

Michael Lesnick

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Education

Ph.D. Institute for Computational and Mathematical Engineering, Stanford University *Sept. 2012*

Thesis: Multidimensional Interleavings and Applications to Topological Inference.

Winner, Gene Golub Dissertation Award.

Advisor: Gunnar Carlsson, Department of Mathematics.

Research focus: Theoretical foundations of topological data analysis; novel tools and algorithms for exploratory analysis and visualization of data; applications to biology.

B.S. Mathematics with Honors, Brown University *May 2004*

Awards

Best Software Demo Award, “Algebraic Topology: Methods, Computation, & Science” *2016*

Demonstrated software, co-authored with Matthew Wright, for interactive visualization of 2-D persistent homology.

Award shared with Ulrich Bauer.

Co-PI, NSF Grant *2015-2018*

Award: \$210,217. Joint with Matthew Wright. Program in *Computational and Data-Enabled Science & Engineering*.

Project title: “Computation and Visualization of Multi-Parameter Topological Invariants of Data.”

Gene Golub Dissertation Award *2012*

Departmental award for best Ph.D thesis.

NDSEG Fellowship in Mathematics *2005*

One of 13 students nationwide to receive three year fellowship in mathematics.

Honorary Stanford Graduate Fellow *2005*

Offered Stanford’s three year internal graduate fellowship (declined).

Fellowship is offered to approximately top 20% of Stanford Ph.D. admits in math, science, and engineering.

Professional Experience

Assistant Professor, SUNY Albany *Sept. 2018-*

Department of Mathematics

Associate Research Scholar, Princeton University *Jan. 2016-Sept. 2018*

Princeton Neuroscience Institute

Visitor, Institute for Advanced Study *Sept. 2016-April 2017*

Simons Center for Systems Biology, School of Natural Sciences

Visitor, Columbia University *Jan.-Dec. 2015*

Department of Bioinformatics

Postdoctoral Fellow, Institute for Mathematics and its Applications *Sept. 2013-Aug. 2015*

Participant in the 2013-2014 thematic program “Scientific and Engineering Applications of Algebraic Topology”

Member, Institute for Advanced Study *Sept. 2012-Aug. 2013*

School of Mathematics

Software

RIVET, software for the visualization and analysis of 2-parameter persistent homology. Designed by Michael Lesnick and Matthew Wright, developed by the “RIVET development team.” <https://github.com/rivetTDA/rivet>. 2014-2020.

Publications

ℓ_p -Metrics on Multiparameter Persistence Modules w/ Håvard Bjerkevik. In preparation.

Computing the Multicover Bifiltration w/ René Corbet, Michael Kerber, Georg Osang. Submitted, 2020.

Stability of 2-Parameter Persistent Homology w/ Andrew Blumberg. 2020. arXiv:2010.09628. 44 pages.

Computing Minimal Presentations and Bigraded Betti Numbers of 2-Parameter Persistent Homology w/ Matthew Wright. Submitted, 2019. arXiv:1902.05708. 29 pages.

PHoS: Persistent Homology for Virtual Screening w/ Bryn Keller, Ted Wilke. Submitted, 2018. ChemRxiv:6969260

Quantifying Genetic Innovation: Mathematical Foundations for the Topological Study of Reticulate Evolution w/ Raul Rabadan and Daniel Rosenbloom. SIAM Journal of Applied Algebra and Geometry, 2020. 44 pages.

Universality of the Homotopy Interleaving Distance w/ Andrew Blumberg. In revision, 2017. arXiv:1705.01690. 29 pages.

Interactive Visualization of 2-D Persistence Modules w/ Matthew Wright. Submitted, 2015. arXiv:1512.00180. 75 pages.

Exact computation of the matching distance on 2-parameter persistence modules w/ Michael Kerber, Steve Oudot. SoCG 2019. Invited, accepted special issue of Journal of Computational Geometry. 18 pages.

Feasibility of Topological Data Analysis for event-related fMRI w/ Cameron Ellis, Gregory Henselman-Petrusek, Bryn Keller, Jon Cohen. Network Neuroscience, 2019.

