

Kaiyi Ji

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Current Position

Assistant Professor, Computer Science and Engineering

State University of New York at Buffalo, NY, USA

Sep 2022 – Present

Affiliated with **Institute for Artificial Intelligence and Data Science**

- Research interests: Bilevel Optimization, Multi-Task/Objective Learning, Meta-Learning and Continual Learning, Large-Scale Optimization, Federated Learning and Networks

Education

The Ohio State University

Ph.D., Electrical and Computer Engineering

Columbus, OH, USA

Sep 2016 – Dec 2021

- Advisor: Prof. Yingbin Liang
- Thesis: *Bilevel optimization for machine learning: Algorithm design and convergence analysis*. 2021.
- Thesis Committee: Yingbin Liang, Ness B. Shroff, Philip Schniter, Cathy Xia

University of Science and Technology of China

B.S., Electronic Engineering and Information Science

Anhui, China

Sep 2012 – Jun 2016

Professional & Industrial Experience

Postdoctoral Research Fellow, Electrical Engineering and Computer Science

University of Michigan, Ann Arbor, MI, USA

Sep 2021 – Sep 2022

Affiliated Postdoc Member with **NSF AI-EDGE Institute**

- Mentor: Prof. Lei Ying
- Topic: Bilevel Learning for Edge Computing

Visiting Student Research Collaborator, Electrical and Computer Engineering

Princeton University, NJ, USA

Mar 2020 – Apr 2020

- Mentor: Prof. H. Vincent Poor
- Topic: Optimization Foundations for Meta-Learning

Research Intern (Database Team)

Alibaba DAMO Academy (US Group), CA, USA

May 2019 – Aug 2019

- Topic: Deep Learning for Database System

Grants and Contracts

Summary of Research Funding Since 2023:

Funding Category	Total	Candidate's Share
Total Funded Research	\$ 1, 100, 000	\$ 550, 190

Current Funding

- “Collaborative Research: CIF: Small: New Theory, Algorithms and Applications for Large-Scale Bilevel Optimization,” Lead PI: Kaiyi Ji, 08/01/2023 - 07/31/2026, CIF program, Division of CCF, \$ 300,190 (50% share)
- “Collaborative Research: Distributed Bilevel Optimization in Multi-Agent Systems,” PI: Kaiyi Ji, 08/15/2023 - 07/31/2026, EPCN-Energy-Power-Ctrl-Netwrks, Division of ECCS \$ 250,000 (50% share)

Pending Funding

- “Collaborative Research: Frameworks: A Unified Open-Source Library for Robot Learning,” Co-PI: Kaiyi Ji, 05/2024 - 04/2029, CSSI, my share: \$ 600,000

Publications

Citations: 1039 (h-index: 15, i-index: 21)

Google Scholar: <https://scholar.google.com/citations?user=E0A31SIAAAAJ&hl=en>

ORCID: orcid.org/0000-0002-9533-0058

Theses

“Bilevel optimization for machine learning: Algorithm design and convergence analysis”, Doctoral thesis, The Ohio State University, 2021.

Refereed Proceedings Articles (*presenter name underlined; *: advised student*)

24. R. Sharma*, K. Ji, Z. Xu, C. Chen. “AUC-CL: A Batchsize-Robust Framework for Self-Supervised Contrastive Representation Learning,” *International Conference on Learning Representations*. [**ICLR 2024**].
23. P. Xiao*, H. Ban*, K. Ji. “Direction-oriented Multi-objective Learning: Simple and Provable Stochastic Algorithms,” in *Conference on Neural Information Processing Systems*. [**NeurIPS 2023**].
22. Y. Yang*, P. Xiao*, K. Ji. “SimFBO: Towards Simple, Flexible and Communication-efficient Federated Bilevel Learning,” in *Conference on Neural Information Processing Systems*. [**NeurIPS spotlight, 2023**] [**5% acceptance rate**].
21. Y. Yang*, P. Xiao*, K. Ji. “Achieving $O(\epsilon^{-1.5})$ Complexity in Hessian/Jacobian-free Stochastic Bilevel Optimization,” in *Conference on Neural Information Processing Systems*. [**NeurIPS 2023**].
20. S. Lin, D. Sow, K. Ji, Y. Liang, N. Shroff. “Non-Convex Bilevel Optimization with Time-Varying Objective Functions,” in *Conference on Neural Information Processing Systems*. [**NeurIPS 2023**].
19. J. Hao, K. Ji, M. Liu. “Bilevel Coreset Selection in Continual Learning: A New Formulation and Algorithm,” in *Conference on Neural Information Processing Systems*. [**NeurIPS 2023**].
18. K. Ji and Lei Ying. “Network Utility Maximization with Unknown Utility Functions: A Distributed, Data-Driven Bilevel Optimization Approach,” *International Symposium on Theory, Algorithmic Foundations, and Protocol Design for Mobile Networks and Mobile Computing*. [**MobiHoc 2023**].
17. M. Huang*, D. Zhang*, K. Ji. “Achieving Linear Speedup in Non-IID Federated Bilevel Learning,” in *International Conference on Machine Learning*. [**ICML 2023**].

