Contact Information

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Research Interests

Algebraic topology, metric geometry, and discrete homotopy theory; Applied topology, computational geometry, topological data analysis; applications in neuroscience, network science, machine learning, and artificial intelligence.

Academic Appointments

Phillip Griffiths Assistant Research Prof., Duke University — Jan 2024 to present
Department of Mathematics
Mentor: Prof. Ezra Miller

ICERM Semester Postdoc, Brown University — Sep 2023 to Dec 2023
Department of Mathematics
Mentor: Prof. Vladimir Itskov

Education

Ph.D. in Mathematics, The Ohio State University — Aug 2017 to Aug 2023
Advisor: Prof. Facundo Mémoli
Thesis: *Beyond Persistent Homology: More Discriminative Persistent Invariants*

M.Phil. in Mathematics, Hong Kong University of Science and Technology, Hong Kong — Aug 2015 to Aug 2017
Advisor: Prof. Jing-song Huang
Thesis: *Generalized Fourier Transforms Associated With Oscillator Representations*

B.S. in Mathematics, Sichuan University, China — Aug 2010 to Aug 2015

Publications and Preprints

Refereed Journal Publications:

[9] Facundo Mémoli and Ling Zhou. Ephemeral Persistence Features and the Stability of Filtered Chain Complexes. *Journal of Computational Geometry* (2025), Volume 15 (2): Special Issue of Selected Papers from SoCG 2023, pp. 258–328.
doi: 10.20382/jocg.v15.i2.a8.

[8] Facundo Mémoli and Ling Zhou. Persistent Homotopy Groups of Metric Spaces. *Journal of Topology and Analysis* (2024), pp. 1–62.
doi: 10.1142/S1793525324500018.

[7] Facundo Mémoli, Anastasios Stefanou, and Ling Zhou. Persistent Cup Product Structures and Related Invariants. *Journal of Applied and Computational Topology* (2024), Volume 8, pp. 93–148.
doi: 10.1007/s41468-023-00138-5.

[6] Tong Qin, Ling Zhou, and Dongbin Xiu. Reducing Parameter Space for Neural Network Training. *Theoretical and Applied Mechanics Letters* (2020). Volume 10 (3), pp. 170–181.
doi: 10.1016/j.taml.2020.01.043.

[5] Jing-Song Huang and Ling Zhou. Generalized Fourier Transforms Associated with the Oscillator Representation. *Journal of Fourier Analysis and Applications* (2019). Volume 25, pp. 2782–2800.
doi: 10.1007/s00041-019-09682-0.

Refereed Conference Publications:

[4] Inés García-Redondo, Claudia Landi, Sarah Percival, Anda Skeja, Bei Wang, and Ling Zhou. Finding the Cores of Higher Graphs Using Geometric and Topological Means: A Survey. *(accepted to WinCompTop3 Proceedings)* (2025).
link: https://arxiv.org/abs/2506.19857.

[3] Facundo Mémoli and Ling Zhou. Ephemeral Persistence Features and the Stability of Filtered Chain Complexes. In: *39th International Symposium on Computational Geometry (SoCG 2023)* (2023), Volume 258, pp. 51:1–51:18.
doi: 10.4230/LIPIcs.SoCG.2023.51.

[2] Luis Scoccola, Hitesh Gakhar, Johnathan Bush, Nikolas Schonsheck, Tatum Rask, Ling Zhou, and Jose A. Perea. Toroidal Coordinates: Decorrelating Circular Coordinates with Lattice Reduction. In: *39th International Symposium on Computational Geometry (SoCG 2023)* (2023), Volume 258, pp. 57:1-57:20.
doi: 10.4230/LIPIcs.SoCG.2023.57.

[1] Marco Contessoto, Facundo Mémoli, Anastasios Stefanou, and Ling Zhou. Persistent Cup-Length. In: *38th International Symposium on Computational Geometry (SoCG 2022)* (2022), Volume 224, pp. 31:1-31:17.
doi: 10.4230/LIPIcs.SoCG.2022.31.

PREPRINTS

[7] Inés García-Redondo, Claudia Landi, Sarah Percival, Anda Skeja, Bei Wang, and Ling Zhou. Effective Resistance in Simplicial Complexes as Bilinear Forms: Generalizations and Properties. *arXiv preprint* (2025).
link: https://arxiv.org/abs/2511.10749.

[6] Ekaterina S Ivshina, Galit Anikeeva, and Ling Zhou. Doughnut or Mickey Mouse? Detecting Toroidal Structure in Data through Persistent Cup-Length. *arXiv preprint* (2025).
link: https://arxiv.org/abs/2507.11151.

