Mikhail Sweeney

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Salt Lake City, UT

Education

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

Research Interests

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.

Additionally, I am interested in solving inverse problems and developing algorithms in **Signal Processing towards Cryo-EM**, especially those involving data science over groups. Such problems include multi-target detection and multi-reference alignment, simplified models of Cryo-EM, and are closely tied to deconvolution. I am also interested in seeing how the methods I've developed can be applied to other biological imaging problems, such as cytometry.

Publications

Al-Ghattas, Omar & Little, Anna & Sanz-Alonso, Daniel & Sweeney, Mikhail. **Functional multi-reference alignment via deconvolution.** Submitted 2025 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.** Submitted 2024 to Communications in Mathematical Physics. https://arxiv.org/abs/2407.07866

Research Experience

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

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

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

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

Awards:

Optimization and inversion research training grant fellowship	May 2024
Outstanding graduate student award	April 2024
Norman and Beatrice Haaser mathematics scholar	September 2020
Glynn honors student	May 2016

Talks and Posters given:

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

Shocks and Instability in the Directed Landscape (forthcoming). 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