Halley Fritze

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EDUCATION

Ph.D, Mathematics, University of Oregon. 2025

- Dissertation: *Multiscale 2-Mapper: Exploratory Data Analysis Guided by the First Betti Number*
- Advisor: *Dev Sinha*

M.S, Mathematics, University of Oregon. 2021
B.S.Mathematics, North Dakota State University. 2017

- *Magna cum laude*

JOURNAL PUBLICATIONS

A forest is more than a bunch of trees: haplotypes in inferred ARGs. Halley Fritze, Peter Ralph, Nathaniel Pope, Jerome Kelleher. *Accepted to Genetics*, September 2025. https://doi.org/10.1093/genetics/iyaf198.

TopoBench: A Framework for Benchmarking Topological Deep Learning. Lev Telyatnikov, Guillermo Bernardez, Halley Fritze, Marissa Masden, et al. *Accepted to The Journal of Data-centric Machine Learning Research (DMLR)*, July 2025.
Preprint

OTHER PUBLICATIONS AND PROJECTS

Faithful Reeb Graph Reconstruction of a Tectonic Subduction Zone from Earthquake Hypocenters. Halley Fritze, Sushovan Majhi, Marissa Masden, Atish Mitra, Michael Stickney. *The 11th conference in the Algebraic Topology: Methods, Computation, & Science (ATMCS)*, July 2025.
Preprint

Multiscale 2-mapper – exploratory data analysis guided by the first Betti number. Halley Fritze. *Submitted to 42nd International Symposium in Computational Geometry (SoCG 2026).*
Preprint, GitHub Repository

Probabilistic Statements for Mapper Graphs. Enrique Alvarado, Robin Belton, Nicholas Della Pesca, Aine Doherty, Halley Fritze. *Submitted to 42nd International Symposium in Computational Geometry (SoCG 2026).*

The Erdös Institute Data Science Bootcamp: Foursquare Location Matching. Halley Fritze, Jay Hathaway, Max Vargas (2022).
GitHub Repository

ONGOING RESEARCH PROJECTS

Identifying orbits in atmospheric dynamical systems through temporally enriched mapper graphs. Halley Fritze, Joshua Dorrington.

Neutrophil State-space Modeling: Combining morphology and dynamics. Halley Fritze, Bhagirath Mehta, Alexandra Stavrianidi, Arianna Cao, Ishani Mukherji, Dev Sinha, Ronald Davis, Sharada Kalanidhi.

Restricted Mapper Classes. Enrique Alvarado, Robin Belton, Halley Fritze.

Topological Data Analysis for Prediction for Recombination in ARGs. Halley Fritze and Jonathan Terhorst.

Extending Haplotypes to Improve Accuracy for Geographic Ancestry Inference. Isla Roy, Halley Fritze, Gideon Bradburd.

ACADEMIC RESEARCH EXPERIENCE

University of Michigan, Ann Arbor, MI. 2025–Present
Department of Statistics: Postdoctoral Research Fellow

- Advisor: *Jonathan Terhorst*

Stanford Genome Technology Center, San Jose, CA. 2023–2025
Applied Statistician and Data Scientist Internship

- Principle Investigator: *Sharada Kalanidhi*

University of Oregon, Eugene, OR. 2019–2025
Mathematics Department: Graduate Research 2021–2025

- Advisor: *Dev Sinha*

Institute of Evolution and Ecology: Kern-Ralph Co-Lab 2022–2025

- Advisor: *Peter Ralph*

Sam Houston State University, Huntsville, TX. Summer 2016
NSF Research Experience for Undergraduates Program

North Dakota State University, Fargo, ND. 2015–2017
Ronald E. McNair Scholar

TEACHING EXPERIENCE

Mathematics Department, University of Oregon. 2019–2025
Instructor of Record for the following courses:

- Introduction to Probability and Statistics (Math 243)
- Calculus I (Math 251)
- Calculus II (Math 252)

Teaching Assistant and Grader for the following courses:

- College Algebra (Math 111)
- Calculus for Business and Social Sciences (Math 241)
  Lead TA: Winter 2025, Spring 2025
- Introduction to Probability and Statistics (Math 243)
  Lead TA: Fall 2023
- Calculus I (Math 251)

- Stochastic Processes (Math 467/567)
- Applied Mathematics II (Math 607)

Mathematics Department, North Dakota State University. 2017–2019
Teaching Assistant and Grader for the following courses:

- College Algebra (Math 103)
- Trigonometry (Math 105)
- College Pre-calculus (Math 107)
- Calculus I (Math 165)
- Calculus II (Math 166)

PRESENTATIONS

External Invited Talks

Topological Data Analysis for Inferring Genetic Recombination
Topological Data Analysis Seminar, Michigan State University. November 2025

Mapper Complexes: Probabilistic Guarantees and Empirical Outcomes
Applied Topology Seminar, SUNY Albany. November 2025

Multiscale 2-Mapper: Exploratory Data Analysis through the First Betti Number.
AMS Fall Southeastern Sectional Meeting, Tulane University. October 2025

Faithful Reeb Graph Reconstruction of a Tectonic Subduction Zone from Earthquake Hypocenters.
Invited Speaker, ATMCS 11, Montana State University. July 2025

Multiscale 2-Mapper: Exploratory Data Analysis through the First Betti Number.
Invited Speaker (Talk and Software Demo), TDV, University of Iowa. June 2025

A forest is more than its trees: haplotypes and ancestral recombination graphs.
TSKIT-dev Seminar. April 2025

