Joshua Mirth

Curriculum Vitae

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Education

2015–present **Doctorate**, *(In progress)*, Colorado State University, *Mathematics*.
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

Submitted *Metric Thickenings of Euclidean Submanifolds* with Henry Adams. Available at arXiv:1709.02492.

Talks and Presentations

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

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

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).

Teaching

2015–2018 **Graduate Teaching Assistant**, *Colorado State University*, Mathematics Department.
Instructor of record:
- Math 340 – Introduction to Ordinary Differential Equations, Spring 2018
- Math 261 – Calculus for Physical Scientists III, Fall 2017
- Math 160 – Calculus for Physical Scientists I, Fall 2016, Sprint 2017

Teaching assistant:
- Math 161 – Calculus for Physical Scientists II, Fall 2015, Sprint 2016

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

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.

Miscellaneous

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

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

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*.

Awards

- Taylor Award - Highest GPA among Hillsdale College Mathematics graduates (2015)
- Kimball Medal - top male athlete at Hillsdale College (2015).
- Hillsdale College Dean's List (7 semesters)
- National Merit Scholar (2011)
- NCAA Division II All-American – three times
- GLIAC conference champion – four times

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Tutorial on Multiparameter Persistence, Computation, and Applications

March 10, 2018

Personal Statement

I am a third-year doctoral student at Colorado State University working in the field of applied algebraic topology. My advisor is Henry Adams. My research interests are in the structure of simplicial complexes (such as the Vietoris–Rips and Čech complexes arising in applied topology), discrete Morse theory, and persistent homology. In the fall of 2017 I completed a master's thesis on the homotopy types of metric thickenings (that is, a metric analogue of a Vietoris–Rips or Čech complex) of Euclidean submanifolds. Some current research projects include further work on metric thickenings—now with the vertex set being a geodesic space—as well as a collaborative, computational project with the Colorado State University Pattern Analysis Lab to define and compute a persistent homology fractal dimension. A long-term project is the development of a Morse theory for filtrations of (possibly infinite) simplicial complexes.

Multiparameter persistence is closely related to the above topics, particularly to Morse theory. Similar to how multiparameter persistence studies a space equipped with several filtrations and seeks to understand the persistent homology as both vary, I am interested in a Morse theory that can identify both critical simplices, as in the established discrete Morse theory, and also critical scale parameters, as in the classical smooth setting. Not only am I interested in better understanding multiparameter persistence generally, but I am hopeful there may be enlightening connections here. I am also interested in developing a more thorough knowledge of the state of the art with regard to computational tools for persistent homology. I have used Ripser and JavaPlex extensively, and have a passing familiary with RIVET, GUDHI, and some other packages, but would like to become more proficient with these and other tools.