Renbo Zhao

W384, Pappajohn Business Building
21 E Market St
Iowa City, IA 52242

Telephone: +1-857-999-6954
Email: renbo-zhao@uiowa.edu
Web: http://web.mit.edu/renboz/www/

Research Interests

Theory and computational practice of **continuous optimization** and its applications in **machine learning**, **data science** and **operations management**.

Education

PhD in Operations Research   Sept. 2018 – June 2023 (Expected)
Massachusetts Institute of Technology
Thesis: New Theory and Algorithms for Optimization Problems with Non-Standard Structures
Thesis advisor: Robert M. Freund

M.Sc. in Mathematics   Sept. 2016 – June 2018
National University of Singapore
Thesis: Stochastic and Randomized Algorithms for Large-Scale Optimization in Machine Learning
Thesis advisors: Vincent Y. F. Tan and William B. Haskell

B.Eng. in Electrical Engineering (First Class Honors)   Sept. 2011 – June 2015
National University of Singapore
Thesis: Online Nonnegative Matrix Factorization with Outliers
Thesis advisor: Vincent Y. F. Tan

Professional Experience

- **Tippie College of Business, University of Iowa**, Assistant Professor   Aug. 2023 – Present
  - Conducting research in continuous optimization and its applications in machine learning, data science and operations management
  - Teaching Master level courses in statistical thinking, data analysis and decision making

- **JP Morgan Chase AI Research (NYC)**, Research Intern   Summer 2022

  Worked with Vamsi Potluru on efficient inference of multi-dimensional Hawkes processes. Paper titled "Fast Learning of Multidimensional Hawkes Processes via Frank-Wolfe" has been accepted to NeurIPS 2022 Workshop on Synthetic Data for Empowering ML Research.

- **Amazon.com (Seattle)**, Research Intern   Summer 2021

  Worked with Phillip Kriett and Georgios Patsakis on two-stage stochastic resource planning problems. Developed code for primal-dual gradient methods for solving LP relaxations of certain two-stage stochastic mixed-integer programs. (Proprietary, no publicly available paper.)

- **Microsoft AI Research (Redmond)**, Research Intern   Summer 2020

  Worked with Lin Xiao and Shiqian Ma on Bregman Alternating Direction Method of Multipliers (ADMM) for large-scale optimal transport problems. Paper titled "Bregman ADMM With Applications to Optimal Transport", in preparation.

- **IBM AI Research (Yorktown Heights)**, Research Intern   Summer 2019

  Worked with Lior Horesh, Kenneth Clarkson and Sara Magliacane on Bayesian optimal experimental design for symbolic regression problems. (Initially intended to work with Andrew Conn, who tragically passed away shortly before the internship started.)

- **École Polytechnique Fédérale de Lausanne (EPFL)**, Research Intern   Summer 2017

  Worked with Volkan Cevher on primal-dual algorithms for stochastic three-composite convex minimization with a linear operator. Paper titled "Stochastic Three-Composite Convex Minimization with a Linear Operator", published in *AISTATS*, 2018.

- **National University of Singapore (NUS)**, Research Engineer   July 2015 – Aug. 2018

  - Worked with William B. Haskell and Vincent Y. F. Tan on stochastic and randomized algorithms for large-scale optimization in machine learning. Several papers published.
  - Worked with Vincent Y. F. Tan and Huan Xu on machine learning algorithms for online matrix factorization and ranking from pairwise comparisons. Several papers published.

Journal Papers

J1. Renbo Zhao, "New Analysis of An Away-Step Frank-Wolfe for Minimizing Logarithmically-Homogeneous Barriers", minor revision at *Mathematics of Operations Research*, 2024.

J2. Le T. K. Hien, Renbo Zhao and William B. Haskell, "An Inexact Primal Dual Smoothing Framework for Large-Scale Non-Bilinear Saddle Point Problems", *Journal of Optimization Theory and Applications*, Vol. 200, Pages 34–67, 2024.

J3. Renbo Zhao, "A Primal-Dual Smoothing Framework for Max-Structured Nonconvex Optimization", to appear in *Mathematics of Operations Research*, 2024.