Topological Exploration through higher dimensional mapper graphs.
AWM Pittsburgh Graduate Seminar, University of Pittsburgh. March 2025

Identifying orbits in atmospheric dynamical systems through temporally enriched mapper graphs.
Invited Speaker, Joint Mathematics Meetings, Seattle, WA. January 2025

Stability of higher-order covers for mapper.
Invited Speaker, Topology and Geometry Seminar, Oregon State University. November 2024

Embedded graph reconstruction under Hausdorff noise.
Invited Speaker, Fall Workshop in Computational Geometry, Tufts University. November 2024

Internal Talks

Fast Estimation of Recombination Rates using Topological Data Analysis.
Genetics Reading Seminar, University of Michigan. September 2025

2-mapper and stability for lattice covers.
Topology Seminar, University of Oregon. January 2025

Algebraic-topological tools for understanding higher-order structure in neural data.
Neuroscience Journal Club, University of Oregon. November 2024

Towers of Covers and Mapper.
Student Topology and Geometry Seminar, University of Oregon. May 2024

Inference in Hidden Markov Models.
Neuroscience Journal Club, University of Oregon. January 2024

Controllability of Nonlinear Systems.
Neuroscience Journal Club, University of Oregon. November 2023

Persistence Homology, an Overview.
Student Topology and Geometry Seminar, University of Oregon. April 2023

Topological Morphology Descriptors and Neuron Classification.
Neuroscience Journal Club, University of Oregon. March 2023

Topological Data Analysis and Tracking C. Elegans.
Student Topology and Geometry Seminar, University of Oregon. January 2023

Lefschetz Fibrations and Dehn Twists.
Topology Geometry Seminar, North Dakota State University April 2019

From Symplectic Geometry to Chaos.
Graduate Colloquium, North Dakota State University September 2018

Analysis of a Mathematical Model of the Carolina Wolfberry Plant.
Applied Mathematics Seminar, North Dakota State University August 2018

Poster Presentations

Multiscale 2-Mapper: Exploratory Data Analysis through the First Betti Number.
Invited Poster, ATMCS 11, Montana State University. July 2025

Enhanced topological inference through higher dimensional mapper graphs.
AWM Workshop Poster Presentations, Joint Mathematics Meetings, Seattle, WA. January 2025

CONFERENCES AND WORKSHOPS ATTENDED

AMS Sectional Meeting. Tulane University. October 2025
Invited Speaker in Advances in Applied Topology and Topological Data Analysis Special Session.

The Geometric Realization of AATRN. August 2025

Institute for Mathematical and Statistical Innovation (ISMI).

Algebraic Topology: Methods, Computation, & Science (ATMCS) 11.
Montana State University. July 2025
Accepted Abstracts for a Poster and Presentation.

Topological Data Visualization Workshop. University of Iowa. June 2025
Invited Speaker.

Joint Mathematics Meetings. Seattle, WA. January 2025
Invited Speaker and Poster Presenter.

31st Annual Fall Workshop on Computational Geometry. Tufts University. November 2024
Accepted Abstract for Presentation.

Climate Science at the Interface Between Topological Data Analysis and Dynamical Systems Theory.
Java Center, NY. June 2024
AMS Mathematics Research Communities Summer Workshop.

Topology and Geometry in Neuroscience.
Institute for Computational and Experimental Research in Mathematics (ICERM). October 2023
Workshop in ICERM Semester Program Math+Neuroscience: Strengthening the Interplay Between Theory and Mathematics.

Simons Laufer Mathematical Sciences Institute Summer Graduate School: Machine Learning.
University of California San Diego. June 2023
Topological data analysis and deep learning.

Simons Laufer Mathematical Sciences Institute Summer Graduate School: From Symplectic Geometry to Chaos.
University of California Berkeley. July 2018
Symplectic geometry and dynamics related to the n-body problem.

HONORS AND AWARDS

Marie Vitulli Scholar, University of Oregon. 2019–2020
Ronald E. McNair Scholar, North Dakota State University. 2015–2017

CONFERENCES AND JOURNALS REFEREE

Applied Topology: Methods, Computations, & Science (ATMCS) 11
Montana State University 2025

LEADERSHIP, SERVICE AND OUTREACH

Mathematics Directed Reading Program Mentor. University of Oregon
Topolgical data analysis and applications in dynamical systems. 2024–2025
Topolgical data analysis and applications in neuroscience. 2024–2025

Modeling predator-prey systems with Lotka-Volterra equations. 2023–2024

Mathematics Department Climate Committee. University of Oregon
Graduate Student Member 2021–2025

Graduate Topology and Geometry Seminar. University of Oregon.
Organizer 2022–2024

Association for Women in Mathematics. University of Oregon, Graduate Student Chapter.
Vice President 2022–2023
Chair of the Social and Professional Enrichment Committee 2020–2023
Member of the Speaker Series Committee 2023–2024

American Mathematical Society. University of Oregon, Graduate Student Chapter.
Founding Member 2020
Member at Large 2020–2021
Department Liason 2023–2024

uCodeGirl. Non-profit Organization.
Mentor 2018–2019

PROFESSIONAL AFFILIATIONS

American Statistical Association. Member since 2025.
The Erdös Institute. Member since 2022.
American Mathematical Society. Member since 2020.
Association for Women in Mathematics. Member since 2020.

TECHNICAL SKILLS

Programming Languages:

- Strong Proficiency: Python, LaTeX
- Proficiency: R, Java, C, C++, HTML

Software: ImageJ/Fiji