Joshua Mirth

Curriculum Vitae

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Academic Employment

2020–Present **Postdoctoral Research Associate**, Michigan State University, Computational Mathematics, Science, and Engineering Department. PI: Jose Perea.

2020 **Graduate Research Assistant**, Colorado State University, Mathematics Department. PI: Henry Adams.

2015–2019 **Graduate Teaching Assistant**, Colorado State University, Mathematics Department.

Education

2015–2020 **Doctorate**, Colorado State University, *Mathematics*.
Dissertation: *Vietoris–Rips Metric Thickenings and Wasserstein Space.* Advisor: Henry Adams

2015–2017 **Master of Science**, Colorado State University, *Mathematics*.
Thesis – *Metric Thickenings of Euclidean Submanifolds*. Advisor: Henry Adams.

2011–2015 **Bachelor of Science**, *Summa Cum Laude, with Departmental Honors*, Hillsdale College, *Mathematics*.
Senior Thesis – *Functional Analysis and the Dirichlet Problem*, minor in physics. Advisor: David Gaebler.

Publications

Refereed Journal Papers

2021 **Representations of Energy Landscapes by Sublevelset Persistent Homology: An Example with n-Alkanes** (first author) with Yanqin Zhai, Johnathan Bush, Enrique G Alvarado, Howie Jordan, Mark Heim, Bala Krishnamoorthy, Markus Pflaum, Aurora Clark, Y Z, and Henry Adams. To appear in the *Journal of Chemical Physics.* Available at arXiv:2011.00918

2020 **A fractal dimension for measures via persistent homology** with Henry Adams, Manuchehr Aminian, Elin Farnell, Michael Kirby, Rachel Neville, Chris Peterson, Patrick Shipman, and Clayton Shonkwiler. In: Baas N., Carlsson G., Quick G., Szymik M., Thaule M. (eds), *Topological Data Analysis.* Abel Symposia, Springer vol 15 (2020), 1-32. Available at arXiv:1808:01079.

2020 **A torus model for optical flow.** with Henry Adams, Johnathan Bush, Brittany Carr, and Lara Kassab. *Pattern Recognition Letters* 129 (2020) 304-310. Available at arXiv:1812.00875.

2019 **Metric thickenings of Euclidean submanifolds** with Henry Adams. *Topology and its Applications*, 254:69-84, 2019. Available at arXiv:1709.02492.

Refereed Conference Proceedings

2020 **Operations on Metric Thickenings** with Johnathan Bush and Henry Adams. In: Spivak, D., Vicary, J. (eds), *Applied Category Theory, Electronic Proceedings in Theoretical Computer Science* 328:1-15 (2020)

2019 **On the nonlinear statistics of optical flow** with Henry Adams, Johnathan Bush, Brittany Carr, and Lara Kassab. *Proceedings of Computational Topology in Image Context*, LNCS volume 11382 (2019), 151-165.

Book Chapters

2020 **Topological Data Analysis** with Johnathan Bush and Henry Adams in the book *Data Science for Mathematicians*, editor Nathan Carter, Chpman & Hall/CRC, New York, DOI 10.1201/9780429398292.

Teaching

2015–2019 **Colorado State University**, *Mathematics Department.*

As instructor of record:

- Math 340 – Introduction to Ordinary Differential Equations, Spring 2018, Fall 2018, Spring 2019, Fall 2019
- Math 261 – Calculus for Physical Scientists III, Fall 2017
- Math 160 – Calculus for Physical Scientists I, Fall 2016, Spring 2017
- Math 141 – Calculus in Management Sciences (online), Summer 2019

As teaching assistant:

- Math 161 – Calculus for Physical Scientists II, Fall 2015, Spring 2016

Outreach:

- Co-taught (with Henry Adams) a two week course on Applied and Computational Topology at the Universidad de Costa Rica, Summer 2017.

Grants and Fellowships

2020 NSF Grant #1934725, DELTA: Descriptors of Energy Landscape by Topological Analysis, NSF Harnessing the Data Revoloution (HDR): Institutes for Data-Intensive Research in Science and Engineering Frameworks (I-DIRSE-FW). Funded as research assistant under Co-PI Henry Adams.

Talks and Presentations

Research Talks

2021 Mar. *Non-Euclidean Dimensionality Reduction*, Data Science Seminar (Virtual), Colorado State University.

2021 Jan. *Geodesic Homotopies in Metric Thickenings*, Vietoris–Rips — Tight Span Seminar (Virtual), Ohio State University / Colorado State University.

2020 Oct. *Analytic Formulas for Persistent Homology*, Topological Data Analysis Seminar, Michigan State University.

2020 Jan. *Morse Theory for Wasserstein Spaces*, Joint Mathematics Meetings, Denver Colorado.

2019 Jul. *Morse Theory for Wasserstein Spaces*, Young Topologists Meeting, École Polytechnique Fédérale de Lausanne.

2019 May *Morse Theory for Wasserstein Spaces*, Geometric Data Analysis Conference, University of Chicago (poster presentation).