16. P. Xiao*, K. Ji. "Communication-Efficient Federated Hypergradient Computation via Aggregated Iterative Differentiation," in *International Conference on Machine Learning*. [ICML 2023].
15. D. Sow, K. Ji, Y. Liang. "On the Convergence Theory for Hessian-Free Bilevel Algorithms," in *35nd Conference on Neural Information Processing Systems*. [NeurIPS, 2022].
14. K. Ji, M. Liu, Y. Liang, L. Ying. "Will Bilevel Optimizers Benefit from Loops ," in *35nd Conference on Neural Information Processing Systems*. [NeurIPS spotlight, 2022] [5% acceptance rate].
13. S. Ma, Z. Chen, Y. Zhou, K. Ji, Y. Liang. "Data Sampling Affects the Complexity of Online SGD over Dependent Data ," in *Conference on Uncertainty in Artificial Intelligence*. [UAI 2022].
12. J. Yang, K. Ji, Y. Liang. "Provably Faster Algorithms for Bilevel Optimization," in *35nd Conference on Neural Information Processing Systems*. [NeurIPS spotlight, 2021] [3% acceptance rate].
11. K. Ji, J. Yang, Y. Liang. "Bilevel Optimization: Convergence Analysis and Enhanced Design," in *38th International Conference on Machine Learning*. [ICML 2021].
10. K. Ji, J. Lee, Y. Liang, H. Poor. "Convergence of Meta-Learning with Task-Specific Adaptation over Partial Parameters," in *34nd Conference on Neural Information Processing Systems*. [NeurIPS 2020].
9. K. Ji, Z. Wang, Y. Zhou, Y. Liang. "History-Gradient Aided Batch Size Adaptation for Variance Reduced Algorithms," in *37th International Conference on Machine Learning*. [ICML 2020].
8. Y. Zhou, Z. Wang, K. Ji, Y. Liang. "Proximal Gradient Algorithm with Momentum and Flexible Parameter Restart for Nonconvex Optimization," *International Joint Conference on Artificial Intelligence*. [IJCAI 2020].
7. Z. Guan, K. Ji, D. Bucci Jr, T. Hu, J. Palombo, M. Liston, Y. Liang. "Robust Stochastic Bandit Algorithms under Probabilistic Unbounded Adversarial Attack," in *34th AAAI Conference on Artificial Intelligence*. [AAAI spotlight, 2020].
6. Z. Wang, K. Ji, Y. Zhou, Y. Liang, V. Tarokh. "SpiderBoost and Momentum: Faster Stochastic Variance Reduction Algorithms," in *33nd Conference on Neural Information Processing Systems*. [NeurIPS 2019].
5. K. Ji, Z. Wang, Y. Zhou, Y. Liang. "Improved Zeroth-Order Variance Reduced Algorithms and Analysis for Nonconvex Optimization," in *36th International Conference on Machine Learning*. [ICML 2019].
4. K. Ji, Y. Liang. "Minimax Estimation of Neural Net Distance," in *32nd Conference on Neural Information Processing Systems*. [NeurIPS 2018].
3. K. Ji, G. Quan, J. Tan. "Miss Ratio for LRU Caching with Consistent Hashing," in *IEEE International Conference on Computer Communications*, 2018. [INFOCOM 2018].
2. G. Quan, K. Ji, J. Tan. "LRU Caching with Dependent Competing Requests," in *IEEE International Conference on Computer Communications*, 2018. [INFOCOM 2018].
1. J. Tan, G. Quan, K. Ji, N. Shroff. "On Resource Pooling and Separation for LRU Caching," in *International Conference on Measurement and Modeling of Computer Systems*, 2018. [SIGMETRICS 2018]. An extended version has been published in the journal *PACM on Measurement and Analysis of Computing Systems*. [POMACS 2018].

