PERSONAL INFORMATION

Davide Murari

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Gender Male | Date of birth 22 May 1996 | Nationality Italian

PERSONAL STATEMENT

Postdoctoral Research Associate exploring the interplay between neural networks, dynamical systems, and structure-preserving numerical analysis.

PUBLICATIONS

The papers listed here and in the preprint section are those to which I have substantially contributed. They follow different author ordering conventions, depending on where they have been submitted. **The year on the left is written in magenta for those where I am the main author.**

2025 **Murari, Davide**, Takashi Furuya, Carola-Bibiane Schönlieb. "Approximation theory for 1-Lipschitz ResNets" NeurIPS Poster (2025).

2025 Celledoni, Elena, James Jackaman, **Davide Murari**, and Brynjulf Owren. "Predictions Based on Pixel Data: Insights from PDEs and Finite Differences." Journal of Computational Physics (2025): 114166.

2025 Celledoni, Elena, Ergys Çokaj, Andrea Leone, Sigrid Leyendecker, **Davide Murari**, Brynjulf Owren, Rodrigo T. Sato Martín de Almagro, and Martina Stavole. "Neural networks for the approximation of Euler's elastica." Computer Methods in Applied Mechanics and Engineering 435 (2025): 117584.

2024 Eliasof, Moshe, **Davide Murari**, Ferdia Sherry, and Carola-Bibiane Schönlieb. "Resilient Graph Neural Networks: A Coupled Dynamical Systems Approach ." ECAI - 27TH European Conference on Artificial Intelligence (2024): 1607-1614.

2024 Sherry, Ferdia, Elena Celledoni, Matthias J. Ehrhardt, **Davide Murari**, Brynjulf Owren, and Carola-Bibiane Schönlieb. "Designing stable neural networks using convex analysis and ODEs." Physica D: Nonlinear Phenomena 463 (2024): 134159.

2023 Celledoni, Elena, **Davide Murari**, Brynjulf Owren, Carola-Bibiane Schönlieb, and Ferdia Sherry. "Dynamical Systems–Based Neural Networks." SIAM Journal on Scientific Computing 45, no. 6 (2023): A3071-A3094.

2023 Celledoni, Elena, Andrea Leone, **Davide Murari**, and Brynjulf Owren. "Learning Hamiltonians of constrained mechanical systems." Journal of Computational and Applied Mathematics 417 (2023): 114608.

2021 Celledoni, Elena, Ergys Çokaj, Andrea Leone, **Davide Murari**, and Brynjulf Owren. "Lie group integrators for mechanical systems." International Journal of Computer Mathematics 99, no. 1 (2022): 58-88.

MAIN PREPRINTS

2025 Massucco, Alex, **Davide Murari**, Carola-Bibiane Schönlieb. "Neural Networks with Orthogonal Jacobian" arXiv preprint arXiv:2508.02882 (2025).

2025 **Murari, Davide**, Nicola Sansonetto. "From Euler-Jacobi to Bogyavlensky and back" arXiv preprint arXiv:2503.21950 (2025).

2025 De Marinis, Arturo, **Davide Murari**, Elena Celledoni, Nicola Guglielmi, Brynjulf Owren, and Francesco Tudisco. "Approximation properties of neural ODEs." arXiv preprint arXiv:2503.15696 (2025).

2025 Liu, Chaoyu, **Davide Murari**, Chris Budd, Lihao Liu, and Carola-Bibiane Schönlieb. "Enhancing Fourier Neural Operators with Local Spatial Features." arXiv preprint arXiv:2503.17797 (2025).

2024 Canizares, Priscilla, **Davide Murari**, Carola-Bibiane Schönlieb, Ferdia Sherry, and Zakhar Shumaylov. "Symplectic Neural Flows for Modeling and Discovery." arXiv preprint arXiv:2412.16787 (2024).

2024 Betcke, Marta M., Lisa Maria Kreusser, and **Davide Murari**. "Parallel-in-Time Solutions with Random Projection Neural Networks." arXiv preprint arXiv:2408.09756 (2024).

RESEARCH POSITIONS

1st October 2024 - 31st July 2028
Postdoctoral Research Associate in the Cambridge Image Analysis group of Professor Carola-Bibiane Schönlieb, Department of Applied Mathematics and Theoretical Physics, University of Cambridge. The position is funded by two EPSRC programme grants under the projects EP/V026259/1 and EP/Y028783/1.

RESEARCH SECONDMENTS

March-May 2023
Visiting researcher at the Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom, during the thematic programme titled "The mathematical and statistical foundation of future data-driven engineering".

October 2021
Visiting researcher at the Isaac Newton Institute for Mathematical Sciences, Cambridge, United Kingdom, during the thematic programme titled "Mathematics of deep learning".

EDUCATION

2020-September 2024
PhD in Numerical Analysis, Norwegian University of Science and Technology, supervised by Professors Elena Celledoni and Brynjulf Owren. Thesis title: "Neural Networks, Differential Equations, and Structure Preservation".

2018-2020
Master in Mathematics (L-40), University of Verona, Italy. Thesis title: "Integrable Non-Hamiltonian Systems: From B-Integrability to Euler-Jacobi Theorem and Back", supervised by Professor Nicola Sansonetto. Final mark: 110/110 cum laude.

