Robin Belton

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Academic Appointments

Smith College — Northampton, MA
Postdoctoral Researcher and Lecturer — *July 2022 - Present*

Education

Montana State University (MSU) — Bozeman, MT
Ph.D. - Mathematics — *May 2022*
Thesis: *Directed Graph Descriptors and Distances for Analyzing Multivariate Time Series Data*
Advisor: *Tomáš Gedeon*

Montana State University — Bozeman, MT
M.S. - Mathematics — *May 2019*

Kenyon College — Gambier, OH
B.A. - Mathematics — *May 2016*
magna cum laude
Honors and Distinction in Mathematics
Concentration in Scientific Computing

Research Interests

Topological and Geometric Data Analysis, Computational Topology & Geometry, Machine Learning, Network Science, Mathematical Biology.

Publications

Due to working in an interdisciplinary setting, my work follows different conventions for authorship. Mathematics tends to be published alphabetically. Biology tends to be published in descending order of contribution, with students and postdocs listed first, followed by PIs.

7. *Extremal Event Graphs: A (Stable) Tool for Analyzing Noisy Time Series.* **Belton, R.**, Cummins, B., Fasy, B.T., Gedeon, T., Journal of Foundations of Data Science, Volume 5(1): 81-151. 2023.

6. *Combinatorial Conditions for Directed Collapsing.* **Belton, R.**, Brooks, R., Ebli, S., Fajstrup L., Fasy, B. T., Sanderson, N., & Vidaurre E. Research in Computational Topology 2. Association for Women in Mathematics Series, Volume 30, Springer, Cham. 2022.

5. *Reconstructing Embedded Graphs from Persistence Diagrams.* **Belton, R.**, Fasy, B. T., Mertz, R., Micka, S., Millman, D., Salinas, D., Schenfisch, A., Schupbach, & Williams, L. Computational Geometry Theory and Applications, Volume 90, 2020.

4. *Towards Directed Collapsibility.* **Belton, R.**, Brooks, R., Ebli, S., Fajstrup L., Fasy, B. T., Ray, C., Sanderson, N., & Vidaurre E. Advances in Mathematical Sciences. Association for Women in Mathematics Series, Volume 21. Springer, Cham. 2020.

3. *Learning Simplicial Complexes from Persistence Diagrams.* **Belton, R.**, Fasy, B. T., Mertz, R., Micka, S., Millman, D., Salinas, D., Schenfisch, A., Schupbach, & Williams, L. In Proceedings of Canadian Conference on Computational Geometry (CCCG), 2018.

2. *Loss of TXNIP Enhances Peritoneal Metastasis and Can be Abrogated by Dual TORC1/2 Inhibition.*Spaeth, D., Burch, M., **Belton, R.**, Demoret, B., Grosenbacher, N., David, J., Stets, C., Cohen, D., Shakya, R., Hays, J., & Chen, J. L. Oncotarget, 2018.

1. *A Shape-Context Model for Matching Placental Surface Vascular Networks.* Farnell, E., Farnell, S., Chang, J., Hoffman, M., **Belton, R.**, Keaty, K., Lederman, S., & Salafia, C. Image Analysis & Stereology, 37(1), 55-62. 2018.

Preprints

1. *G-Mapper: Learning a Cover in the Mapper Construction.* Alvarado, E., **Belton, R.**, Fischer, E., Lee, K.J., Palande, S., Percival, S., and Purvine, E. 2023.

Code

1. *Computing and Comparing Extremal Event DAGs.* **Belton, R.**, Cummins, B., Narem, R., 2021.
2. *G-Mapper: Learning a Cover in the Mapper Construction.* **Belton, R.**, Lee, K.J., Palande, S. 2024.

Book Reviews

1. The Structure and Stability of Persistence Modules, by Chazal, F., Silva, V., Glisse, M., & Oudot, S. Review by **Belton, R.**, and Fasy, B.T., ACM SIGACT News, Vol. 48 Issue 2, June 2017.

Grants and Fellowships

AMS-Simons Travel Grant - 2023. $6000 over two years for research travel expenses.

TDA Week Travel Grant - 2023. $1700 towards expenses for participating in TDA Week at Kyoto University.