[5] Facundo Mémoli and Ling Zhou. Persistence and Topological Complexity. *arXiv preprint* (2025).
link: https://arxiv.org/abs/2506.17888.

[4] Anibal M. Medina-Mardones and Ling Zhou. Persistent Cohomology Operations and Gromov–Hausdorff Estimates. *arXiv preprint* (2025).
link: https://arxiv.org/abs/2503.17130.

[3] Ling Zhou. Persistent Sullivan Minimal Models of Metric Spaces. *arXiv preprint* (2023).
link: https://arxiv.org/abs/2310.06263.

[2] Henry Adams, Johnathan Bush, Nate Clause, Florian Frick, Mario Gómez, Michael Harrison, R. Amzi Jeffs, Evgeniya Lagoda, Sunhyuk Lim, Facundo Mémoli, Michael Moy, Nikola Sadovek, Matt Superdock, Daniel Vargas, Qingsong Wang, and Ling Zhou. Gromov-Hausdorff distances, Borsuk-Ulam theorems, and Vietoris-Rips complexes. *arXiv preprint* (2023).

link: https://arxiv.org/abs/2301.00246.

[1] Sunhyuk Lim, Facundo Memoli, Zhengchao Wan, Qingsong Wang, and Ling Zhou. Some Results about the Tight Span of Spheres. *arXiv preprint* (2021). link: https://arxiv.org/abs/2112.12646.

INVITED TALKS *Talks associated with conference publications listed above are not included here.*

[30] Beyond Persistent Homology: Persistent Cup Products and Related Persistent Invariants. In: *Bridging Algebraic Combinatorics, Topology and Applications*, Rutgers, Aug 5, 2025.

[29] Persistence and Topological Complexity. In: *Mathematical Congress of the Americas 2025*, Miami, Jul 22, 2025.

[28] Persistent Cup Product Structures and Related Invariants. In: *Geometry and Topology Seminar*, University of Missouri, Mar 13, 2025.

[27] Persistent Cohomology Operations and Gromov–Hausdorff Estimates. In: *Special Session on Applied Topology, 58th Spring Topology and Dynamics Conference*, Christopher Newport University, Mar 8, 2025.

[26] Persistent Cohomology Operations and Gromov-Hausdorff Estimates. In: *AMS Special Session on Applied and Computational Topology*, at University of Albany, Oct 20, 2024.

[25] Ephemeral Persistence Features and the Stability of Filtered Chain Complexes. In: *AMS Special Session on Geometry and Symmetry in Data Science*, at Florida State University, Oct 23, 2024.

[24] Persistent Cup Product Structures and Related Invariants. In: *Topology Seminar*, at University of California, Santa Barbara, Mar 12, 2024.

[23] Persistent Cup Product Structures and Related Invariants. In: *AMS Special Session on Discrete Homotopy Theory*, at JMM 2024, Jan 6, 2024.

[22] Decoding Zero-Length Bars. In: *AIM-AMS Special Session on Applied Topology Beyond Persistence Diagrams*, at JMM 2024, Jan 6, 2024.

[21] Persistent Cup Product Structures and Related Invariants. In: *Northeastern Topology Seminar*, Oct 10, 2023.

[20] Other Persistence Invariants: Homotopy Groups and the Cohomology Ring. In: *OU Topology and Data Science Seminar*, Nov 7, 2022.

[19] Ephemeral Persistence Features and the Stability of Filtered Chain Complexes. In: *Computational Persistence 2022 Workshop*, Nov 2, 2022.

[18] From Discrete to Persistent Homotopy Groups. In: *Quantitative Topology Seminar*, at University of Tennessee, Oct 19, 2022.

[17] Persistent Cup-Length. In: *Algebraic Topology and Topological Data Analysis: A Conference in Honor of Gunnar Carlsson*, Aug 2, 2022.

[16] Persistent Cup-Length. In: *Women in Computational Topology at 2022 AWM Research Symposium*, Jun 16–19, 2022.

[15] Persistent Homotopy Groups of Metric Spaces. In: *Homotopical Aspects of TDA*, at Center for Quantum and Topological Systems, NYU Abu Dhabi, Jun 2, 2022.

[14] Persistent Cup-Length. In: *AMS Special Session on Computational Topology and Applications*, at AMS Spring Western Sectional Meeting, May 14–15, 2022.

[13] Persistent Homotopy Groups of Metric Spaces. In: *Bridging Applied and Quantitative Topology*, May 10, 2022. [Video].

[12] Persistent Homotopy Groups of Metric Spaces. In: *AATRN Vietoris-Rips Seminar*, Jan 21, 2022. [Video].