Refereed Journal Articles (*: graduate student; +: undergraduate student)

Published

9. K. Ji and Y. Liang. "Lower Bounds and Accelerated Algorithms for Bilevel Optimization." *Journal of Machine Learning Research* 24 (2023): 22-1. [JMLR 2023]
8. K. Ji, J. Yang, Y. Liang. "Theoretical Convergence of Multi-Step Model-Agnostic Meta-Learning," *Journal of Machine Learning Research*, 2021. [JMLR 2021]
7. K. Ji, Y. Zhou, Y. Liang. "Understanding Estimation and Generalization Error of Generative Adversarial Networks," *IEEE Transactions on Information Theory*, 2021. [TIT 2021]
6. Y. Zhang, Y. Zhou, K. Ji, M. Zavlanos. "A New One-Point Residual-Feedback Oracle For Black-Box Learning and Control," *Automatica*, 2021. [Automatica 2021]
5. T. Xu, Y. Zhou, K. Ji, Y. Liang. "When Will Gradient Methods Converge to Max-margin Classifier under ReLU Models?" *Stat, Special Issue of Deep Learning from Statistical Perspective*, 2021.
4. K. Ji, J. Tan, Y. Chi, J. Xu. "Learning Latent Features with Pairwise Penalties in Matrix Completion," *IEEE Transactions on Signal Processing*, 2020. [TSP 2020]

In Review

3. M. Huang, K. Ji, S. Ma, L. Lai. "Efficiently Escaping Saddle Points in Bilevel Optimization." *Journal of Machine Learning Research*, in revision.
2. Y. Zhang, Y. Zhou, K. Ji, and M. M. Zavlanos. "Boosting one-point derivative-free online optimization via residual feedback." *IEEE Transactions on Automatic Control*, Technical Note, 2023. Accepted with minor revision.
1. D. Sow, K. Ji, Z. Guan, Y. Liang. "A Primal-Dual Approach to Bilevel Optimization with Multiple Inner Minima," *Transaction on Machine Learning Research*, In First Review, 2023.

Honors and Awards

AISTATS Top Reviewer Award	2023
Presidential Fellowship , OSU (1-3 per department, highest honor for graduates)	2020-2021
Outstanding Reviewer Award (Top 8%) in NeurIPS, ICML	2020, 2021
University Fellowship, OSU (top honor for fresh graduates)	2016-2019
Outstanding Student Scholarship (1st prize), USTC	2012-2016

Technical Presentations

Invited Talks

Bilevel Optimization in Continual Learning

- Asilomar, Pacific Grove, CA Nov 2023

Network Utility Maximization via Bilevel Optimization

- ACM MobiHoc, Washington, DC Oct 2023

Bilevel Optimization in Continual Learning

- INFORMS Annual Meeting, Phoenix, Arizona Oct 2023
- Stochastic Bilevel Optimization and Application in Continual Learning**
- SIAM Conference on Optimization, Seattle, Washington Jun 2023
- Bilevel Stochastic Methods for Optimization and Learning**
- INFORMS Annual Meeting, Indianapolis, IN Oct 2022
- Co-organizer and Speaker of Invited Session on “Bilevel Machine Learning”**
- Conference on Information Sciences and Systems (CISS) virtually Mar 2022
- Optimization Theory and Faster Algorithms on Bilevel Learning**
- Next Generation Transportation Systems (NGTS) Seminar, virtual Dec 2021
- Meta-Learning: Theoretical Convergence and Algorithms.**
- Presidential Fellowship Winner Seminar, OSU, virtual Oct 2020
- University of Michigan, Ann Arbor, virtual Aug 2021
- Meta-Learning with Task-Specific Adaptation over Partial Parameters.**
- Neural Information Processing Systems (NeurIPS), spotlight presentation, virtual Dec 2020
- Machine Learning Seminar, OSU Dec 2020
- Learning Latent Features with Pairwise Penalties in Matrix Completion.**
- IEEE SAM invited talk, virtual Jul 2020
- History-Gradient Aided Batch Size Adaptation.**
- International Conference of Machine Learning (ICML), oral presentation, virtual Jul 2020
- Zeroth-Order (Gradient-Free) Variance Reduced Algorithms.**
- Machine Learning Seminar, OSU May 2019
- International Conference of Machine Learning (ICML), oral presentation, virtual Jun 2019
- Minimax Estimation of Neural Net Distance in GANs.**
- Machine Learning Seminar, OSU Oct 2018
- Miss Ratio for LRU Caching with Consistent Hashing.**
- IEEE INFOCOM, Honolulu, HI, USA Apr 2018