SIAM Early Career Travel Award - 2023. $800 towards expenses for participating in the SIAM Conference on Applied Algebraic Geometry.

AMS MRC Collaboration Grant - 2023. $800 towards expenses for visiting collaborators at UC Davis, and $800 towards expenses for attending JMM 2023.

Graduate Women in Science and Engineering Funding - 2020-2023. $10589.48 over three years from the MSU office of student engagement.

Graduate Leadership Fellowship Program - 2020. Year long leadership program at MSU that consists of discussions and workshops on leadership, bystander intervention, and equity, diversity, and inclusion.

STEM Communication Fellowship - 2018. Year long program at MSU that focuses on science communication.

National Science Foundation Graduate Research Fellowship Program (NSF GRFP) Recipient - 2018. National award that provided a $34000 stipend per year for three years to a select number of graduate students.

Research Travel Award - 2017. $1500 from the MSU Department of Mathematical Sciences.

Awards and Honors

MSU Student Organization of the Year: Graduate Women in Science and Engineering (WISE) - 2022. Award to one of the 270+ student organizations at MSU that makes significant contributions to the MSU and Bozeman community. I was on the leadership team for WISE from 2020-2022.

William A. Stannard Award for Excellence in Graduate Student Teaching - 2020. $500 award to a graduate teaching assistant in the Department of Mathematical Sciences at MSU.

Outstanding Graduate Student - 2018. Award from the MSU Department of Mathematical Sciences.

Meritorious Award - 2016. $5000 award to a select number of incoming graduate students at MSU.

Two Pieces of Artwork featured at Bridges Interdisciplinary Art and Mathematics Conference - 2016.

Outstanding Presentation Award - 2015. Award to a select number of undergraduate presenters at Math Fest.

Risk Taker Award - 2015. Award to a math major at Kenyon College.

Presentations

Talks at seminars or colloquia at universities are typically 50 minutes, while my talks at conferences are typically 30 minutes.

Invited Talks

33. Applied Algebraic Topology Research Network (AATRN) Online Seminar, *Time Series and Biological Network Analysis via Directed Graphs.* January 2024.
32. Joint Mathematics Meetings (JMM) for the AMS special session: Applied Topology: Theory, Algorithms, and Applications, *Directed Collapsibility and its Connections to Topological Data Analysis.* January 2024.
31. SIAM Conference on Applied Algebraic Geometry - Minisymposium on Applied Algebraic Topology, Eindhoven University of Technology, *Adaptive Mapper Graphs.* July 2023.
30. Geometry and Topology Seminar, University of Massachusetts Amherst, *Directed Descriptors of Data.* March 2023.
29. University of Florida Topological Data Analysis Conference, *Extremal Event Graphs: A Stable Tool for Analyzing Noisy Time Series.* February 2023.
28. Joint Mathematics Meetings (JMM) for the AMS special session: Models and Methods for Sparse (Hyper)Network Science, *Towards Automating Covers for Mapper Graphs.* January 2023.
27. Theoretical Biology Seminar, The Pennsylvania State University, *Extremal Event Graphs: A Stable Tool for Analyzing Noisy Time Series.* November 2022.
26. Algebraic and Combinatorial Perspectives in the Mathematical Sciences (ACPMS) Online Seminar, *Extremal Event Graphs: A Stable Tool for Analyzing Noisy Time Series.* November 2022.
25. Sigma Xi Inaugural International Forum for Research Excellence (IFoRE) in the session: The Convergence of Data, Geometry, and Biology: Insights from the 'shape' of Biological Data, *Extremal Event Graphs: A Stable Tool for Analyzing Noisy Time Series.* November 2022.
24. Topology and Data Science Seminar, University of Oklahoma, *Extremal Event Graphs: A Stable Tool for Analyzing Noisy Time Series.* February 2022.
23. Math Colloquium, Kenyon College, *Going Backwards. Reconstructing Shapes from Topological Data Descriptors.* February 2021.
22. Math Colloquium, Augustana University, *Going Backwards. Reconstructing Shapes from Topological Data Descriptors.* September 2020.
21. SIAM Central States Meeting – Minisymposium on Applied and Computational Topology, University of Oklahoma, *Reconstructing Graphs from Persistence Diagrams.* October 2018.