[11] Persistent Cup-Length. In: *University of Florida Topological Data Analysis Conference*, Jan 20, 2022.

Contributed talks and poster presentations

[10] Ephemeral Persistence Features and the Stability of Filtered Chain Complexes. In: *Third Graduate Student Conference: Geometry and Topology Meet Data Analysis and Machine Learning (GTDAML2023)*, Jun 9, 2023.

[9] (Poster) Persistent Homotopy Groups of Metric Spaces. In: *ATMCS10*, Jun 20, 2022.

[8] (Poster) Persistent Cup-Length. In: *ATMCS10*, Jun 20, 2022.

[7] Other Persistence Invariants: Homotopy and the Cohomology Ring. In: *Topology Seminar*, at Florida State University, Jan 18, 2022.

[6] Short Tutorial: The Cup Product Operation. In: *Tutorial-a-thon hosted by AATRN and WinCompTop*, Jan 3, 2022.

[5] Persistent Cup-Length and Its Computation. In: *OSU Topology, Geometry, and Applications - Graduate Student Seminar Group*, Dec 10, 2021.

[4] Other Persistence Invariants: Homotopy and the Cohomology Ring. In: *Online Workshop "Beyond TDA – Persistent Topology and Its Applications in Data Sciences"*, at The Ohio State University, Aug 2021.

[3] Persistent Homotopy Groups of Metric Spaces. In: *TGDA Talks co-hosted by AATRN*, Jan 2021.

[2] Filtered Chain Complexes and Verbose Barcodes. In: *OSU Topology, Geometry, and Applications - Graduate Student Seminar Group*, at The Ohio State University, Nov 20, 2022.

[1] Persistent Homotopy Groups of Metric Spaces. In: *MBI Seminar Series*, at The Ohio State University, Sep 2020.

Teaching Experience

Duke University, Durham, NC **Spring 2024 to present**

Instructor

- MATH 412: Topological Data Analysis, Fall 2025
- MATH 393: Research Independent Study, Fall 2025
- MATH 230: Probability (Section 3), Spring 2025
- MATH 230: Probability (Sections 4 & 5), Fall 2024
- MATH212: Multivariable Calculus, Summer 2024

Teaching Assistant

- MATH218D-1: Problem Sessions for Linear Algebra (Sections 1 & 2), Spring 2024

The Ohio State University, Columbus, OH **Fall 2016 to Fall 2022**

Teaching Assistant

- MATH 2173: Engineering Mathematics B, Fall 2022
- MATH 1172: Calculus II, Spring 2019

Grader

- MATH 4350: Quantitative Neuroscience, Spring 2021
- MATH 4570: Applied Algebraic Topology, Spring 2021
- MATH 3345: Foundations of Higher Mathematics, Fall 2018

Erdős Institute's Boot Camp **May 2022**

Answered questions during group discussions

Hong Kong University of Science and Technology, Hong Kong **Spring 2016 to Spring 2017**

Teaching Assistant

- MATH 4151: Introduction to Lie Groups, Fall 2017
  Authored lecture notes of course material archived at https://zhouling0903.wixsite.com/math4151t.
- MATH3033: Real Analysis, Fall 2016
- MATH1014: Calculus II, Spring 2016

Mentoring Experience

Duke University, Durham, NC **Fall 2025**

Research Mentor, Research Independent Study & Duke Semester Research Program

- Student: Yuan Xie (Duke Kunshan University undergraduate)
- Title: *Topological Unification of Barotropic and Baroclinic Atmospheric Regimes: A Morse Theory Approach*
- Goal: Apply Morse graph methods for time series analysis.

The Ohio State University, Columbus, OH **Spring 2022**

Research Mentor, Directed Reading Program

Guided an undergraduate to read about topological data analysis (TDA) and to code in Python to analyze football data using TDA tools

Professional Service and Outreach

Organizing Service

- Organizer of the weekly group meetings of Prof. Ezra Miller's research lab, at Duke, Fall 2024 – present.
- Co-organizer of Data Science and Applied Math Working Group (DAWG) Workshop at Duke University, Fall 2024. (with Ranthony Clark, Aziz Burak Gülen, and Jonathan Mousley)
- Co-organizer of Applied Math Working Groups, at Duke University, Spring 2024 and Fall 2024. (with Ranthony Clark and Jonathan Mousley)
- Co-organizer of an AMS Special Session on Bridging Applied and Quantitative Topology, at JMM 2024, San Francisco, CA, 2024. (with Henry Adams)

