Mikhail Sweeney

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Salt Lake City, UT

Education

Ph.D. Mathematics May 2026
University of Utah
B.A. Honors Mathematics 2016-2020
University of Notre Dame

Research Interests

I am interested in solving **high-noise signal recovery problems**, in which the noise is so great that signal location estimation is unreliable, and algorithms that leverage invariant algebraic features of the data must be used. Such problems include those concerning data science over groups, such as Cryo-EM. Other related problems of interest to me include multi-target detection, multi-reference alignment, cytometry, spike sorting, and mass spectometry.

Additionally, I am interested in **random geometry and stochastic partial differential equations (PDE's)**, and specifically, in studying properties of stochastic PDE's through the behavior of their characteristics in random geometry models of the KPZ universality class, such as Brownian last passage percolation and the directed landscape. The random geometry in such models yields important insights into features of these stochastic PDE's such as shocks, instability, and turbulence, with applications to quantum gravity and fluids.

Publications

All author orders are alphabetical.

Al-Ghattas, Omar & Little, Anna & Sanz-Alonso, Daniel & Sweeney, Mikhail. **Functional multi-reference alignment via deconvolution.** Accepted 2026 to SIAM Journal on Mathematics of Data Science. https://arxiv.org/abs/2506.12201.

Rassoul-Agha, Firas & Sweeney, Mikhail. **Shocks and instability in Brownian Last Passage Percolation.** Accepted 2026 to Communications in Mathematical Physics. https://arxiv.org/abs/2407.07866

Preprints and Manuscripts

Works submitted and awaiting revision. All author orders are alphabetical.

Rassoul-Agha, Firas & Sweeney, Mikhail. **Shocks, instability, and the twenty networks of infinite geodesics in the Directed Landscape.** Submitted 2026 to Inventiones Mathematicae.
https://arxiv.org/abs/2604.12963.

Little, Anna & Sanz-Alonso, Daniel & Sweeney, Mikhail & Yang, Ruiyi. **Functional multi-target detection using bispectrum inversion.** Submitted 2026 to Inverse Problems.
https://arxiv.org/abs/2605.31579.

Rassoul-Agha, Firas & Sweeney, Mikhail. **The Martin boundary of the Directed Landscape.** Submitted 2026 to Geometric and Functional Analysis.
https://arxiv.org/abs/2605.21366.

Research Experience

Signal Processing and Deconvolution Spring 2023 to present

Constructed estimators and proved convergence guarantees for recovering signals in the multi-reference alignment and multi-target detection problems. Wrote algorithms to numerically verify the performance of these estimators.
Advisor: Dr. Anna Little

Shocks and instability in the KPZ universality class Fall 2022 to present

Defined and constructed the instability graph for BLPP and the directed landscape, two KPZ universality class models. Related the instability graph to the shock trees in both models.
Advisor: Dr. Firas Rassoul-Agha

Anomalous Diffusion Summer 2019

Proved that the large time diffusion of anisotropic particles subject to a external magnetic field behaves like an ordinary Brownian diffusion process. REU at Indiana University, Bloomington.
Advsior: Dr. Wai-Tong (Louis) Fan

Host-tumor network analysis Summer 2018

Constructed a network interaction model for genes, proteins, and metabolites both inside tissues and then between tissues and tumors. Bioinformatics project at Cincinnati Children's Research Hospital, department of Hematology and Experimental Cancer Biology.
Advisor: Dr. Kakajan Komurov

Awards:

Outstanding thesis award May 2026
Optimization and inversion research training grant fellowship May 2024, November 2025
Outstanding graduate student award April 2024
Norman and Beatrice Haaser mathematics scholar September 2020

Talks and Posters given:

Functional Multi-Reference Alignment. March 2026
AMS Western Sectional meeting . Talk.

Shocks and Instability in the Directed Landscape. November 2025
Columbia University Probability Seminar. Talk.

Moment Invariant Distribution Learning. October 2024
Siam Conference on MDS. Poster.

Random Polymers and Paper Tearing. April 2022
University of Utah Applied Math Colloquium. Talk.

Long Time Diffusion of an Anisotropic Random Walker. August 2019
Indiana University Bloomington. Talk.

Other conferences attended:

Universality and Integrability in KPZ, Columbia University. March 2024

Southeastern Probability Conference I, Duke University. May 2023

Service:

Graduate Student Advisory Committee (GSAC) chair	Fall 2024 - Spring 2025
Graduate Student Recruitment Committee member	Spring 2025
GSAC Fun and Friendship chair	Fall 2023 to Spring 2024
University of Utah math help center tutor	Fall 2021-Spring 2024
University of Notre Dame math tutor	2017-2020

Computational skills

MATLAB, R, Python, Latex, HPC (SLURM), Git

Numerical methods: optimization, Fourier analysis, spectral methods, frequency marching, expectation-maximization, non-convex optimization, numerical linear algebra.

Teaching:

Instructor on Record:

1070 Introduction to Statistics	Spring 2024
3170 R Lab I	Fall 2024
1100 Business Calculus	Spring 2023
1070 Introduction to Statistics	Spring 2022
5010 Introduction to Probability	Summer 2021

Teaching Assistant:

3140 Engineering Vector Calculus and PDE's	Spring 2025
1320 Engineering Calculus II	Fall 2022
1310 Engineering Calculus I	Fall 2020, Spring 2021