Feature Ratings and Dimension-Specific Similarity Explain Distinct Aspects of Semantic Similarity Judgments w/ Marius Cătălin Iordan, Cameron T. Ellis, Daniel N. Osherson, and Jonathan D. Cohen. Proceedings of the 40th Annual Meeting of the Cognitive Science Society, 2018.

Persistence Diagrams as Diagrams: A Categorification of the Stability Theorem w/ Ulrich Bauer. Proceedings of the 2018 Abel Symposium. 23 pages.

Algebraic Stability of Zigzag Persistence Modules w/ Magnus Botnan. Algebraic and Geometric Topology, Vo. 18, No. 6, 2018. 72 pages.

Induced Matchings and the Algebraic Stability of Persistence Barcodes, w/ Ulrich Bauer. Invited to special issue of Journal of Computational Geometry, Vol. 6, No. 2, 2015. 30 pages. Conference Version in SoCG 2014.

The Theory of the Interleaving Distance on Multidimensional Persistence Modules. Journal of Foundations of Computational Mathematics, Vo. 15, No. 3, 2015. 36 pages.

Studying the Shape of Data Using Topology. The IAS Letter, Summer 2013.

Topological Methods for Exploring Low-density States in Biomolecular Folding Pathways, w/Y. Yao, J. Sun, X. Huang, G. Bowman, G. Singh, L. Guibas, V. Pande, G. Carlsson. Journal of Chemical Physics, Apr 2009. 23 pages.

Teaching Experience

Instructor, Algorithms for Data Science *Spring 2021 (online)*
SUNY Albany

Designing and teaching a graduate level course on algorithms for Data Science MS students

Instructor, Topological Data Analysis III *Fall 2020 (online)*
SUNY Albany

Designed and taught a TDA practicum.

Instructor, Masters Seminar *Spring 2020*
SUNY Albany

Led a seminar where students did independent expository research and gave presentations.

Instructor, Topological Data Analysis II *Spring 2020*
SUNY Albany

Designed and taught the sequel to my TDA course from the fall.

Instructor, Topological Data Analysis I *Fall 2019 (in person), Spring 2021 (online)*
SUNY Albany

Designed and taught a course on topological data analysis.

Instructor, Topology *Fall 2019 (in person), Fall 2020 (online)*
SUNY Albany

Designed and taught an undergraduate course on topology.

Instructor, Topics in Topology *Spring 2019*
SUNY Albany

Designed and taught a graduate topics course on multi-parameter persistence. Wrote an 82-page set of course notes.

Instructor, Honors Calc II SUNY Albany Taught an honors second semester calculus class.	<i>Spring 2019</i>
Instructor, Honors Calc I SUNY Albany Designed and taught an honors first semester calculus course.	<i>Fall 2018</i>
Instructor, Topology for Biologists Columbia University Held an informal weekly series of eight introductory lectures on topology.	<i>Fall 2015</i>
Co-Instructor, Short Course on Topological Data Analysis CIMAT, Guanajuato, Mexico Gave four hours of lectures on multidimensional persistent homology.	<i>Jan. 2015</i>
Instructor, Applied Linear Algebra University of Minnesota Designed and taught a linear algebra class.	<i>Fall 2014</i>
Teaching Assistant, Multivariable Calculus Stanford University Held problem sessions and Matlab tutorials for a multivariable calculus class of 160 students.	<i>Fall 2011</i>
Teaching Assistant, Accelerated Calculus Brown University Held weekly recitations for class of 20 students in second semester calculus course.	<i>Fall 2003</i>

Ph.D. Students Mentored

Tung Lam Ph.D. student in mathematics, SUNY Albany.	<i>Fall 2019-</i>
Sam Spellman Ph.D. student in mathematics, SUNY Albany.	<i>Fall 2019-</i>

Postgraduate Research Assistants Advised

Simon Segert Princeton University '14, mathematics major.	<i>Spring-Summer 2018</i>
Alexander Yu Princeton University '16, mathematics major.	<i>Summer 2016-Spring 2017</i>

Undergraduate Research Assistants Advised

William Wang University of Pennsylvania '20, mathematics major.	<i>Summer 2017</i>
Roy Zhao Princeton University '17, mathematics major.	<i>Spring 2016-Spring 2017</i>
Samuel Harris Princeton University '17, mathematics major.	<i>Spring 2016</i>

