Benjamin Jiahong Zhang

bjz@mit.edu

Education

Massachusetts Institute of Technology, Cambridge, MA — Expected 2021

PhD, Computational Science and Engineering

- Working title: *Efficient sampling methods by and for stochastic dynamical systems*
- Thesis committee: Youssef Marzouk (Chair), Tuhin Sahai, Themis Sapsis

SM, Aeronautics and Astronautics — 2017

- Thesis: *A Coupling Approach to Rare Event Simulation via Dynamic Importance Sampling*
- Advisor: Youssef Marzouk

University of California, Berkeley, Berkeley, CA — 2015

BS, Engineering Physics

BA, Applied Mathematics, Concentration in Numerical Analysis

- Graduated Highest Honors in Applied Mathematics, Distinction in General Scholarship
- Thesis: *A Computational Study of Seizure Attenuation via Anderson Localization*
- Advisors: Mohammad-Reza Alam and Per-Olof Persson

Research Interests

Rare event simulation, Monte Carlo methods, Computational dynamical systems, Data assimilation

Research Experience

Department of Aeronautics and Astronautics, MIT — Cambridge, MA

Graduate research assistant — 2015 - Present

Supervised by Professor Youssef Marzouk in the Aerospace Computational Design Laboratory (ACDL). Currently studying importance sampling and multilevel splitting approaches for rare events in dynamical systems and Bayesian computation based on Koopman operator theory.

Department of Mechanical Engineering, UC Berkeley — Berkeley, CA

Undergraduate research assistant — 2013 - 2015

Supervised by Professor Reza Alam. Studied noninvasive seizure attenuation methods via Anderson localization. Also did experimental study of cavity dynamics of spheres entering fluid surfaces.

Teaching experience

Department of Aeronautics and Astronautics, MIT — Cambridge, MA

Course developer — 2019 - 2020

Designed and co-wrote curriculum for MIT xPro online course on Modeling, Simulation, and Machine learning for working professionals.

Teaching assistant — Spring 2019

Undergraduate probability & statistics for aerospace engineering. Awarded best teaching assistant award by the students.

Course developer and co-instructor — Spring 2018, 2019

Designed curriculum and co-taught course for "A hands-on introduction to computational engineering," an introductory course targeted at first and second year undergraduates.

Seminar XL instructor — 2018-2019

Lead small 18.03 (Differential Equations) study groups for first year URM students. Facilitated by the MIT Office of Minority education.

Teaching assistant and grader — Fall 2018

Graduate class on numerical methods for stochastic processes and inference. Also served as informal teaching assistant and held office hours.

Subject Design Certificate Program — Summer 2020

From the MIT Teaching and Learning lab.

Department of Mathematics, UC Berkeley — Berkeley, CA

Teaching assistant — Spring 2015

Second semester introductory calculus.

Professional experience

United Technologies Research Center, UTC — Berkeley, CA

Applied Mathematics Intern — Summer 2017

Researched queuing systems for modeling human operators. Also investigated using quantum computing for optimization.

California State Assembly — Sacramento, CA

Legislative Intern — Summer 2013

Analyzed policy and wrote briefs related to natural resources, environmental regulation, hydraulic fracturing, and services for the developmentally disabled. Responded to constituent affairs.

Mentoring

Undergraduate research students advised:

- Joshua W. (MIT UROP and SuperUROP) — 2019 - 2021
- Karolina P. (MIT UROP) — 2018 - 2019

Honors

Mathworks Engineering Fellowship	2019
AIAA Aeronautics & Astronautics Teaching Assistantship Award	2019
NSF Graduate Research Fellowships Program Honorable Mention	2015, 2016
Phi Beta Kappa	2015
Summer Undergraduate Research Fellowship (SURF L&S)	2014
Tau Beta Pi Engineering Honor Society	2013
Matsui Center Cal-in-Sacramento Fellowship	2013

Service

Journal referee for SIAM Journal on Scientific Computing (SISC)	2021
Journal referee for Physica D: Nonlinear Phenomena	2020
SIAM CSE 2021 Minisymposium organizer Title: *Computational Dynamics meets Computational Statistics* (8 talks)	2021
SIAM CSE 2019 Minisymposium organizer Title: *Advances in Rare Event Simulation for Complex Dynamical Systems* (8 talks)	2019
Organizer of the Uncertainty Quantification Reading Group	2019 - Present
ACDL Undergraduate Research Opportunity Coordinator (UROP)	2017 - Present
Association of Computational Science and Engineering Students Co-President	2017 - 2018

- Organized the 2018 and 2019 MIT Center for Computational Engineering annual symposium

Publications

6. **B. Zhang**, Y. Marzouk, and K. Spiliopoulos. Geometry-informed irreversible perturbations for accelerated convergence of Langevin dynamics. In preparation.
5. **B. Zhang**, T. Sahai, and Y. Marzouk. Computing the eigenfunctions of the multidimensional Ornstein-Uhlenbeck operator. In preparation.
4. **B. Zhang**, T. Sahai, and Y. Marzouk. Sampling via controlled stochastic dynamical systems. In preparation.
3. **B. Zhang**, T. Sahai, and Y. Marzouk. A Koopman framework for rare event simulation in stochastic differential equations. *arXiv preprint arXiv:2101.07330*, 2021
2. **B. Zhang**, Y. Marzouk, B.-Y. Min, and T. Sahai. Rare event simulation of a rotorcraft system. In *2018 AIAA Non-Deterministic Approaches Conference*, 2018
1. **B. Zhang**, M. Chamanzar, and M.-R. Alam. Suppression of epileptic seizures via Anderson localization. *Journal of The Royal Society Interface*, 2017

Invited Talks and Seminars

4. **B. Zhang**, T. Sahai, and Y. Marzouk. A Koopman framework for sampling in stochastic dynamical systems. LIDS and Stats Tea Talk, Cambridge, MA, April 8, 2020.