2015-2018
Bachelor in Applied Mathematics (L-35), University of Verona, Italy. Thesis title translating to "An Overview of Ergodic Theory and Dynamical Billiards", supervised by Professor Nicola Sansonetto. Final mark: 110/110 cum laude.

PEER REVIEW

Reviewer for the following scientific journals:

- Calcolo
- Journal of Computational and Applied Mathematics
- IMA Journal of Applied Mathematics
- IMA Journal of Numerical Analysis
- SIAM Journal of Scientific Computing
- Journal of Computational Physics

ORGANISED MINI-SYMPOSIA

Collaborated on the organisation of two mini-symposia:

- Mini-symposium at SciCADE 2024, Singapore, July 15 2024 - July 19 2024. Title of the mini-symposium: "Dynamical systems, structure preservation and deep learning".
- Mini-symposium at Geometric Science of Information (GSI), St. Malo, France, August 30 2023 - September 1 2023. Title of the mini-symposium: "Deep Learning: Methods, Analysis and Applications to Mechanical systems".

EDITORIAL WORK

2021-2022
Guest editor for the ECMI Annual reports of the years 2021 and 2022.

SELECTED FUNDING SOURCES

January 2024
Trond Mohn Foundation (TMS) grants: Support for attending the Geilo Winter School "Graphs and Applications", from the 21st to the 26th of January 2024. The funding has been of 12,000.00 NOK, currently valued at about £885.00.

March-April 2023
Simons visiting fellowship: Support for participating in the thematic semester "The mathematical and statistical foundation of future data-driven engineering" during the days from the 7th of March 2023 to the 2nd of May 2023. The funding has been £1,400.00.

October 2021
Isaac Newton Institute: Support for participating in the thematic semester titled "Mathematics of deep learning" during the days from the 8th to the 30th of October 2021. The funding has been £330.00.

TEACHING AND SUPERVISION

29 September - 03 October 2025
Invited lecturer at the 11th CISM–AIMETA Advanced Course on "Machine Learning for Solid Mechanics".

July 2025 - September 2025	Supervision of two summer interns at the University of Cambridge through the Philippa Fawcett Internship and Summer Research in Maths (SRIM) programmes.
February 2025 - current date	Co-supervision of the master's thesis of a student from Politecnico di Milano.
January - March 2025	Teaching the graduate course "Geometric Numerical Analysis and Deep Learning" at the University of Cambridge.
November 2024	Teaching the master-level mini-course "Geometric Methods for Differential Equations and Learning Applications" at the University of Verona.
Fall 2023	Assistant for the course "Numerical Solution of Partial Differential Equations Using Element Methods - TMA4220" at NTNU.
Fall 2022	Assistant for the course "Numerical Solution of Partial Differential Equations Using Element Methods - TMA4220" at NTNU.
Spring 2022	Assistant for the course "Optimization 1 - TMA4180" at NTNU.
Fall 2021	Assistant for the course "Numerical Solution of Partial Differential Equations Using Element Methods - TMA4220" at NTNU.
Spring 2021	Assistant for the course "Differential Equations and Dynamical Systems - TMA4165" at NTNU.

SELECTED INVITED TALKS

July 2025	Joint SIAM/CAIMS annual meeting (AN25), Montreal, Canada. Talk title: "Symplectic Neural Flows".
October 2024	Workshop "Deep Learning for PDE-based Inverse Problems", Oberwolfach, Germany. Talk title: "Dynamical systems-based structured networks".
October 2024	SIAM Conference on Mathematics of Data Science (MDS24), Atlanta, USA. Talk title: "Structure-Preserving Solutions of Hamiltonian Systems Based on Neural Networks"
February 2024	BIRS Workshop "Structured Machine Learning and Time–Stepping for Dynamical Systems", Banff, Canada. Talk title: "Improving the robustness of Graph Neural Networks with coupled dynamical systems".
August 2023	ICIAM 2023, Tokyo, Japan. Talk title: "Structured neural networks and some applications".
June 2023	ECMI Conference 2023, Wroklav, Poland. Talk title: "Learning Hamiltonians of constrained mechanical systems".
June 2023	FoCM 2023, Paris, France. Talk title: "Structured neural networks and some applications to dynamical systems".
February 2023	SIAM CSE, Amsterdam, Netherlands. Talk title: "Structured neural networks and their relevance for mechanical systems".
December 2022	Theoretical and Computational aspects of Dynamical Systems (HB60), Trysil, Norway. Talk title: "Dynamical systems-based neural networks".
July 2022	SciCADE, Reykjavík, Iceland. Talk title: "Structure preserving neural networks coming from ODE models".
May 2022	Machine Learning and Dynamical Systems Seminar of the Alan Turing Institute, Online. Talk title: "Learning Hamiltonians of constrained mechanical systems".

POPULARISATION OF MATHEMATICS

Interested in communicating mathematics, sharing content about various topics in this field with an ongoing outreach project in Italian:

- in written format on the blog: https://www.mathone.it/

- in video format on the YouTube channel: https://www.youtube.com/@MathoneVideo (8.6k subscribers).

LANGUAGE SKILLS

Mother tongue	Italian
Other languages	
English	Full professional proficiency
Norwegian (Bokmål)	Intermediate