Contributed Talks

20. Geometry and Topology Meet Data Analysis and Machine Learning Conference, Northeastern University, *Adaptive Mapper Graphs.* June 2023.
19. Hudson River Undergraduate Mathematics Conference, Mount Holyoke College, *Tackling 3 Data Science Problems with a Topological Stone.* April 2023.
18. Topological Data Visualization Workshop, University of Iowa, *Extremal Event Graphs: A Stable Tool for Analyzing Noisy Time Series.* May 2022.
17. Geometry and Topology Meet Data Analysis and Machine Learning Conference, The Ohio State University, *Directed Collapsibility of Euclidean Cubical Complexes.* June 2019.
16. Math Colloquium, Carroll College, *Playing with Numbers.* March 2017.

Local Talks

15. Sigma Xi Tuesday Talks, Smith College, *The Common Misinterpretations and Pitfalls in Topological Data Analysis.* September 2023.
14. Math Colloquium, Smith College, *Tackling 3 Problems with A Topological Stone: My Math Journey.* September 2022.
13. Applied Mathematics Seminar, MSU, *Research Updates.* 2017, 2021, and 2022.

12. Graduate Student Seminar, MSU, *Research Updates.* 2016-2022.
11. Computational Topology and Geometry Seminar, MSU. 2-3 talks per semester on various topics in computational topology and geometry including Reeb spaces, persistent path homology, ε-nets, and algebraic geometry. 2016-2021.
10. Topology and Geometry Seminar, MSU. 1-2 talks per semester on various topics in geometry and topology including lagrangian mechanics, stratified spaces, sheaf theory, and representation theory. 2018-2021.
9. White Dog Brewery, Bozeman, MT, *Everyone has to share. Even the processors in computers.* March 2019.
8. Undergraduate Mathematics Seminar, MSU, *Analyzing Musical Scores Using Topological Data Analysis.* April 2018.
7. Computer Science Seminar, MSU, *Overview of Computational Topology.* September 2017.

Posters

6. TDA Week, Kyoto University, *Extremal Event Graphs: A Stable Tool for Analyzing Noisy Time Series.* August 2023.
5. SIAM Conference on Mathematics of Data Science, San Diego, CA, *Extremal Event Graphs: A Stable Tool for Analyzing Noisy Time Series.* September 2022.
4. Algebraic Topology in Data and Dynamics, MSU, *Analyzing Musical Scores Using Topological Data Analysis.* July 2018.
3. Algebraic Topology: Methods, Computation, and Science, IST Austria, *Analyzing Musical Scores Using Topological Data Analysis.* June 2018.
2. Joint Mathematics Meetings, Seattle, WA, *A Shape-Context Model for Matching Placental Surface Vascular Networks.* January 2016.
1. Translational Data Analytics Forum, The Ohio State University, *Identifying Genes of Interest through Clustering and Outlier Analysis of Genomic Time Series Data.* October 2015.

Conference or Workshop Organizer

- Minisymposium on Applied Algebraic Topology: Theory and Implementation at the SIAM Conference on Applied Algebraic Geometry, Eindhoven University of Technology. This event was co-organized with Elizabeth Munch and Sarah Percival. July 2023.
- WISE Undergraduate Workshop at MSU. A one day workshop for undergraduates interested in graduate school in STEM. The workshop included talks about funding resources, graduate student panels, small group discussions, and mentor-mentee pairings. This event was co-organized with Hannah Goemann and Katrina Lyon. April 2022.
- WISE Conference on COVID-19 Research at MSU. A one day conference free to the public about research and outreach efforts concerning COVID-19. This event was co-organized with Hannah Goemann and Marziah Hashimi. December 2021.

Workshops

Programs I have participated in that either had an active research or skills development component.

Mathematical Challenges in Neuronal Network Dynamics, ICERM, 2023.

Third Workshop for Women in Computational Topology, Swiss Federal Institute of Technology Lausanne (EPFL), 2023.

AMS Mathematical Research Community on Models and Methods for Sparse (Hyper)Network Science, 2022.

Applied Mathematical Modeling with Topological Techniques, ICERM, 2019.

Women in Topology (WIT) Workshop, MSRI, 2017.

Spring School and Conference in Applied and Computational Algebraic Topology, Hausdorff Research Institute for Mathematics (HIM), 2017.

