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## Academic Experience

2023.8 – Pre **Postdoctoral Fellow, Computing + Mathematical Sciences,**  
*California Institute of Technology, CA, USA,*  
Supervisors: Adam Wierman and Eric Mazumdar.

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## Education

2018.8 – 2023.8 **Ph.D. Candidate, Electrical and Computer Engineering,**  
*Carnegie Mellon University, PA, USA,*  
Advisor: Yuejie Chi.

2014.9 – 2018.7 **B.Eng., Electronic Engineering,** *Tsinghua University, Beijing, China,*  
Working with Yimin Liu.

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## Honors & Awards

### Honors/Fellowships:

- 2023 Rising Stars In Machine Learning by University of Maryland
- 2023 Computing, Data, and Society Postdoctoral Fellow by Caltech
- 2023 ICASSP Rising Stars in Signal Processing
- 2023 UT Austin Rising Stars in Computational and Data Sciences
- 2022 UChicago Rising Stars in Data Science
- 2022 NeurIPS 2022 Top Reviewer
- 2022 Leo Finzi Memorial Fellowship
- 2022 Wei Shen and Xuehong Zhang Presidential Fellowship
- 2021 Liang Ji-Dian Graduate Fellowship
- 2018 Presidential Fellowship granted by Carnegie Mellon University
- 2018 Carnegie Institute of Technology Dean's Fellowship
- 2018 Excellent Honors Graduate granted by Tsinghua University
- 2017 The First Prize in 35th Tsinghua University Academic Challenge Cup
- 2015-2017 Technology Innovation Excellence Award granted by Tsinghua University
- 2017 Enterprise Sponsored Scholarship granted by Tsinghua University
- 2016 National Scholarship granted by the government of China
- 2016 Qualcomm Scholarship granted by Tsinghua University
- 2016 Outstanding Project of Undergraduate Research Competition of Tsinghua University
- 2015 The First Prize in National Physics Contest for College Student
- 2014 The Silver Medal of Chinese Physics Olympiad

### Travel Awards:

- 2022 IAS WAM Mathematics in Machine Learning Travel Support
- 2020 National Science Foundation (NSF) Student Travel Grants for ICASSP
- 2020 Computing Research Association Grad Cohort for Women Travel Support
- 2019 The ACM International Workshop on Device-Free Human Sensing Travel Grant
- 2019 Women in Machine Learning Scholarship

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## Research Interests

My research interests focus on designing efficient algorithms for sequential decision making, data science and signal processing by leveraging tools from machine learning, high-dimensional statistics, and large-scale optimization. My contributions span across theory and applications, from providing theoretical footings to heuristics to advancing real-world applications as follows:

- **Enhancing sample efficiency and robustness for reinforcement learning:** designing sample-efficient value-based algorithms for online, offline and robust reinforcement learning with theoretical guarantees.
- **Nonconvex optimization for data science and signal processing:** developing provably efficient and theory-inspired nonconvex optimization methods for signal and data processing by leveraging low-dimensional representation.
- **Real-world application solutions:** seeking data-driven and physics-driven solutions for various sensing, computing, and robotics systems, with collaborators in civil engineering, the robotics institute, high-performance computing, mechanical engineering and industry.

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## Professional Experience

- 2022.9-2022.12 **Google Research, Brain Team, Mountain View, United States**,  
Student Researcher, Mentor: Pablo Samuel Castro, Matthieu Geist, Robert Dadashi.  
We work on designing deep reinforcement learning algorithms by resorting to some regularization techniques in offline RL.
- 2022.6-2022.9 **Google Research, Brain Team, Paris, France**,  
Research Intern, Mentor: Matthieu Geist, Robert Dadashi.  
We work on a project to design efficient deep reinforcement learning algorithms, which includes but not limited to the topics about game theory and optimization.
- 2020.5-2020.8 **Mitsubishi Electric Research Laboratories (MERL), Boston, United States**,  
Research Intern, Mentor: Dehong Liu.  
This confidential project involves blind deconvolution, image fusion and stitching, abnormal estimation detection of a sequence of problems, low rank matrix reconstruction, and sparsity.
- 2017.3-2017.6 **Momenta, Beijing, China**,  
Software Engineering Intern, Mentor: Gang Sun, Le Shan.  
I worked on computer graphics by displaying the HD semantic mapping of the road condition extracted by the deep-learning based perception system of the autonomous vehicles, which used to demonstrate the effect of the real-time “brains” for full autonomous driving.

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## Publications & Preprints

### Reinforcement Learning: Theory

- [1] [Laixi Shi](#), Gen Li, Yuting Wei, Yuxin Chen, Matthieu Geist, Yuejie Chi. "The Curious Price of Distributional Robustness in Reinforcement Learning with a Generative Model" Short version at *Conference on Neural Information Processing Systems (NeurIPS)*, 2023
- [2] [Laixi Shi](#), Yuejie Chi. "Distributionally Robust Model-Based Offline Reinforcement Learning with Near-Optimal Sample Complexity" *In submission*.
- [3] Gen Li, [Laixi Shi](#), Yuxin Chen, Yuejie Chi, Yuting Wei. "Settling the Sample Complexity of Model-Based Offline Reinforcement Learning" *The Annals of Statistics*.

