

# Runyu (Cathy) Zhang

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🌐 [dianyu420376.github.io/runyu-cathy-zhang.github.io/](https://dianyu420376.github.io/runyu-cathy-zhang.github.io/)

## Education

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### Harvard University

Ph.D., Applied Mathematics, School of Engineering and Applied Science

Advisor: Na Li Committee: Jeff Shamma, Lucas B. Janson, Dale Schuurmans

Cambridge, MA

Sept. 2019 – Present

### Peking University

B.Sc. in Scientific and Engineering Computing

School of Mathematical Sciences Department

Beijing, China

Sept. 2015 – July 2019

## Other Academic Experiences

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### Salesforce Research

Research Intern

Advisor: Yu Bai

Palo Alto, CA

June 2022 – September 2022

### University of California, Los Angeles

Student Researcher

Advisor: Deanna Needell

Los Angeles, CA

June 2018 – September 2018

## Research Interests

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**Areas:** Reinforcement Learning, Optimization, Optimal Control, Multi-agent Systems, Game Theory, Distributed Control for Network Systems

**Topics:** Multi-agent reinforcement learning, Risk-sensitive/ Robust reinforcement learning, Optimization from control-theoretic perspective, Constrained optimization, Distributed/decentralized control for multi-agent network systems, Online adaptive control.

## Publications

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### Journal Publications

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**R. Zhang**, W. Li, and N. Li, "On the Optimal Control of Network LQR with Spatially-exponential Decaying Structure," *Automatica*, 2024.

**R. Zhang**, Z. Ren, and N. Li, "Gradient Play in Stochastic Games: Stationary Points, Convergence, and Sample Complexity," *IEEE Transactions on Automatic Control (TAC)*, 2024.

E. X. Chen, X. Han, A. Malkawi, **R. Zhang**, and N. Li, "Adaptive Model Predictive Control with Ensembled Multi-Time Scale Deep-learning Models for Smart Control of Natural Ventilation," *Building and Environment*, p. 110519, 2023.

Y. Li\*, Y. Tang\*, **R. Zhang**, and N. Li, "Distributed Reinforcement Learning for Decentralized Linear Quadratic Control: A Derivative-Free Policy Optimization Approach," *IEEE Transactions on Automatic Control (TAC)*, 2022.

### Peer-Reviewed Conference Proceedings

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**R. Zhang**, H. Ma, and N. Li, "Multi-Agent Coverage Control with Transient Behavior Consideration," in *Learning for Dynamics and Control Conference (LADC)*, 2024.

**R. Zhang**, Y. Hu, and N. Li, "Soft Robust MDPs and Risk-Sensitive MDPs: Equivalence, Policy Gradient, and Sample Complexity," in *International Conference on Learning Representations (ICLR)*, 2024.

J. Olsson, **R. Zhang**, E. Tegling, and N. Li, "Scalable Reinforcement Learning for Linear-Quadratic Control of Networks," in *American Control Conference (ACC)*, 2024.

P. Paschalidis, **R. Zhang**, and N. Li, "Cooperative Multi-Agent Graph Bandits: UCB Algorithm and Regret Analysis," in *American Control Conference (ACC)*, 2024.

**R. Zhang**, Y. Zhang, R. Konda, B. Ferguson, J. Marden, and N. Li, "Markov Games with Decoupled Dynamics: Price of Anarchy and Sample Complexity," in *the 62nd IEEE Conference on Decision and Control (CDC)*, 2023.

Y. Zhang, **R. Zhang**, Y. Gu, and N. Li, "Multi-agent Reinforcement Learning with Reward Delays," in *Learning for Dynamics and Control Conference (L4DC)*, 2023.

**R. Zhang**, W. Li, and N. Li, "On the Optimal Control of Network LQR with Spatially-exponential Decaying Structure," in *American Control Conference (ACC)*, 2023.

**R. Zhang**, Y. Zheng, W. Li, and N. Li, "On the Relationship of Optimal State Feedback and Disturbance Response Controllers," in *the 22nd World Congress of the International Federation of Automatic Control (IFAC)*, 2023.

**R. Zhang\***, Q. Liu\*, H. Wang, C. Xiong, N. Li, and Y. Bai, "Policy Optimization for Markov Games: Unified Framework and Faster Convergence," in *Advances in Neural Information Processing Systems (NeurIPS)*, 2022.

**R. Zhang**, J. Mei, B. Dai, D. Schuurmans, and N. Li, "On the Global Convergence Rates of Decentralized Softmax Gradient Play in Markov Potential Games," in *Advances in Neural Information Processing Systems (NeurIPS)*, 2022.

**R. Zhang**, Z. Ren, and N. Li, "Gradient Play in Stochastic Games: Stationary Points and Local Geometry," in *the 25th International Symposium on Mathematical Theory of Networks and Systems (MTNS)*, 2022.

**R. Zhang**, Y. Li, and N. Li, "On the Regret Analysis of Online LQR Control with Predictions," in *American Control Conference (ACC)*, 2021.

