JIANHAO MA

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RESEARCH INTERESTS

His research focuses on developing efficient and theoretically grounded optimization algorithms for high-dimensional machine learning problems with noisy data through the lens of nonsmooth optimization and robust statistics. Especially, he focuses on exploiting low-dimensional structures such as sparsity, low-rankness, and quantization.

EDUCATION

University of Michigan, Ann Arbor *January 2021 - 2025 (expected)*
Department of Industrial and Operational Engineering Ph.D. candidate
Advisor: Prof. Salar Fattahi

Tsinghua University *September 2016 - June 2020*
B.E. in Industrial Engineering and B.S. in Mathematics

University of California, Berkeley *January 2019 - August 2019*
Exchange student in the Department of Statistics

AWARDS

- Rackham Predoctoral Fellowship, University of Michigan *2024-2025*
- INFORMS Junior Faculty Interest Group Paper Competition – Second Place (as a coauthor) *2023*
- Katta Murty Prize for Best Research Paper on Optimization, IOE Department *2023*
- NeurIPS Scholar Award *2022*

EXPERIENCE

FAIR Labs, Meta *May 2024 - August 2024*
Research scientist intern, hosted by Dr. Lin Xiao

IIIS, Tsinghua University *August 2020 - June 2021*
Visiting student, hosted by Prof. Yuhao Wang

AI Lab, ByteDance *April 2020 - July 2020*
Machine learning engineer intern in deep reinforcement learning lab

PREPRINTS/WORKING PAPERS

1. Can Learning Be Explained By Local Optimality In Low-rank Matrix Recovery? [link]
   Jianhao Ma, Salar Fattahi
   under review at the **Mathematics of Operations Research**
   Latest status: Major Revision
   INFORMS Junior Faculty Interest Group Paper Competition – Second Place
2. Parsimonious Trajectories in Gradient Descent: Emerging Low-dimensionality in Over-parameterized Models
   Jianhao Ma, Geyu Liang, Salar Fattahi
   to be submitted to the **Mathematics of Operations Research**

Latest status: under preparation

3. Quantization through Piecewise-Affine Regularization: Optimization and Statistical Guarantees
   Jianhao Ma, Lin Xiao
   to be submitted to the **SIAM Journal on Mathematics of Data Science**
   Latest status: under preparation

4. Piecewise-Affine Regularized Quantization
   Lisa Jin, Jianhao Ma, Zechun Liu, Andrey Gromov, Aaron Defazio, Lin Xiao
   to be submitted to the **International Conference on Machine Learning 2025**
   Latest status: under preparation

PUBLICATIONS

(∗: equal contribution; †: student mentored.)

1. Convergence of Gradient Descent with Small Initialization for Unregularized Matrix Completion
   Jianhao Ma, Salar Fattahi
   Conference on Learning Theory (COLT), 2024 [link]

2. Robust Sparse Mean Estimation via Incremental Learning
   Jianhao Ma, Rui Ray Chen†, Yinghui He†, Salar Fattahi, Wei Hu
   International Conference on Learning Representations (ICLR) Workshop on Bridging the Gap Between Practice and Theory in Deep Learning, 2024 [link]

3. Global Convergence of Sub-gradient Method for Robust Matrix Recovery: Small Initialization, Noisy Measurements, and Over-parameterization
   Jianhao Ma, Salar Fattahi
   Journal of Machine Learning Research (JMLR), 2023 [link]

4. Behind the Scenes of Gradient Descent: A Trajectory Analysis via Basis Function Decomposition
   Jianhao Ma, Lingjun Guo†, Salar Fattahi
   International Conference on Learning Representations (ICLR), 2023 [link]

5. Blessing of Nonconvexity in Deep Linear Models: Depth Flattens the Optimization Landscape Around the True Solution
   Jianhao Ma, Salar Fattahi
   Advances in Neural Information Processing Systems (NeurIPS), 2022 (**Spotlight**) [link]
   Katta Murty Prize for Best Research Paper on Optimization

6. Towards Understanding Generalization via Decomposing Excess Risk Dynamics
   Jiaye Teng*, Jianhao Ma*, Yang Yuan
   International Conference on Learning Representations (ICLR), 2022 [link]

7. Sign-RIP: A Robust Restricted Isometry Property for Low-rank Matrix Recovery
   Jianhao Ma, Salar Fattahi
   Advances in Neural Information Processing Systems (NeurIPS) Workshop on Optimization for Machine Learning, 2021 [link]

INVITED TALK/PRESENTATION

1. **Annual Conference on Learning Theory**, Edmonton, July 2024
   "Convergence of Gradient Descent with Small Initialization for Unregularized Matrix Completion"

2. **Peking University**, Center for Machine Learning Research, Beijing, April 2024
   "Robust Matrix Recovery through Nonconvex Optimization: Challenges and Promises"

3. **The Chinese University of Hong Kong**, SEEM Seminar Series, Hong Kong, April 2024
   "Robust Matrix Recovery through Nonconvex Optimization: Challenges and Promises"
4. **INFORMS Optimization Society Conference**, Houston, TX, March 2024
   "Convergence of Gradient Descent with Small Initialization for Unregularized Matrix Completion"
5. **INFORMS Annual Meeting**, Phoenix, AZ, October 2023
   "Behind the Scenes of Gradient Descent: A Trajectory Analysis via Basis Function Decomposition"
6. **ICSA Applied Statistics Symposium**, Ann Arbor, MI, June 2023
   "Robust Sparse Mean Estimation via Incremental Learning"
7. **INFORMS Annual Meeting, Indianapolis, IN, October 2022**
   "Blessing of Nonconvexity in Deep Linear Models: Depth Flattens the Optimization Landscape Around the True Solution"
8. **INFORMS Optimization Society Conference**, Greenville, SC, March 2022
   "Global Convergence of Sub-gradient Method for Robust Matrix Recovery: Small Initialization, Noisy Measurements, and Over-parameterization"
9. **INFORMS Annual Meeting**, Anaheim, CA, October 2021
   "Sign-RIP: A Robust Restricted Isometry Property for Low-rank Matrix Recovery"
10. **MOPTA Conference**, Bethlehem, PA, August 2021
    "Sign-RIP: A Robust Restricted Isometry Property for Low-rank Matrix Recovery"

ACTIVITIES/ACADEMIC SERVICE

Organizer
Session chair: INFORMS Annual Meeting 2021, 2022, 2024

Reviewer

Journal: IEEE Transactions on Information Theory, IEEE Transactions on Signal Processing.

Conference: ICML, NeurIPS, ICLR, AISTATS, NeurIPS Workshop on Optimization for Machine Learning, ICLR Workshop on Bridging the Gap Between Practice and Theory in Deep Learning.