J4. Renbo Zhao, "Convergence Rate Analysis of the Multiplicative Gradient Algorithm for PET-Type Problems", *Operations Research Letters*, Vol. 51, No. 1, Pages 26–32, 2023.

J5. Renbo Zhao and Qiuyun Zhu, "A Generalized Frank-Wolfe Method With "Dual Averaging" for Strongly Convex Composite Optimization", *Optimization Letters*, Vol. 17, No. 7, Pages 1595–1611, 2023.

J6. Renbo Zhao and Robert M. Freund, "Analysis of the Frank-Wolfe Method for Convex Composite Optimization involving a Logarithmically-Homogeneous Barrier", *Mathematical Programming (Series A)*, Vol. 199, No. 1–2, Pages 123–163, 2023.

J7. Renbo Zhao, "Accelerated Algorithms for Stochastic Three-Composite Convex-Concave Saddle Point Problems", *Mathematics of Operations Research*, Vol. 47, No. 2, Pages 1443-1473, 2022.

J8. Weikang Gong, Renbo Zhao and Stefan Grünewald, "Structured sparse K-means clustering via Laplacian smoothing", *Pattern recognition letters*, Vol. 112, No. 5, Pages 63-69, 2018.

J9. Renbo Zhao, William B. Haskell and Vincent Y. F. Tan, "Stochastic L-BFGS: Improved Convergence Rates and Practical Acceleration Strategies", *IEEE Transactions on Signal Processing*, Vol. 66, No. 5, Pages 1155–1169, 2018.

J10. Renbo Zhao and Vincent Y. F. Tan, "A Unified Convergence Analysis of the Multiplicative Update Algorithm for Regularized Nonnegative Matrix Factorization", in *IEEE Transactions on Signal Processing*, Vol. 66, No. 1, Pages 129–138, 2018.

J11. Changho Suh, Vincent Y. F. Tan and Renbo Zhao, "Adversarial Top-K Ranking", in *IEEE Transactions on Information Theory*, Vol. 63, No. 4, Pages 2201–2225, 2017.

J12. Renbo Zhao and Vincent Y. F. Tan, "Online Nonnegative Matrix Factorization with Outliers", in *IEEE Transactions on Signal Processing*, Vol. 65, No. 3, Pages 555-570, 2017.

Submitted and Working Papers

W1. Renbo Zhao, "On the Closed Convex Hull of Some Spectral Sets", in preparation and to be submitted to *Operations Research*, 2024.

W2. Sentao Miao, Yining Wang and Renbo Zhao, "Dynamic Learning Policy for Multi-Warehouse Multi-Store Systems with Censored Demands", under first round review at *Management Science*, 2024.

W3. Renbo Zhao, "The Generalized Multiplicative Gradient Method and Its Convergence Rate Analysis", in preparation and to be submitted to *SIAM Journal on Optimization*, 2024.

Conference Proceedings

C1. Niccolo Dalmasso*, Renbo Zhao*, Mohsen Ghassemi, Vamsi K. Potluru, Tucker Balch and Manuela Veloso, "Efficient Event Series Data Modeling via First-Order Constrained Optimization", in *Proc. ACM Int. Conf. AI Financ. (ICAIF)*, 2023.

C2. Renbo Zhao, William B. Haskell and Vincent Y. F. Tan, "An Optimal Algorithm for Stochastic Three-Composite Optimization", in *Proc. 22nd Int. Conf. Artif. Intell. Stat. (AISTATS)*, Okinawa, Japan, 2019.

C3. Renbo Zhao and Volkan Cevher, "Stochastic Three-Composite Convex Minimization with a Linear Operator", in *Proc. 21st Int. Conf. Artif. Intell. Stat. (AISTATS)*, Lanzarote, Canary Islands, Spain, 2018.

C4. Renbo Zhao, William B. Haskell and Vincent Y. F. Tan, "Stochastic L-BFGS Revisited: Improved Convergence Rates and Practical Acceleration Strategies", in *Proc. 33rd Conf. Uncertain. Artif. Intell. (UAI)*, Sydney, Australia, 2017.