Visiting Graduate Students Advised

René Corbet Ph.D. Student at TU Graz.	<i>Spring 2019</i>
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Service

Referee , Discrete and Computational Geometry, SIAM Journal on Imaging Sciences, ACM Symposium on Computational Geometry, ACM-SIAM Symposium on Discrete Algorithms, Foundations of Computational Mathematics, Homology Homotopy and Applications, Journal of Applied and Computational Topology.	
Co-organizer , Workshop on Metrics in Multiparameter Persistence, Lorentz Center, Netherlands.	<i>July 2020 (postponed)</i>
Co-organizer , Session on Applied Topology, Union College Mathematics Conference.	<i>September 2019</i>

- Co-organizer**, Tutorial on Multiparameter Persistence, Computation, and Applications, Institute for Mathematics and Its Applications, Minneapolis. *August 2018*
- Co-organizer**, BIRS Workshop on Multiparameter Persistent Homology, Oaxaca, Mexico. *August 2018*
- Member**, Scientific Committee, ATMCS 8, IST Austria, Vienna. *June 2018*
- Co-organizer**, Fifth Annual Minisymposium on Applied Topology, SoCG, Boston. *June 2016*
- Co-organizer**, Evening Applied Topology Seminar, Institute for Advanced Study. *Spring 2016*
- Co-organizer**, Upper West Side Applied Topology Seminar, Columbia University. *Fall 2015*
- Organizer**, Multidimensional Persistence Workgroup, Applied Topology Research Network, IMA. *Spring 2015*
- Co-organizer**, School on Topological Data Analysis and Stochastic Topology, CIMAT, Guanajuato, Mexico. *January 2015*
- Co-organizer**, Workshop on Topological Data Analysis, Kyoto University. *June 2014*
- Co-organizer**, Mathematical Conversations Seminar, Institute for Advanced Study. *Fall 2012-Spring 2013*

Presentations

Stability of 2-Parameter Persistent Homology (2 talks)

Applied Topology in Albany (ATiA) Seminar, June 4, June 13, 2020

Computing Minimal Presentations of 2-Parameter Persistent Homology

SIAM Conference on Mathematics of Data Science, Minisymposium on Topological Data Learning, online, June 26, 2020

Studying the Shape of Data Using Topology

Lightning Talks on Artificial Intelligence, SUNY Albany, April 7, 2020

Computing Minimal Presentations of 2-Parameter Persistent Homology

Data Science and Applied Topology Seminar, Graduate Center, CUNY, October 11, 2019

Computing Minimal Presentations of 2-Parameter Persistent Homology

International Congress on Industrial and Applied Mathematics, Valencia, July 16, 2019

Computing Minimal Presentations of 2-Parameter Persistent Homology

SIAM Conference on Applied Algebraic Geometry, University of Bern, July 9, 2019

Multiparameter Persistent Homology and Interleavings

Bummer and Partners MathDataLab Seminar, KTH, 5/28/2019

Computational Aspects of 2-Parameter Persistent Homology

Workshop on Topology, Computation and Data Analysis, Schloss Dagstuhl, 5/20/2019

Computing Minimal Presentations and Bigraded Betti Numbers of 2-Parameter Persistent Homology

Computational Applications of Quiver Representations: TDA and QPA, Bielefeld University, 5/4/2019

Computational Aspects of 2-Parameter Persistence (Three Talks)

Algebra and Topology Seminar, SUNY Albany, 10/25/2018, 11/1/2018, 11/29/2018

Computing Minimal Presentations of Bipersistence Modules in Cubic Time

Tutorial on Multiparameter Persistence, Computation, and Applications, Institute for Mathematics and Its Applications, Minneapolis, 8/14/2018.

An Introduction to Multiparameter Persistent Homology

Tutorial on Multiparameter Persistence, Computation, and Applications, Institute for Mathematics and Its Applications, Minneapolis, 8/13/2018.

Multiparameter Persistent Homology: Future Promises

Workshop on Persistence, Representations, and Computation, Burghausen, 2/26/2018.

