Manuel Lecha

Predoctoral Fellow at AITHYRA · ELLIS PhD Student

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RESEARCH

I'm a predoctoral fellow at AITHYRA in Michael Bronstein's group and an ELLIS PhD student working on representation learning. My recent paper, Intrinsic Geometry Matching, learns the *intrinsic geometry* of a process independently of how it is observed. Previously, I worked on graph and higher-order neural networks.

EDUCATION

Nov 2024–present
PhD in Machine Learning
ELLIS PhD Program · TU Wien · University of Oxford
Supervised by Michael Bronstein and Iolo Jones.

2021–2022
MSc in Advanced Mathematics and Mathematical Engineering
Universitat Politècnica de Catalunya
Thesis: *Multiparameter Persistent Homology*.

2020–2021
Postgraduate Diploma in Financial Mathematics
Universitat Politècnica de Catalunya

2015–2021
BSc in Mathematics
Universitat de Barcelona · University of Warwick
Thesis: *Functional Summaries of Persistence Diagrams for Time Series Analysis*.

2015–2021
BSc in Computer Science and Software Engineering
Universitat de Barcelona

EXPERIENCE

2026–present
Predoctoral Fellow, AITHYRA
Michael Bronstein's group.

2026
Visiting PhD Student, University of Oxford
ELLIS PhD Program.

2024–2026
Research Fellow, Italian Institute of Technology
ELLIS PhD Program.

2023–2024
Research Fellow, Universitat de Barcelona
Sergio Escalera's group.

2021
Data Analyst, KPMG, Madrid
Development and validation of risk and forecasting models for financial services.

2020–2021
Data Analyst Intern, iMath Sherpa, Barcelona
Machine-learning models for stock-market analysis.

PUBLICATIONS

2026

Intrinsic Geometry Matching: Learning Observation-Equivariant Process Geometry
M. Lecha, M. Bronstein, I. Jones
arXiv preprint arXiv:2610.16995, 2026 — arXiv

Expressivity Saturation: Reduced Affine Region Usage Under Increasing Task Complexity
X. Qi, Y. Wei, F. Yu, **M. Lecha**
Transactions on Machine Learning Research (TMLR), 2026 — paper arXiv

E-M3RF: An Equivariant Multimodal 3D Re-assembly Framework
A. Islam, S. Fiorini, **M. Lecha**, T. Tsesmelis, S. James, P. Morerio, A. Del Bue
European Conference on Computer Vision (ECCV), 2026 — paper arXiv code

2026 **Directed Semi-Simplicial Learning with Applications to Brain Activity Decoding**
M. Lecha, A. Cavallo, F. Dominici, R. Levi, A. Del Bue, E. Isufi, P. Morerio, C. Battiloro
International Conference on Learning Representations (ICLR), 2026 paper arXiv code

Topological Deep Learning Challenge 2025: Expanding the Data Landscape
G. Bernárdez, L. Telyatnikov, ..., **M. Lecha**, ..., N. Miolane (66 authors)
Conference on Topology, Algebra, and Geometry in Data Science (TAG-DS 2025), PMLR 321 paper code

2025 **Higher-Order Topological Directionality and Directed Simplicial Neural Networks**
M. Lecha, A. Cavallo, F. Dominici, E. Isufi, C. Battiloro
IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP), 2025
paper arXiv code

TopoBench: A Framework for Benchmarking Topological Deep Learning
L. Telyatnikov, G. Bernárdez, ..., **M. Lecha**, ..., T. Papamarkou (37 authors)
Journal of Data-centric Machine Learning Research (DMLR) 2(20), 2025 paper arXiv code

2024 **TopoX: A Suite of Python Packages for Machine Learning on Topological Domains**
M. Hajij, M. Papillon, ..., **M. Lecha**, ..., N. Miolane (43 authors)
Journal of Machine Learning Research (JMLR) 25(374), 2024 paper arXiv code

ICML Topological Deep Learning Challenge 2024: Beyond the Graph Domain
G. Bernárdez, L. Telyatnikov, ..., **M. Lecha**, ..., N. Miolane (73 authors)
GRaM Workshop at ICML 2024, PMLR 251 paper arXiv code

2023 **ICML 2023 Topological Deep Learning Challenge: Design and Results**
M. Papillon, M. Hajij, ..., **M. Lecha**, ..., N. Miolane (56 authors)
TAG-ML Workshop at ICML 2023, PMLR 221 paper arXiv code

AWARDS AND HONOURS

2026 G-Research Early-Career Researcher Grant.

2024 ICML 2024 Topological Deep Learning Challenge winner.

2023 ICML 2023 Topological Deep Learning Challenge winner.

TALKS AND SERVICE

2026 **Co-organizer, GRaM Workshop at ICLR 2026**
Geometry-grounded Representation Learning and Generative Modeling.

2026 ***Learning with Directed Higher-Order Structure***
Invited seminar, Applied Algebraic Topology Research Network (AATRN); recording.

2023 ***Laplacians and Network Sheaves***
Invited seminar, Topological Machine Learning Seminar, Universitat de Barcelona.

SCHOOLS

2026 G-Research Spring Week.

2025 Oxford Machine Learning Summer School: Representation Learning and Generative AI.

2024 Cambridge ELLIS Summer School on Probabilistic Machine Learning.