

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

- 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](https://arxiv.org/abs/2011.00918)
- 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)
- 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., Thaulé M. (eds), *Topological Data Analysis*. Abel Symposia, Springer vol 15 (2020), 1–32. Available at [arXiv:1808.01079](https://arxiv.org/abs/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. Conference version **On the nonlinear statistics of optical flow** published in *Proceedings of Computational Topology in Image Context*, LNCS volume 11382 (2019), 151-165. 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.

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 Revolution (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.
- 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.
- 2016–2020 **Officer**, SIAM, Colorado State University Student Chapter.
- 2013–2015 **Officer**, *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