Quantifying Genetic Innovation: Mathematical Foundations for the Topological Study of Reticulate Evolution

TAGS: Linking Topology, Algebraic Geometry, and Statistics, Max Plank Institute, Leipzig, 2/23/2018.

Multiparameter Persistent Homology

Theoretical Biology Seminar, Department of Mathematics, Penn State, 11/28/2017.

Universality of the Homotopy Interleaving Distance

Institute for Advanced Study, Evening Applied Topology Seminar, 10/12/2017.

Universality of the Homotopy Interleaving Distance

Topological Data Analysis: Developing Abstract Foundations, Banff International Research Station, 8/1/2017.

An Introduction to Multidimensional Persistent Homology

Topology, Computation and Data Analysis, Schloss Dagstuhl, 7/17/2017.

Universality of the Homotopy Interleaving Distance

Foundations of Computational Mathematics, Universitat de Barcelona, 7/10/2017.

Universality of the Homotopy Interleaving Distance

New York Applied Topology Seminar, Columbia University, 3/31/2017

Multiparameter Persistent Homology and Interleavings

New York Applied Topology Seminar, Columbia University, 3/1/2017

Universality of the Homotopy Interleaving Distance

Applied Topology Seminar, cole Polytechnique Fdrale de Lausanne, 2/21/2017

Multiparameter Persistent Homology and Interleavings

Department of Mathematics Colloquium, SUNY Albany, 2/7/2017.

Multiparameter Persistent Homology and Interleavings

Department of Mathematics, UC Davis, 2/1/2017.

Universality of the Homotopy Interleaving Distance

Union Math Conference, Union College, 12/3/2016

Introduction to Multidimensional Persistent Homology

Applied Topology Seminar, Brown University, 12/1/2016

Interactive Visualization of 2-D Persistence Modules: Mathematical Foundations

SIAM Central States Meeting, 10/1/2016.

Interactive Visualization of 2-D Persistence Modules

Algebraic Topology: Methods Computation, and Science, ISI, Torino, 7/25/2016.

Algebraic Stability of Zigzag Persistence Modules

Topology, Geometry, and Data Analysis Conference, OSU, 5/17/2016.

Interactive Visualization of 2-D Persistence Modules

Mathematics Colloquium, Rutgers-Newark, 3/9/2016.

Induced Matchings and Algebraic Stability

Evening Applied Topology Seminar, Institute for Advanced Study, 3/3/2016.

Algebraic Stability of Zigzag Persistence Modules

Algebra and Topology Seminar, SUNY Albany, 2/18/2016.

Interactive Visualization of 2-D Persistence Modules

Applied and Computational Topology Session, Joint Mathematics Meetings, Seattle, 12/9/2016.

Interactive Visualization of 2-D Persistence Modules

Workshop on Topology: Identifying Order in Complex Systems, Institute for Advanced Study, 11/7/2015.

Interactive Visualization of 2-D Persistence Modules

Seminar in Topology, University of Florida, 11/3/2015.

The Stability of Persistent Homology

Applied Topology and High Dimensional Data Analysis, University of Victoria, 8/19/2015.

Interactive Visualization of 2-D Persistent Homology

Colloquium in Discretization in Geometry and Dynamics, TU Munich, 7/14/2015.

Interactive Visualization of 2-D Persistent Homology

ACAT Meeting IST Austria, 7/7/2015.

Multidimensional Persistent Homology

PNI/Intel Joint Meeting, Princeton Neuroscience Institute, Princeton University, 5/29/2015.

An Introduction to Topological Data Analysis

Intel Joint Meeting, Princeton Neuroscience Institute, Princeton University, 4/10/2015.

The (Algebraic) Stability of Persistent Homology

Algebraic Topology: Computation, Data Analysis, and Applications, University of Oxford, 2/24/2015.

Interleavings and Stability in Topological Data Analysis

Mathematics Colloquium, University of Rochester, 2/20/2015.

Universality of the Homotopy Interleaving Distance

53rd Cascade Topology Seminar, Banff Centre, Canda, 11/8/2014.

Visualizing Rank Invariants of 2-D Persistence Modules

Applied Topology Seminar, Ohio State University, 6/19/2014.