2018 Nov. *On the nonlinear statistics of optical flow*, SPAMlab, Colorado State University.

2018 Apr. *Metric Thickenings of Euclidean Submanifolds*, Graduate Student Topology and Geometry Conference, University of Chicago.

2017 Sep. *Metric Thickenings of Euclidean Submanifolds*, SIAM Central States Sectional Meeting, Applied Algebraic Topology session, Colorado State University.

2017 Jul. *Metric Thickenings of Euclidean Submanifolds*, TDA: Theory and Applications, workshop at Macalaster College (poster presentation).

2015 Apr. *Functional Analysis and the Dirichlet Problem*, Michigan Undergraduate Mathematics Conference, Hope College.

2013 Jul. *Simulating Post-Reconnection Coronal Flux Tubes* American Astronomical Society Solar Physics Division Meeting (Poster with Dana Longcope).

Expository Talks

2021 Feb. *Dimensionality Reduction in Projective Space*, Perea Lab Group Seminar, Michigan State University.

2020 Apr. *Algebraic Topology for Chemists/Applied Mathematicians*, CSU Greenslopes Seminar.

2020 Feb. *A Study in Mediocrity: Averages in Non-Euclidean Spaces*, CSU Greenslopes Seminar.

2019 Oct. *Optimal Transport and Machine Learning*, Data Science Seminar, CSU.

2019 Sep. *Optimal Transport and PDEs*, SPAM Lab, CSU.

2019 May *The Optimal Transport Problem*, SPAM Lab, CSU.

2018 Oct. *Simplicial Complexes, Simplicial Sets, and Realizations*, CSU Category Theory Seminar.

2018 Oct. *Introduction to Derived Categories*, CSU Category Theory Seminar.

2018 Sep. *Smooth and Discrete Morse Theory*, CSU Topology Seminar.

2018 Sep. *Limits and Colimits*, CSU Category Theory Seminar.

2018 Jul. *The Yoneda Lemma*, CSU Category Theory Seminar.

2018 Jun. *Simplicial Sets*, CSU Category Theory Seminar.

2017 Dec. *Morse Theory: An Introduction*, CSU Greenslopes seminar.

Conferences and Workshops

2019 Aug. Workshop on Applied Mathematical Modeling with Topological Techniques, ICERM

2019 Jul. Young Topologists Meeting, École Polytechnique Fédérale de Lausanne

2019 May Geometric Data Analysis Conference, University of Chicago

2018 Aug. Tutorial on Multiparameter Persistence, Computation, and Applications, The Institute for Mathematics and its Applications

2018 May TGDA@OSU TRIPODS Center Summer School and Workshop, Mathematical Biosciences Institute at the Ohio State University

2018 Apr. Graduate Student Topology and Geometry Conference 2018, University of Illinois at Chicago

2017 Jun. Topological Data Analysis: Theory and Applications, Macalaster College

2017 Apr. Graduate Student Topology and Geometry Conference 2017, Michigan State University

Service and Administrative

Peer-Review

2019 Symposium on Computational Geometry

Seminar and Conference Organization

2018-2020 **Co-organizer**, *Category Theory Seminar*, Colorado State University.

2018 **Co-organizer**, *Greenslopes Seminar*, Colorado State University.

Miscellaneous

2019-2020 **President**, *AMS*, Colorado State University Graduate Student Chapter.

2019-2020 **Webmaster**, *SIAM*, Colorado State University Student Chapter.

2017-2018 **Secretary**, *SIAM*, Colorado State University Student Chapter.

2016-2017 **Treasurer**, *SIAM*, Colorado State University Student Chapter.

2014-2015 **Vice-President**, *Kappa Mu Epsilon*, Hillsdale College Chapter.

2013-2014 **Treasurer**, *Kappa Mu Epsilon*, Hillsdale College Chapter.

2013-2015 **Putnam Team**, Hillsdale College.

Other Experience

Computational

2016–2017 **Programmer**, *Colorado State University*, Environmental Health Department.
Developed tools for analysis of motion tracker data in MatLab.

2013 **REU**, *Montana State University*, Solar Physics.
Developed and tested numerical models of magnetic reconnection in the solar corona.

Awards

- Outstanding Graduate Teaching Assistant – Colorado State University Mathematics Department (2018-2019)
- 2015 GLIAC Postgraduate Scholarship Award Recipient – Annual award provided by the Great Lakes Intercollegiate Athletic Conference to one male and one female athlete for postgraduate studies.
- Taylor Award – Highest GPA among Hillsdale College Mathematics graduates (2015)
- NCAA Division II All-American – Cross Country: 2012 and 2014, Indoor Track: 2015