C5. Renbo Zhao, Vincent Y. F. Tan and Huan Xu, "Online Nonnegative Matrix Factorization with General Divergences", in *Proc. 20th Int. Conf. Artif. Intell. Stat. (AISTATS)*, Fort Lauderdale, FL, USA, 2017.

C6. Renbo Zhao and Vincent Y. F. Tan, "A Unified Convergence Analysis of the Multiplicative Update Algorithm for Nonnegative Matrix Factorization", in *Proc. 42nd IEEE Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, New Orleans, LA, USA, 2017.

C7. Renbo Zhao and Vincent Y. F. Tan, "Online Nonnegative Matrix Factorization with Outliers", in *Proc. 41st IEEE Int. Conf. Acoust. Speech Signal Process. (ICASSP)*, Shanghai, China, 2016.

C8. Renbo Zhao, Siu Wa Lee, Dong-Yan Huang and Minghui Dong, "Soft Constrained Leading Voice Separation with Music Score Guidance", in *Proc. 9th ISCA/IEEE Int. Symp. Chin. Spok. Lang. Process. (ISCSLP)*, Singapore, 2014.

Teaching Experience

Instructor at University of Iowa for:

- BAIS:9100 Data and Decisions (Master level)   Fall 2023
    - BAIS:9100:0700: For students majoring in Master of Business Analytics
    - BAIS:9100:0800: For students majoring in Master of Finance

Teaching Assistant at MIT for:

- 15.075: Statistical Thinking and Data Analysis (Undergraduate)   Spring 2022
- 6.252/15.084: Nonlinear Optimization (Doctoral)   Spring 2021
- 6.251/15.081: Introduction to Mathematical Programming (Doctoral)   Fall 2020

Mentor for a capstone project in MIT Masters in Business Analytics program   2019

Talks

Individual Invited Talks at Universities:

- University of Minnesota, Machine Learning Seminar   Apr. 2024
- University of Waterloo, Workshop on Large Scale Optimization and Applications   Oct. 2022
- Clemson University, Operations Research Seminar   Sept. 2022

Conference Talks:

- INFORMS Annual Meeting, Phoenix, AZ   Oct. 2023
- SIAM Conference on Optimization   June 2023
- INFORMS Annual Meeting, Indianapolis, IN   Oct. 2022
- ICCOPT (Int. Conf. on Continuous Optimization), Lehigh University   July 2022
- INFORMS Optimization Society Conference, Clemson University   Mar. 2022
- SIAM Conference on Optimization   July 2021
- INFORMS Annual Meeting, Virtual   Nov. 2020
- Microsoft Research, Machine Learning & Optimization Group   Sept. 2020
- INFORMS Annual Meeting, Seattle, WA   Oct. 2019
- National University of Singapore, ISEM Seminar   May 2019

- Rensselaer Polytechnic Institute, Applied Math Day   Apr. 2019

- MIT, LIDS Student Conference   Jan. 2019

- INFORMS Annual Meeting, Phoenix, AZ   Nov. 2018

- ISMP (Int. Symp. on Mathematical Programming), Bordeaux, France   July 2018

Professional Activities

Session Chair/Co-Chair: INFORMS 2022, ICCOPT 2022, SIAM Conference on Optimization 2021, INFORMS 2019

Reviewer for:

- Journals: *Mathematical Programming (Series A)*, *SIAM Journal on Optimization*, *Journal of Optimization Theory and Applications*, *Journal of Machine Learning Research*, *Computational Optimization and Applications*, *IEEE Transactions on Signal Processing*

- Conferences: *Conf. Neural Inf. Process. Syst. (NeurIPS)*, *IEEE Int. Symp. Inf. Theory (ISIT)*, *IEEE Int. Conf. Acoust. Speech Signal Process. (ICASSP)*

Memberships: INFORMS, SIAM, MOS, IEEE

Other

Interests: Cooking (Chinese and American cuisines), Sports (basketball, kayaking, cycling, table tennis), Travel, Hiking

Computer Languages: Python, MATLAB, R, Julia