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 complex systems and neural networks.

Education

Politecnico di Torino — *Turin, Italy*

PhD in Pure and Applied Mathematics — *Nov. 2022 - April 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. Marjieh, 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 — *Princeton, US*

Visiting student — *June 2025 - July 2025*

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

RWTH Aachen — *Aachen, Germany*

Visiting student — *April 2025 - May 2025*

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

Network Science Institute, Northeastern University London — *London, UK*

Visiting student — *Nov. 2025 - Jan. 2025*

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

Internships

CENTAI Institute — *Turin, Italy*

Master's Thesis — *May 2022 - Oct. 2022*

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

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 — *Boston, US*

Talk: *Bound by semanticity: universal laws governing the generalization-identification tradeoff* — *July 2025*

Thirty-Eighth Annual Conference on Neural Information Processing Systems — *Vancouver, Canada*

Poster: *Topological obstructions to the training of shallow ReLU networks* — *Dec. 2024*

WINQ Program on Complex and Quantum Systems — *Stockholm, Sweden*

PhD talk: *Interactions and peculiarities of simplicial dynamical models* — *May 2024*

NetSciX 2024, International School and Conference on Network Science — *Venice, Italy*

Speaker: *Higher-order Laplacian renormalization of simplicial complexes* — *Jan. 2024*

Mini-Workshop: TDA in Turin — *Turin, Italy*

Speaker: *Interactions and topological synchronization in the simplicial Kuramoto model* — *Nov. 2023*

ECML PKDD 2023 — *Turin, Italy*

Volounteer staff — *Oct. 2023*

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

PhD talk: *Interactions and topological synchronization in the simplicial Kuramoto model* — *July 2023*

Extra-Professional Activity

Hobbies and passions Illustration, guitar playing, literature, RPGs.