3. **B. Zhang**, T. Sahai, and Y. Marzouk. A Koopman framework for sampling in stochastic dynamical systems. Aerospace Computational Design Laboratory Seminar, Cambridge MA, December 6, 2019.
2. **B. Zhang**, T. Sahai, and Y. Marzouk. Sampling methods for stochastic dynamical systems using Koopman eigenfunctions. United Technologies Research Center, Berkeley, CA, September 25, 2019.
1. N. Chandramoorthy, and **B. Zhang**. Koopman operators and the problems related to their computation. Aerospace Computational Design Laboratory Seminar, Cambridge MA, December 7, 2018.

Conference & Workshop Presentations

13. **B. Zhang**, J. White, T. Sahai, and Y. Marzouk. Rare event simulation for linear SDEs via multilevel splitting, 2021. SIAM Conference on Applications of Dynamical Systems, Portland, OR.
12. **B. Zhang**, T. Sahai, and Y. Marzouk. Sampling via controlled stochastic dynamical systems, 2021. SIAM Conference on Computational Science and Engineering, Austin, TX.
11. **B. Zhang**, T. Sahai, and Y. Marzouk. Sampling via controlled stochastic dynamical systems, 2020. Second symposium on machine learning and dynamical systems, Fields Institute.
10. **B. Zhang**, T. Sahai, and Y. Marzouk. Importance sampling for linear SDEs using eigenfunctions of the Ornstein-Uhlenbeck operator (poster), 2019. ICERM workshop on Mathematical Optimization of Systems Impacted by Rare, High-Impact Random Events, Providence, RI. (**Travel grant awarded**)
9. **B. Zhang**, T. Sahai, and Y. Marzouk. Rare event simulation in nonlinear dynamical systems via the Koopman operator, 2019. International Congress on Industrial and Applied Mathematics, Valencia, Spain.
8. **B. Zhang**, T. Sahai, and Y. Marzouk. Towards a generalized theory of rare event simulation for linear stochastic differential equations, 2019. SIAM Conference on Applications of Dynamical Systems, Snowbird, UT.
7. Q. Long, **B. Zhang**, Y. Marzouk, A. Gorodetsky, and T. Sahai. Tensor decomposition-based splitting methods for rare event simulation, 2019. SIAM Conference on Applications of Dynamical Systems, Snowbird, UT.
6. **B. Zhang**, T. Sahai, and Y. Marzouk. Efficient simulation of rare events in stochastic differential equations, 2019. SIAM Conference on Computational Science and Engineering, Spokane, WA.
5. **B. Zhang**, T. Sahai, and Y. Marzouk. Rare event simulation for dynamical systems in the presence of an attractor, 2018. SIAM Annual Meeting, Portland, OR.
4. **B. Zhang** and T. Sahai. A probabilistic analysis and rare event study of a dynamical queue for modeling human operators, 2018. SIAM Conference on Uncertainty Quantification, Garden Grove, CA.
3. **B. Zhang**, Y. Marzouk, B.-Y. Min, and T. Sahai. Rare event simulation of a rotorcraft system, 2018. AIAA Scitech Forum Non-deterministic Approaches Conference, Kissimmee, FL.
2. **B. Zhang**, Y. Marzouk, B.-Y. Min, and T. Sahai. Rare event simulation via dynamic importance sampling and measure transport (poster), 2017. USACM Thematic Workshop on Uncertainty Quantification and Data-Driven Modeling, Austin, TX. (**Travel grant awarded**)
1. **B. Zhang**, Y. Marzouk, and T. Sahai. Scalable methods for rare event simulation in rotorcraft systems, 2017. SIAM Conference on Computational Science and Engineering, Atlanta, GA.

Workshops attended

5. Second Symposium on Machine Learning and Dynamical Systems, Fields Institute for Research in Mathematical Sciences, University of Toronto, September 21-29, 2020.
4. Workshop on Mathematical Optimization of Systems Impacted by Rare, High-Impact, Random Events, Institute for Computational and Experimental Research in Mathematics (ICERM), Brown University, June 24-28, 2019.
3. Optimal Transport: Numerical Methods and Applications, Lake Como School of Advanced Studies, May 7-11, 2018.

2. USACM Workshop on Uncertainty Quantification and Data-Driven Modeling, Austin TX, March 23-24, 2017.

1. Summer School in Monte Carlo Methods for Rare Events, Division of Applied Mathematics, Brown University, June 13-17, 2016.