[4] [Laixi Shi](#), Gen Li, Yuxin Chen, Yuting Wei, Yuejie Chi. "Pessimistic Q-Learning for Offline Reinforcement Learning: Towards Optimal Sample Complexity" *International Conference on Machine Learning (ICML)*, 2022.

[5] Gen Li, [Laixi Shi](#), Yuxin Chen, Yuejie Chi. "Breaking the Sample Complexity Barrier to Regret-Optimal Model-Free Reinforcement Learning" *Information and Inference: A Journal of the IMA*. A short version has been accepted by *Conference on Neural Information Processing Systems (NeurIPS)*, 2021 (**NeurIPS Spotlight**).

### Reinforcement Learning: Practice

[6] Wenhao Ding\*, [Laixi Shi](#)\*, Yuejie Chi, Ding Zhao. "Seeing is not Believing: Robust Reinforcement Learning against Spurious Correlation" *Conference on Neural Information Processing Systems (NeurIPS)*, 2023

[7] [Laixi Shi](#), Robert Dadashi, Yuejie Chi, Pablo Samuel Castro, Matthieu Geist. "Offline Reinforcement Learning with On-Policy Q-Function Regularization" *European Conference on Machine Learning (ECML)*, 2023.

[8] Yiqi Wang, Mengdi Xu, [Laixi Shi](#), Yuejie Chi. "A Trajectory is Worth Three Sentences: Multimodal Transformer for Offline Reinforcement Learning" Accepted by *The Conference on Uncertainty in Artificial Intelligence (UAI)*, 2023.

[9] Peide Huang, Mengdi Xu, Jiacheng Zhu, [Laixi Shi](#), Fei Fang, Ding Zhao. "Curriculum Reinforcement Learning using Optimal Transport via Gradual Domain Adaptation" *Conference on Neural Information Processing Systems (NeurIPS)*, 2022.

### Data Science and Signal Processing

[10] [Laixi Shi](#) and Yuejie Chi. "Manifold Gradient Descent Solves Multi-channel Sparse Blind Deconvolution Provably and Efficiently." *IEEE Transactions on Information Theory*, vol. 67, no. 7, pp. 4784-4811, 2021. Short version at *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 2020.

[11] [Laixi Shi](#), Dehong Liu, Jay Thornton. "Robust Camera Pose Estimation For Image Stitching" *IEEE International Conference on Image Processing (ICIP)*, 2021. Another version at *U.S. Patent Application 17/214,813*, 2022.

[12] Sang Yu, [Laixi Shi](#), and Yimin Liu. "Micro hand gesture recognition system using ultrasonic active sensing." *IEEE Access*, vol. 6, pp. 49339-49347, 2018.

### Real-World Applications

[13] T. Low, Y. Chi, J. Hoe, S. Kumar, A. Prabhakara, [L. Shi](#), U. Sridhar, N. Tukanov, C. Wang, and Y. Wu. "Zoom Out: Abstractions for Efficient Radar Algorithms on COTS Architectures." *IEEE International Symposium on Phased Array Systems and Technology (PAST)*, 2022.

[14] [Laixi Shi](#)\*, Peide Huang\*, Rui Chen\*. "Latent Goal Allocation for Multi-Agent Goal-Conditioned Self-Supervised Learning." *NeurIPS Bayesian Deep Learning Workshop*, 2021. (\* = equal contribution)

[15] [Laixi Shi](#), Dehong Liu, Masaki Umeda, and Norihiko Hana. "Fusion-Based Digital Image Correlation Framework for Strain Measurement." *International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, 2021. Another version at *U.S. Patent Application 17/148,609*, 2022.

[16] [Laixi Shi](#), Yue Zhang, Shijia Pan, and Yuejie Chi. "Data Quality-Informed Multiple Occupant Localization using Floor Vibration Sensing." *The 21st International Workshop on Mobile Computing Systems and Applications*, 2020.

[17] [Laixi Shi](#), Mostafa Mirshekari, Jonathon Fagert, Yuejie Chi, Hae Young Noh, Pei Zhang, and Shijia Pan. "Device-free Multiple People Localization through Floor Vibration." *First ACM Workshop on Device-Free Human Sensing*, 2019.

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## Patents

[1] Dehong Liu, [Laixi Shi](#). "System and Method of Image Stitching using Robust Camera Pose Estimation." *US Patent App. 17/214,813*, 2022.

[2] Dehong Liu, [Laixi Shi](#), Masaki Umeda, and Norihiko Hana. "Fusion-Based Digital Image Correlation Framework for Strain Measurement" *US Patent App. 17/148,609*, 2022.