Park City Mathematics Institute (PCMI) Undergraduate Summer School, 2016.

Referee or Reviewer

AWM/Springer volume for the proceedings of the Women in Data Science and Mathematics (WiSDM) workshop

European Symposium on Algorithms (ESA)

European Workshop on Computational Geometry (EuroCG)

Grace Hopper Celebration (GHC) Poster Session

Journal of Applied and Computational Topology (JACT)

MathSciNet Mathematical Reviews

Symposium on Computational Geometry (SoCG)

Symposium on Discrete Algorithms (SODA)

Underrepresented Students in Topology and Algebra Research Symposium (USTARS)

Women in Computational Topology (WinCompTop)

Teaching

Instructor of Record.

Smith College

M 153: Discrete Mathematics, Spring 2024.

M 212: Multivariable Calculus, Fall 2023.

M 211: Linear Algebra, Spring 2023.

M 111: Calculus I, Fall 2022.

Montana State University

M 172: Calculus II, Fall 2019, Spring 2020.

M 171: Calculus I, Fall 2017.

M 121: College Algebra, Fall 2016, Spring 2017.

Teaching Adjacent Experience

Teaching Assistant for Applied Mathematical Modeling with Topological Techniques workshop at ICERM, 2019.

Teaching Assistant for "Learning R" workshops at MSU, 2019.

Mentoring Experience

- Met once a week with students (10 total) throughout the academic year and everyday during a 6 week summer period. The project focuses on simulating and analyzing plant data using topological and geometric measures. This project was co-advised with Chris Golé. 2022-2024.
- Met twice a week with an REU student studying TDA applied to music. The project was supervised by Brittany Terese Fasy and David L. Millman. 2017.
- Assisted math and CS undergraduates prepare presentations for the Computational Topology and Geometry Seminar.

Tutoring and Grading Positions

Tutor at Math Learning Center at MSU for 5 semesters and 1 summer.

Grader for M 151: Precalculus, MSU, Summer 2019.

Lead Tutor for Calculus II (2 semesters) and Art of Mathematics (1 semester), Kenyon College.

Tutor at Math and Science Skills Center, Kenyon College.

Grader for Multivariable Calculus, Spring 2014, Kenyon College.

Leadership Experience

President of Graduate Women in Science and Engineering (WISE) - MSU
WISE aims to support graduate student women and gender minorities in STEM at MSU. In my leadership role, I applied for funding, managed the budget, maintained the website, and organized events such as seminars, article discussions, book clubs, and social events. 2020-2022.

Graduate Program Committee Representative - MSU
Organized social events for the Department of Mathematical Sciences and acted as a liaison between graduate students and faculty. 2018-2020.

President of Computational Topology and Geometry - MSU
Managed the budget and helped organize a weekly seminar for graduate and undergraduate students. 2016-2018.

Invited Panels

Applying to Graduate School Panel, Smith College Math Club, 2023.

Picture a Scientist Panel, MSU, 2020.

Graduate student panelist at the Nebraska Conference for Undergraduate Women in Mathematics, 2019.

Outreach

Putnam Problem Co-instructor for Smith College students, 2022.

Volunteer for the Women in Mathematics in New England Conference, Smith College, 2022-2023.

Co-organized Math Craft Workshop at Girls for a Change Workshop at MSU, 2020.

STEM Expo judge at Longfellow Elementary School in Bozeman, MT, 2017-2020.

Volunteer for (middle school) Girl Science Saturdays at Kenyon College, 2014-2016.

STEM mentor for first year students at Kenyon College, 2015-2016.

Upper Classman Counselor at Kenyon College, 2013-2016.

Computational Skills

Certificates. High Performance Computing Certificate from Oak Ridge Computing Facility Course, 2022.

High Level Programming Languages. Python, MATLAB, R, HTML.

Command Line/Version Control. Vim, git.

Software. GitHub, LaTeX, Inkscape, Microsoft.

Operating Systems. Mac, Windows, Linux.

Organizations

American Mathematical Society (AMS)

Association for Women in Mathematics (AWM)

Pi Mu Epsilon National Mathematics Honor Society

Sigma Xi Scientific Research Society

Women in Computational Topology (WinCompTop)

Women in Topology (WIT)