

Marco Nurisso

PHD STUDENT IN PURE AND APPLIED MATHEMATICS

Politecnico di Torino, Turin, Italy

CENTAI Institute, Turin, Italy

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Summary

I am a PhD student in mathematics, passionate about how topology and geometry can give us insights about neural networks and cognitive systems.

Education

Politecnico di Torino

Turin, Italy

PHD IN PURE AND APPLIED MATHEMATICS

Nov. 2022 - Jan. 2026 (expected)

- In collaboration with CENTAI Institute of Turin
- Theme: Topological Methods for Explainable Artificial Intelligence
- Supervisors: Prof. Francesco Vaccarino (Politecnico di Torino), Prof. Giovanni Petri (Northeastern University London / CENTAI Institute)

Politecnico di Torino

Turin, Italy

MASTER'S DEGREE IN MATHEMATICAL ENGINEERING

Sep. 2020 - Oct. 2022

- 110/110 cum laude
- Thesis title: Analytical Characterization of the Simplicial Kuramoto Model
- Thesis supervisors: Prof. Francesco Vaccarino, Prof. Giovanni Petri
- External collaborators: Dr. Alexis Arnaudon, Dr. Maxime Lucas, Dr. Paul Expert, Dr. Ropert Peach

Politecnico di Torino

Turin, Italy

BACHELOR'S DEGREE IN MATHEMATICS FOR ENGINEERING

Sep. 2017 - Sep. 2020

- 110/110 cum laude
- Member of Young Talent Project: additional courses and scholarship awarded to the top 2% of Politecnico di Torino's students
- Thesis title: Symmetries of the Geodesic Equation
- Thesis supervisor: Prof. Giovanni Manno (Politecnico di Torino)

Publications

- [1] **M. Nurisso**, J. Fernando, R. Deshpande, A. Perotti, R. Marjeh, S. M. Frankland, R. L. Lewis, T. W. Webb, D. Campbell, F. Vaccarino, et al., "Bound by semanticity: Universal laws governing the generalization-identification tradeoff," *arXiv preprint arXiv:2506.14797*, 2025.
- [2] A. Santoro, **M. Nurisso**, and G. Petri, "From nodes to edges: Edge-based laplacians for brain signal processing," in *33rd European Signal Processing Conference (EUSIPCO)*, 2025.
- [3] P. Leroy, A. Mastropietro, **M. Nurisso**, and F. Vaccarino, "Attributes shape the embedding space of face recognition models," in *Forty-Second International Conference on Machine Learning*, 2025.
- [4] **M. Nurisso**, P. Leroy, and F. Vaccarino, "Topological obstruction to the training of shallow relu neural networks," in *Advances in Neural Information Processing Systems*, vol. 37, 2024.
- [5] **M. Nurisso**, M. Morandini, M. Lucas, F. Vaccarino, T. Gili, and G. Petri, "Higher-order laplacian renormalization," *Nature Physics*, pp. 1–8, 2025.
- [6] **M. Nurisso**, A. Arnaudon, M. Lucas, R. L. Peach, P. Expert, F. Vaccarino, and G. Petri, "A unified framework for simplicial kuramoto models," *Chaos: An Interdisciplinary Journal of Nonlinear Science*, vol. 34, no. 5, 2024.
- [7] **M. Nurisso**, M. Raviola, and A. Tosin, "Network-based kinetic models: Emergence of a statistical description of the graph topology," *European Journal of Applied Mathematics*, pp. 1–22, 2024.

Technical Skills

Programming Python, Deep Learning (Pytorch), MATLAB, Mathematica, R, LaTeX

Graphics Inkscape, Adobe Photoshop

Languages Italian, English

Academic Experience

VISITING PERIODS

Princeton Neuroscience Institute

VISITING STUDENT

- Worked with Prof. Jonathan Cohen on the information-theoretic formulation of the fundamental tradeoff between generalization and identification in cognitive systems.

Princeton, US

June 2025 - July 2025

RWTH Aachen

VISITING STUDENT

- Worked with Prof. Michael Schaub on the formulation of diffusion geometry for graphs and point clouds.

Aachen, Germany

April 2025 - May 2025

Network Science Institute, Northeastern University London

VISITING STUDENT

- Collaborated with the institute's students on a information and graph-theoretic formalization of generalization and parallel processing.

London, UK

Nov. 2025 - Jan. 2025

INTERNSHIPS

CENTAI Institute

MASTER'S THESIS

- Worked with researchers at CENTAI Institute and performed a full analytical study of the topological variant of the Kuramoto model.

Turin, Italy

May 2022 - Oct. 2022

PEER REVIEW Nature Communications, Complexity, Applicable Algebra in Engineering, Communication and Computing (AAECC)

Awards & Grants

AWARDS

2022	National Recovery and Resilience Plan (NRRP) PhD Grant , Italian Ministry of Education, University and Research, CENTAI Institute	
2022	Sergio Marchionne Student Achievement Award , Stellantis NV — scholarship awarded to students graduating with top marks	
2020	1st place , Promoting the Sustainability of College Campuses through Serious Games	
2020	Winner , EUvsVirus Hackathon Challenge	
2017	Young Talent Project , Politecnico di Torino — scholarship awarded to top students in the entry test	

Conferences & Talks

Network Science Institute seminar

TALK: *Bound by semanticity: universal laws governing the generalization-identification tradeoff*

Boston, US

July 2025

Thirty-Eighth Annual Conference on Neural Information Processing Systems

POSTER: *Topological obstructions to the training of shallow ReLU networks*

Vancouver, Canada

Dec. 2024

WINQ Program on Complex and Quantum Systems

PHD TALK: *Interactions and peculiarities of simplicial dynamical models*

Stockholm, Sweden

May 2024

NetSciX 2024, International School and Conference on Network Science

SPEAKER: *Higher-order Laplacian renormalization of simplicial complexes*

Venice, Italy

Jan. 2024

Mini-Workshop: TDA in Turin

SPEAKER: *Interactions and topological synchronization in the simplicial Kuramoto model*

Turin, Italy

Nov. 2023

ECML PKDD 2023

VOLOUNTEER STAFF

Turin, Italy

Oct. 2023

Lipari school. Complex networks: from socio-economic systems to biology and the brain

PHD TALK: *Interactions and topological synchronization in the simplicial Kuramoto model*

Lipari, Italy

July 2023

Extra-Professional Activity

HOBBIES AND PASSIONS Illustration, guitar playing, literature, RPGs.