- Co-organizer of a AMS special session on Topological Persistence: Theory, Algorithms, and Applications, at the Spring Southeastern AMS Sectional Meeting at Georgia Institute of Technology, Atlanta, GA, 2023. (with Luis Scoccola and Hitesh Gakhar)
- Organizer of the weekly group meetings of the research group Network Data Analysis, at OSU, Jan 2020 – Aug 2022.
- Co-organizer of the First Midwest Graduate Student Conference: Geometry and Topology meet Data Analysis and Machine Learning, at OSU, 2019. (with Samir Chowdhury, Woojin Kim, Sunhyuk Lim, Luis Polanco, Kritika Singhal, and Zhengchao Wan)

Training Service

- Teaching Assistant, PUMA: Practicum for Undergraduate Mathematicians in Topology, Institute for Pure and Applied Mathematics (IPAM), UCLA, April 2025.

Referee Service

- *ACM-SIAM Symposium on Discrete Algorithms (SODA26)*, 2025
- *Discrete & Computational Geometry*, 2024
- *IEEE Pacific Visualization Conference (PacificVis 2025)*, 2024
- *Analysis and Geometry in Metric Spaces*, 2024
- *European Symposium on Algorithms*, 2024
- *Journal of Applied and Computational Topology*, 2022 and 2024
- *The 39th International Symposium on Computational Geometry*, 2023
- *Expositiones Mathematicae*, 2022
- *The 38th International Symposium on Computational Geometry (subreviewer)*, 2022
- *The 37th International Symposium on Computational Geometry (subreviewer)*, 2021

Committee Service

- M.Sc. Thesis Defense Committee, Felix Friedrich (University of Bremen, Germany), *Persistence Theory for Finitely Generated K-Algebras: A Focus on Face Rings of Simplicial Complexes with a Combinatorial Approach*, February 12, 2024

Grants and Awards

[10] "AMS-Simons Travel Grant", $2,500 per year, July 1, 2024 to June 30, 2026

[9] "Special Graduate Assignment", OSU, Spring 2020 & Spring 2023

[8] "Tibor Radó Graduate Fellowship", OSU, 2017–18

[7] "The 12th Epsilon Fund Award to Top Students", HKUST, 2016–2017

[6] "Din-Yu Hsieh Teaching Award", HKUST, 2016-2017

[5] "Scholarship of the Pilot Project for Fostering Top-Notch Students in Basic Science", 2013–2014

[4] "Outstanding Student Award", Sichuan University (Top 10%), 2011–12, 2012–13

[3] "First Class Comprehensive Scholarship", Sichuan University (Top 2%), 2010–11, 2011–12

[2] "National Endeavor Fellowship 2012–13", China, 2013–14

[1] "National Scholarship", China, 2010–11 and 2011–12

Other Projects

Python Project: Fine-tuning LLMs for Math Grading

- Project at Erdős Institute's Bootcamp, Summer 2025
- Collaborators: Mauro Camargo, Ali Naseri Sadr, Arvind Suresh, Yewei Xu
- Description: Built an on-device AI grading assistant to classify student math solutions as correct, conceptual error, or computational error
- Github: https://github.com/arvindsuresh-math/Erdos-DL-June25-Math
- Tools used: Hugging Face Transformers, Gradio, PEFT/LoRA, Unsloth, Scikit-learn

Python Project: Foursquare Location Matching

- Project at Erdős Institute's Bootcamp, May 2022
- Collaborators: Tim Gorman and Yu Cao
- Description: Built a model to decide whether two given locations have the same point of interest
- Github: https://github.com/gormantt/foursquare-location-matching
- Tools used: Scikit-learn, Seaborn

Python Project: Steaming–Hot

- Project at Erdős Institute's Bootcamp, May 2021
- Collaborators: Alex Casella, Eduardo Medina, Joseph Leung, Kanishk Jain, and Rohit Satija
- Description: Built models to classify, predict and do survival analysis of Steam games and user data
- Github: https://github.com/steaming-hot/steaming-hot
- Tools used: BeautifulSoup, Scikit-learn, Pandas, Matplotlib

Python Project: Are you Van Gogh's

- Project at Erdős Institute's Bootcamp, May 2020
- Collaborators: Joseph Leung, Francisco Martinez, and Jiawei Sun
- Description:Built a model to determine if a painting is in Van Gogh's style or not
- Github: https://github.com/francis2martinez/BootCampProject2020
- Tools used: Ripser, Pandas

Undergraduate Research: Parameter Estimation of a Two-Parameter Ito Process

- Sichuan University, 2015
- Supervised by: Prof. Xiao-Hu Wang

Undergraduate Research: Optimization of Urban Public Transport System in Chengdu

- Sichuan University, 2011
- Supervised by: Prof. Bao-Feng Di