães, Portugal* (2024) Proof.

ACADEMIC AND INDUSTRIAL NETWORKING

– Bernd Zimmering, Oliver Niggemann (HSU-AI Institute for Artificial Intelligence, Department of Mechanical and Civil Engineering, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany), Vaibhav Gupta, Maria Maleshkova (HSU-AI Institute for Artificial Intelligence, Department of Electrical Engineering, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany). Work under development and already developed: Laplace transform for forced dynamical systems; applications to engineering.

– Ricardo Baptista (California Institute of Technology - Caltech - Department of Computing and Mathematical Sciences & Amazon). Work under development developed: development in normalizing flows; applications to engineering.

– Bernd Zimmering, Oliver Niggemann (HSU-AI Institute for Artificial Intelligence, Department of Mechanical and Civil Engineering, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany). Work under

development and already developed: optimisation of algorithms; applications of neural networks to engineering; modelling differential equations using neural networks.

- Fernanda Costa (University of Minho - Department of Mathematics), Luís Ferrás (University of Porto - Department of Mechanical Engineering - Section of Mathematics). Work under development and already developed: identifying and addressing training problems in neural networks; developing neural network architectures to model differential equations to data; existence and uniqueness of solutions; using neural networks to solve differential equations; incorporating constraints explicitly into neural networks; developing/adapting constrained optimisation methods for neural networks; modelling fractional differential equations.
- Ming Jin (Virginia Tech - Department of Electrical and Computing Engineering). Work under development and already developed: optimisation of hydropower plants; development of transparent Artificial Intelligence frameworks; incorporating constraints into neural networks.
- Susana Faria, Carolina Ribeiro and Fernanda Costa (University of Minho - Department of Mathematics). Work under development and already developed: Satellite data analysis and knowledge extraction; mathematical modelling of an irrigation system.
- Anabela Fernandes (University of Trás-os-Montes and Alto Douro). Work under development and already developed: Optimisation of irrigation systems for olive orchards
- Luis Albuquerque, Fernanda Costa, Ana Jacinta Soares (University of Minho - Department of Mathematics), Luís Ferrás (University of Porto - Department of Mechanical Engineering - Section of Mathematics). Work under development and already developed: New algorithms for finding a parking spot using Artificial Intelligence.
- Diana Carrilho, Fernanda Costa, Ana Jacinta Soares (University of Minho - Department of Mathematics), Luís Ferrás (University of Porto - Department of Mechanical Engineering - Section of Mathematics). Work under development and already developed: New algorithms for optimising traffic lights using Artificial Intelligence.
- Sónia Vilela, Pedro Carola, Heleza Azevedo, Pedro Ávila (Industry - REN). Work under development and already developed: Numerical methods ans optimisation procedures for the portuguese energy distribution sector.

University Management

2023

4. Member of the Pedagogic Council of the School of Sciences of University of Minho, in the academic year 2023/2024
   Responsibilities: Participating in meetings, intervene in discussions and voting actions related to the function of the pedagogical activies of the School of Sciences. Proof.
3. Member of the Coordinating Committee of the Doctoral College of University of Minho, representing the School of Sciences, in the academic year 2023/2024 Responsibilities: Participating in meetings to promote the quality of the extra-courses for doctoral students. Organising meetings and round-tables. Proof.
2. Students' delegate of the 2nd year of the Doctorate in Mathematics, in the academic year 2023/2024

2022

1. Students' delegate of the 1st year of the Doctorate in Mathematics, in the academic year 2022/2023 Proof.

Technical Skills, References, Collaborators

TECHNICAL SKILLS

Programming:

Python; Pytorch; Tensorflow; Dart; Flutter; Golang; R; C; C++; Fortran; Haskell

Technical Software:

KNIME; MATLAB

REFERENCES

Professor **Luís Ferrás**
Department of Mechanical Engineering - Section of Mathematics, University of Porto, Portugal
lferras@fe.up.pt

Professor **Fernanda Costa**
Department of Mathematics, University of Minho, Portugal
mfc@math.uminho.pt

Professor **Oliver Niggemann**
HSU-AI Institute for Artificial Intelligence, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany
oliver.niggemann@hsu-hh.de

Professor **Eunika Mercier-Laurent**
University of Reims, Champagne-Ardenne, France
eunika.mercier-laurent@univreims.fr

Dr. **Ricardo Baptista**
Department of Computing and Mathematical Sciences, Amazon & California Institute of Technology (Caltech), USA
rsb@caltech.edu

COLLABORATORS

Professor **Ming Jin**
Bradley Department of Electrical and Computer Engineering, Virginia Tech, USA
jinming@vt.edu

Professor **Maria Maleshkova**
HSU-AI Institute for Artificial Intelligence, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany

Dr. **Anna Krause**
Chair for Data Science, CAIDAS, University of Würzburg, Germany
anna.krause@informatik.uni-wuerzburg.de

Bernd Zimmering
HSU-AI Institute for Artificial Intelligence, Helmut-Schmidt-University / University of the Federal Armed Forces Hamburg, Germany
bernd.zimmering@hsu-hh.de

Osvaldo Freitas
Departamento de Astronomía y Astrofísica, Universitat de València and Centro de Física das Universidades do Minho e do Porto (CF-UM-UP), Portugal