## Workshop Papers

M. Gao, J. Haddock, D. Molitor, D. Needell, E. Sadovnik, T. Will, and **R. Zhang**, "Neural Nonnegative Matrix Factorization for Hierarchical Multilayer Topic Modeling," in *IEEE 8th International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP)*, 2019.

## Pre-Prints and Working Papers

**R. Zhang**, J. Shamma, and N. Li, "Equilibrium selection for multi-agent reinforcement learning: A unified framework," 2024.

## Teaching Experience

### ES 202: Learning, Estimation and Control of Dynamical Systems

Spring 2024

Engineering and Applied Sciences — Harvard University

Rating: 4.75/5.0

Section Leader

Led office hours and gave feedback and comments for weekly readings and in-class discussions. Contributed to the design and grading of assignments.

### ES155: Systems and Control

Fall 2020

Engineering and Applied Sciences — Harvard University

Rating: 4.83/5.0

Section Leader

Led weekly sections and office hours. Contributed to the design and grading of weekly assignments as well as the midterm and final exams. Gave feedback to 20+ students' course project.

## Mentorship

- Johan Olsson (Lund University, Visiting Master student), 2023

Project: Distributed reinforcement learning design for networked systems (paper accepted to ACC 2023)

- Phevos Paschalidis, Aryan Naveen (Harvard College), 2023  
Project: Algorithm design for multi-agent graph bandit problem (paper accepted to ACC 2023, preparing journal submission to TAC)

## Awards, Honors, and Scholarships

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<b>Rising Star in EECS</b>	2024
<b>2023 American Control Conference (ACC) Student Travel Award</b>	2023
<b>Finalist of the Two Sigma Diversity PhD Fellowship (1 of 8)</b>	2022
<b>Certificates of Distinction and Excellence in Teaching</b> Derek Bok Center for Teaching and Learning, Harvard University	2020
<b>Excellent Graduate</b> Peking University	2019
<b>Second Prize, China Undergraduate Mathematical Contest in Modeling, Beijing District</b> Peking University	2016
<b>Elite Undergraduate Training Program</b> School of Mathematical Sciences, Peking University	2016-2019
<b>First Prize in Beijing National High School Student Mathematics Competition</b>	2014

## Invited Talks

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<i>Equilibrium Selection for Multi-agent Reinforcement Learning: A Unified Framework</i> Modeling and Optimization: Theory and Applications (MOPTA), Lehigh University	2024
<i>Robust and Risk-sensitive Sequential Decision-Making in the Face of Model Uncertainty</i> CDC workshop on system theory of algorithms, Milan	2024
<i>Multi-Agent Coverage Control with Transient Behavior Consideration (poster, forthcoming)</i> Learning for Dynamics and Control Conference(L4DC), Oxford University	2024
<i>Soft Robust MDPs and Risk-Sensitive MDPs: Equivalence, Policy Gradient, and Sample Complexity (poster)</i> International Conference on Learning Representations (ICLR), Vienna	2024
<i>Efficient and Resilient Coordination of Multi-agent Systems</i> ETH Zurich, MIT, EPFL, Peking University, Tsinghua University	2024
<i>Markov Games with Decoupled Dynamics: Price of Anarchy and Sample Complexity</i> Conference on Decision and Control (CDC)	2023
<i>Optimal Control of Spatially Exponential Decaying Linear Quadratic Regulator</i> The Institute for Operations Research and the Management Sciences (INFORMS)	2023
<i>Real-time Distributed Coordination of Multiagent Networks under Limited Communication</i> ONR Science of Autonomy Program Review	2023
<i>Optimal Control of Spatially Exponential Decaying Linear Quadratic Regulator</i> American Control Conference (ACC)	2023
<i>Policy Optimization for Markov Games: Unified Framework and Faster Convergence (Poster)</i> Advances in Neural Information Processing Systems (NeurIPS)	2022
<i>On the Global Convergence Rates of Decentralized Softmax Gradient Play in Markov Potential Games (Poster)</i> Advances in Neural Information Processing Systems (NeurIPS)	2022
<i>Gradient Play in Stochastic Games: Stationary Points and Local Geometry (Virtual)</i> International Symposium on Mathematical Theory of Networks and Systems (MTNS)	2022
<i>On the Effect of log-barrier Regularization in Decentralized Softmax Gradient Play in Multiagent Systems</i> International Conference on Continuous Optimization (ICCOPT)	2022

## Professional Services

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Reviewer for Advances in Neural Information Processing Systems (NeurIPS), Artificial Intelligence and Statistics (AISTATS), IEEE Trans. Automatic Control (TAC), Automatica, IEEE Intelligent Systems, Systems and Control Letters, Dynamic Games and Applications (DGAA), Learning for Dynamics and Control Conference (L4DC), etc.

Guest Speaker and graduate student panelist for Harvard Women in Engineering & CS Event.

Student co-organizer of Harvard Machine Learning Foundations Seminar Series (2022 Fall - 2023 Fall)

Student co-organizer of Harvard-EEML student seminar (2021 Fall - 2022 Spring).

## Languages and Skills

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**Computer Skills:** Python, MATLAB, Pytorch, TensorFlow, Simulink

**Language:** Chinese (native), English (fluent)