Michael Lesnick

mlesnick@princeton.edu (650)-796-6001

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

Visitor, Institute for Advanced Study *Sept 2016-Present*
Simons Center for Systems Biology, School of Natural Sciences

Associate Research Scholar, Princeton University *Jan 2016-Present*
Princeton Neuroscience Institute

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

Publications

Copies of papers in preparation available upon request.

Universality of the Homotopy Interleaving Distance: Towards an "Approximate Homotopy Theory" Foundation for Topological Data Analysis w/ Andrew Blumberg. In preparation.

Computing Bigraded Betti Numbers in Cubic Time w/ Matthew Wright. In preparation.

Topological signatures of Reticulate Evolution in the Low-Recombination Limit w/ Daniel Rosenbloom and Raul Rabadan. In preparation.

Persistence Diagrams as Diagrams: A Categorification the Stability Theorem w/ Ulrich Bauer. Preprint, 2016. arXiv:1610.10085. 9 pages.

Algebraic Stability of Zigzag Persistence Modules w/ Magnus Botnan. Submitted, 2016. arXiv:1604.00655. 50 pages.

Interactive Visualization of 2-D Persistence Modules w/ Matthew Wright. Submitted, 2015. arXiv:1512.00180. 75 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, Topology for Biologists *Fall 2015*
Columbia University
Held an informal weekly series of eight introductory lectures on topology.

Co-Instructor, Short Course on Topological Data Analysis *Jan. 2015*
CIMAT, Guanajuato, Mexico
Gave four hours of lectures on multidimensional persistent homology.

Instructor, Applied Linear Algebra *Fall 2014*
University of Minnesota
Designed and taught a linear algebra class to 34 undergraduates.

Teaching Assistant, Multivariable Calculus *Fall 2011*
Stanford University
Held problem sessions and Matlab tutorials for a multivariable calculus class of 160 students.

Grader, Analysis on Manifolds *Spring 2004*
Brown University
Graded problem sets and critiqued proofs.

Teaching Assistant, Accelerated Calculus *Fall 2003*
Brown University
Held weekly recitations for class of 20 students in second semester calculus course.

Research Assistants Advised

Roy Zhao *Spring 2016-Spring 2017 (expected)*
Princeton University '17, mathematics major.

Alexander Yu *Summer 2016-Spring 2017 (expected)*
Princeton University '16, mathematics major.

Samuel Harris *Spring 2016*
Princeton University '17, mathematics major.

Service

Referee, Discrete and Computational Geometry, SIAM Journal on Imaging Sciences, ACM Symposium on Computational Geometry, Foundations of Computational Mathematics, Homology Homotopy and Applications, Journal of Applied and Computational Topology.

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. *Jan. 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

Interactive Visualization of 2-D Persistence Modules: Mathematical Foundations
SIAM Central States Meeting, 10/01/2016.

Towards an Interactive Tool for Bidendrogram Clustering
Intel Joint Meeting, Princeton Neuroscience Institute, Princeton University, 9/2/2016.

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
53$^{\text{rd}}$ 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 Janiero, 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 Toplogy Reading Group Meeting, Stanford, 5/18/2011.

Gromov-Hausdorff Stable Signatures for Shapes Using Persistence,
Computational Toplogy Reading Group Meeting, Stanford, 3/16/2011.

Computing Multidimensional Persistence,
Computational Toplogy Reading Group Meeting, Stanford, 11/14/2010.

The Theory of Multidimensional Persistence,
Computational Toplogy 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.