Graduate Students

Dissertations/Theses in Progress

Peiyao Xiao

Ph.D. student, CSE of University at Buffalo

NY, USA

Jan 2023– Present

- degree expected September 2028
- Work on federated learning, bilevel optimization and multi-task learning
- **Achievements:** totally four papers with me accepted at ICML 2023 and NeurIPS 2023 in one year!

Yifan Yang

Ph.D. student, CSE of University at Buffalo

NY, USA

Jan 2023– Present

- degree expected September 2028
- Work on federated learning and bilevel optimization
- **Achievements:** two papers with me accepted at NeurIPS 2023 with one **spotlight** presentation!

Jue Guo

Ph.D. student, CSE of University at Buffalo

NY, USA

Jul 2023– Present

- degree expected September 2028
- Work on continual learning and transfer learning

Hao Ban

Incoming Ph.D. student, CSE of University at Buffalo

NY, USA

Will start in Spring 2024

- degree expected September 2029
- Work on multi-task learning
- **Achievements:** one paper with me accepted at NeurIPS 2023

Adikavya Gupta

Master Student

NY, USA

Jan 2023– May 2023

- graduated with master degree
- Work on online meta-learning
- **Achievements:** completed one project on online meta-learning

Teaching Experience

CSE 676, Deep Learning

University at Buffalo

Fall 2023

- Responsibility: Lecture and instructor

CSE 701, Some Recent Progresses in Machine Learning

University at Buffalo

Spring 2023

- Responsibility: Lecture and instructor

CSE 712, Optimization for Modern Machine Learning

University at Buffalo

Fall 2022

- Responsibility: Lecture and instructor

ECE 8001, Advanced Topics in Communications

The Ohio State University

Fall 2019

- Responsibility: Guest Lecturer

ECE 7005, Information Theory

The Ohio State University

Spring 2019

- Responsibility: Guest Lecturer

Professional Activities

Leadership

Conference on Information Sciences and Systems (CISS)

- Co-organizer Invited Session on “Bilevel Machine Learning”, 2022

Other Service

Conference Reviewer:

- Artificial Intelligence and Statistics Conference (AISTATS) (top reviewer’23)
- Conference on Neural Information Processing Systems (NeurIPS) (23)

- International Conference on Learning Representations (ICLR) (23)
- International Conference on Machine Learning (ICML) (23)

Journal Reviewer:

- IEEE Transactions on Network Science and Engineering
- IEEE Transactions on Intelligent Systems and Technology
- IEEE Transactions on Mobile Computing
- IEEE Transactions on Pattern Analysis and Machine Intelligence
- IEEE Transactions on Signal Processing
- IEEE/ACM Transactions on Networking
- SIAM Journal on Optimization
- Journal of Machine Learning Research
- Computational Optimization and Applications
- Journal of Scientific Computing
- Machine Learning

Membership in Professional and Honor Societies

- MobiHoc, Technical Program Committee, Member, March 2023 - present
- INFORMS, member, August 2023 - present

University Service

Department Committees

- **Chair**, Colloquium + UpBeat Committee, September 2023 - Present
- **Member**, Grad Admissions Committee, September 2023 - Present
- **Member**, Colloquium + UpBeat Committee, September 2022 - May 2023
- **Member**, Grad Admissions Committee, September 2022 - May 2023