Studying the Shape of Data Using Topology

Seminario Internacional: Big Data, INFOTEC, Mexico, 6/17/2014.

Induced Matchings and the Algebraic Stability of Persistence Barcodes

2014 Symposium on Computational Geometry, Kyoto University, 6/10/2014.

The Algebraic Stability of Persistence Barcodes

TOPONETS14, University of California–Berkeley, 6/2/2014.

Universality of the Homotopy Interleaving Distance

Postdoc Seminar, Institute for Mathematics and its Applications (IMA), 3/5/2014.

Induced Matchings of Barcodes and the Algebraic Stability of Persistence

Postdoc Seminar, IMA, 11/12/2013.

Interleavings in the Theory of Persistent Homology

Postdoc Orientation Seminar, IMA, 9/17/2013.

Generalized Interleavings and Universal Distances on Filtrations

SIAM Conference on Applied Algebraic Geometry, Colorado State University, 8/2/2013.

An Introduction to Topological Data Analysis

Neuroimaging Analysis Methods Seminar, Princeton Neuroscience Institute, Princeton University, 7/26/2013.

Generalized Interleavings, Universality, and Topological Inference

Symposium on Computational Geometry, Rio de Janeiro, 6/19/2013.

Generalized Interleavings and Applications to Topological Inference (Two Talks),

Workshop on Dynamics and Applied Topology, Kyoto University, 6/10/2013, 6/11/2013.

An Introduction to Topological Data Analysis,

Rabadan Lab Meeting, Department of Bioinformatics, Columbia University, 6/4/2013.

The Optimality of the Interleaving Distance on Multidimensional Persistence Modules,

Workshop on Topology: Identifying Order in Complex Systems, Institute for Advanced Study, 3/6/2013.

Topological Data Analysis and Persistent Homology,

Thursday Morning Seminar, Simons Center for Systems Biology, Institute for Advanced Study, 2/7/2013.

Multidimensional Interleavings and Applications to Topological Inference (Three Talks),

Macpherson Evening Seminar, Institute for Advanced Study, 11/12/2012, 11/19/2012, 11/26/2012.

The Shape of Data,

After Hours Conversations, Institute for Advanced Study, 11/8/2012.

Multidimensional Interleavings and Applications to Topological Inference,

Ghrist Group Applied Topology Meeting, University of Pennsylvania, 10/4/2012.

Topological Data Analysis and Persistent Homology,

Postdoctoral Member Talk, Institute for Advanced Study, 9/28/2012.

Multidimensional Interleavings and Applications to Topological Inference,

Dissertation Defense, Stanford University, 5/25/2012.

Weak Interleavings and the Inferential Interpretation of Random Bifiltrations,

Geometrica Group Meeting, INRIA-Saclay, 2/14/2012.

Optimality of the Interleaving Distance on Multidimensional Persistence Modules,

SIAM Conference on Applied Algebraic Geometry, NC State University, 10/6/2011.

Optimality of the Interleaving Distance on Multidimensional Persistence Modules,

Seminar on Current Research in Engineering and Applied Mathematics, Stanford, 5/26/2011.

Optimality of the Interleaving Distance on Multidimensional Persistence Modules,

Computational Topology Reading Group Meeting, Stanford, 5/18/2011.

Gromov-Hausdorff Stable Signatures for Shapes Using Persistence,

Computational Topology Reading Group Meeting, Stanford, 3/16/2011.

Computing Multidimensional Persistence,

Computational Topology Reading Group Meeting, Stanford, 11/14/2010.

The Theory of Multidimensional Persistence,

Computational Topology Reading Group Meeting, Stanford, 3/8/2010.

Weak Witnesses for Delaunay Triangulations of Submanifolds,
Carlsson Group Applied Topology Meeting, Stanford 5/17/2007.

Hierarchical Representation of Ensembles of Dynamic Pathways,
Guibas Group Computational Geometry and Topology Meeting, Stanford, 5/1/2007.

Hierarchical Representation of Ensembles of Dynamic Pathways (Two Talks),
Carlsson Group Applied Topology Meeting, Stanford, 2/15/2007, 2/22/2007.

Applied Algebraic Topology,
CME 300 Seminar, Stanford University, 1/13/2006.