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## Student Mentorship

CMU ECE Yuchen Wu (master student), 2021-2022  
Gore Kao (master student), 2022-2023  
Yiqi Wang (master student), 2022-Present  
Caltech CMS Chenbei Lu (PhD student), 2023-Present

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## Selected Professional Services

Area Chair: Conference on Parsimony and Learning (CPAL).  
Organization: Breakout session leader at *3rd Women in Machine Learning Un-Workshop, ICML 2022*.  
Review: *Journal*: FoCM, TPAMI.  
*Conferences*: ICLR (2022-2023), ICASSP (2022-2023), ICML (2020-2023), CHIL (2022), NeurIPS (2021-2022), ISIT (2022), ECML(2023), ICRA(2023).  
*Workshops*: SSP (2021), WiML (2019).

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## Teaching Experience

2020 Spring 18202 Mathematical Foundations of Electrical Engineering, Grad TA, CMU ECE Department.  
2021 Spring 18202 Mathematical Foundations of Electrical Engineering, Grad TA, CMU ECE Department.

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## Presentations

### Talks

- 2023.11 The Cost of Distributional Robustness in Reinforcement Learning: Minimax-Optimal Sample Efficiency. *Rising Stars In Machine Learning, University of Maryland*.
- 2023.11 The Cost of Distributional Robustness in Reinforcement Learning: Minimax-Optimal Sample Efficiency. *WORDS 2023: Workshop in Operations Research and Data Science, Duke University*
- 2023.10 The Cost of Distributional Robustness in Reinforcement Learning: Minimax-Optimal Sample Efficiency. *Safe Reinforcement Learning Online Seminar*
- 2023.10 The Cost of Distributional Robustness in Reinforcement Learning: Minimax-Optimal Sample Efficiency. *2023 INFORMS Annual Meeting*
- 2023.10 Sample-Efficient Artificial Intelligence. *IST ADVISORY COUNCIL MEETING at Caltech*
- 2023.9 The Curious Price of Distributional Robustness in Reinforcement Learning: Towards provable optimal sample efficiency. *RSRG/FALCON Tea Talk at Caltech*
- 2023.4 Provable Algorithms for Reinforcement Learning: Efficiency and Robustness. *UT Austin Rising Stars in Computational and Data Sciences*

- 2023.2 Offline Reinforcement Learning: Towards Optimal Sample Complexity and Distributional Robustness. *Computer Science & Engineering at University of Connecticut*
- 2023.2 Provable Algorithms for Reinforcement Learning: Efficiency and Robustness. *Information Theory and Applications Workshop (ITA)*
- 2023.1 Offline Reinforcement Learning: Towards Optimal Sample Complexity and Distributional Robustness. *Air Force Center of Excellence Meeting*
- 2022.11 Provable Algorithms for Reinforcement Learning: Efficiency and Robustness. *UChicago Rising Stars in Data Science (2022)*
- 2022.9 Reinforcement learning based on game theory, stochastic composition optimization and regularization. *Intern presentation at Google Brain*
- 2022.3 Manifold Gradient Descent Solves Multi-Channel Sparse Blind Deconvolution Provably and Efficiently. *SIAM Conference on Imaging Science (IS22)*
- 2021.8 Multi-channel Sparse Blind Deconvolution via Nonconvex Optimization. *IEEE East Asian School of Information Theory (2021)*
- 2020.8 Fusion-Based Digital Image Correlation Framework for Strain Measurement. *Intern presentation at Mitsubishi Electric Research Laboratories (MERL)*
- 2020.7 Nonconvex Optimization for Multi-channel Sparse Blind Deconvolution. *Optimization interest seminar in Mitsubishi Electric Research Laboratories (MERL)*

#### **Poster presentations at conferences/workshops**

- 2023.10 Provable Algorithms for Reinforcement Learning: Efficiency and Robustness. *2023 INFORMS Annual Meeting QSR Poster Competition Session*
- 2023.6 Provable Algorithms for Reinforcement Learning: Efficiency and Robustness. *ICASSP Rising Stars in Signal Processing*
- 2022.12 Curriculum Reinforcement Learning using Optimal Transport via Gradual Domain Adaptation. *Conference on Neural Information Processing Systems (NeurIPS), 2022*
- 2022.7 Pessimistic Q-Learning for Offline Reinforcement Learning: Towards Optimal Sample Complexity. *International Conference on Machine Learning (ICML), 2022*
- 2021.12 Breaking the Sample Complexity Barrier to Regret-Optimal Model-Free Reinforcement Learning. *Conference on Neural Information Processing Systems (NeurIPS), 2021*
- 2021.9 Robust camera pose estimation for image stitching. *IEEE International Conference on Image Processing (ICIP), 2021*
- 2021.6 Fusion-Based Digital Image Correlation Framework for Strain Measurement. *International Conference on Acoustics, Speech, and Signal Processing (ICASSP), 2021*
- 2019.12 Nonconvex Optimization for Multi-channel Sparse Blind Deconvolution. *Women in Machine Learning at NeurIPS, 2019*
- 2019.11 Device-free Multiple People Localization through Floor Vibration. *First ACM Workshop on Device-Free Human Sensing, 2019*