Yuhan Zhao

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EDUCATION

New York University — New York, NY
Ph.D. Candidate in Electrical and Computer Engineering (ECE) — *Sept. 2019 - Aug. 2024 (Expected)*
Advisor: Prof. Quanyan Zhu | GPA: 3.95/4.00

University of Pennsylvania — Philadelphia, PA
Robotics Master of Science in Engineering (GRASP Lab) — *Sept. 2017 - Jun. 2019*
Advisor: Prof. Michael Posa | GPA: 3.95/4.00

Beijing Institute of Technology — Beijing, China
Bachelor of Science in Automation — *Sept. 2013 - Jun. 2017*
Advisor: Prof. Hongbin Ma | GPA: 3.93/4.00

Research Interests: Task planning, coordination, and decision-making in multi-agent systems. Control theory, game theory, and optimization.

PUBLICATIONS

[1] **Y. Zhao** and Q. Zhu, "Stackelberg Game-Theoretic Trajectory Guidance for Multi-Robot Systems with Koopman Operator", *Accepted by 2024 International Conference on Robotics and Automation (ICRA)*.

[2] **Y. Zhao**, J. Chen, and Q. Zhu, "Integrated Cyber-Physical Resiliency for Power Grids under IoT-Enabled Dynamic Botnet Attacks," *Accepted by IEEE Transactions on Control Systems Technology*.

[3] **Y. Zhao** and Q. Zhu, "Stackelberg Meta-Learning for Strategic Guidance in Multi-Robot Trajectory Planning," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2023.

[4] **Y. Zhao** and Q. Zhu, "Stackelberg Meta-Learning Based Control for Guided Cooperative LQG Systems," *The 22nd World Congress of the International Federation of Automatic Control*, 2023.

[5] **Y. Zhao**, B. Huang, J. Yu, and Q. Zhu, "Stackelberg Strategic Guidance for Heterogeneous Robots Collaboration," *International Conference on Robotics and Automation (ICRA)*, 2022.

[6] T. Li, **Y. Zhao**, and Q. Zhu, "The Role of Information Structures in Game-Theoretic Multi-Agent Learning," *Annual Reviews in Control*, 2022.

[7] **Y. Zhao** and Q. Zhu, "Distributed and Resilient Planning-Control for Optimal LEO Satellite Constellation Coverage," *American Control Conference (ACC)*, 2022.

[8] S. Liu, **Y. Zhao**, and Q. Zhu, "Understanding the Interplay Between Herd Behaviors and Epidemic Spreading Using Federated Evolutionary Games," *American Control Conference (ACC)*, 2022.

[9] S. Liu, **Y. Zhao**, and Q. Zhu, "Herd Behaviors in Epidemics: A Dynamics-Coupled Evolutionary Games Approach," *Dynamic Games and Applications*, 2022.

[10] **Y. Zhao**, Y. Ge, and Q. Zhu, "Combating Ransomware in Internet of Things: A Games-in-Games Approach for Cross-Layer Cyber Defense and Security Investment," *International Conference on Decision and Game Theory for Security (GameSec)*, 2021.

[11] **Y. Zhao** and Q. Zhu, "Combating Online Counterfeits: A Game-Theoretic Analysis of Cyber Supply Chain Ecosystem," *International Conference on Decision and Game Theory for Security (GameSec)*, 2020.

Under Review

[12] **Y. Zhao** and Q. Zhu, "Autonomous and Resilient Control for Optimal LEO Satellite Constellation Coverage Against Space Threats," *Submitted to IEEE Transactions on Control Systems Technology*.

[13] **Y. Zhao** and Q. Zhu, "Stackelberg Meta-Learning Based Shared Control for Assistive Driving," *Submitted to IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2024.

[14] **Y. Zhao** and Q. Zhu, "Incentive-Compatible and Distributed Allocation for Robotic Service Provision Through Contract Theory," *Submitted to IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2024.

RESEARCH EXPERIENCE

Fast Heterogeneous Multi-Robot Task Planning with Meta-Learning [1,2] Jul. 2022 - Present

Laboratory for Agile and Resilient Complex Systems (advisor: Prof. Quanyan Zhu) *New York University*

- Proposed a meta-learning-based methodology for fast generation of collaborative strategies in diverse hierarchical tasks within multi-robot systems, such as trajectory guidance and multi-robot teaming.
- Employed dynamic Stackelberg games to characterize hierarchical interactions between robots in different tasks.
- Developed meta-learning algorithms to distill a generalized behavioral model, serving as essential meta-knowledge for collaborative interactions across different tasks.
- Designed adaptation algorithms that can rapidly generate task-specific collaborative strategies from the meta-knowledge only using a small amount of data, substantially reducing dependence on extensive training data compared to conventional supervised learning approaches.

Multi-Robot Object Rearrangement Planning with Game Theory [3] June. 2021 - Sept. 2021

Laboratory for Agile and Resilient Complex Systems (advisor: Prof. Quanyan Zhu) *New York University*

- Established a receding-horizon planning framework for two heterogeneous robots to achieve multi-object rearrangement tasks in smart warehouses based on stochastic Stackelberg games.
- Developed optimization algorithms rooted in dynamic programming and mixed integer linear programming to find coordination strategies for the two robots.
- Implemented a simulation platform for task evaluation and validated the robustness and adaptability of the developed algorithm in the face of unexpected robot failures.

Distributed Multi-Satellite Coverage Control in Adversarial Environments [5,11] June. 2021 - Feb. 2022

Laboratory for Agile and Resilient Complex Systems (advisor: Prof. Quanyan Zhu) *New York University*

- Established a game-theoretic planning framework to guide multiple satellites in providing optimal coverage service to ground targets.
- Developed distributed planning algorithms and model predictive control strategies to enable resilient coverage control in different adversarial space environments, including space debris and potential satellite collisions.

Cross-Layer Security Design in Industrial IoT Networks [8] Jul. 2021 - Sept. 2021

Laboratory for Agile and Resilient Complex Systems (advisor: Prof. Quanyan Zhu) *New York University*

- Developed an innovative risk assessment model based on Markov games to simulate adversarial ransomware attacks in industrial IoT networks.
- Proposed protective strategies, including optimal ransom payment and security investment, to enhance network security and mitigate cyber threats.

Robot Trajectory Optimization in Contact-Rich Environments May. 2018 - Apr. 2019

Dynamic Autonomy and Intelligent Robotics Lab (advisor: Prof. Michael Posa) *University of Pennsylvania*

- Established a control framework based on time-stepping methods to optimize robot trajectories that need contact forces from environments, such as robot gait planning.
- Developed optimization algorithms based on barrier functions and mixed integer quadratic programming to seek robot's local optimal trajectories that surpasses the time efficiency of brute-force (globally optimal) solutions.

HONORS AND AWARDS

- ACC 2022 Student Travel Grant — National Science Foundation, 2022
- Dean's Scholarship — New York University, 2019-2020
- Outstanding Graduate Representative — Beijing Institute of Technology, 2017
- Scholarship for Academic Excellence (Top 5%) — Beijing Institute of Technology, 2017

PROFESSIONAL ACTIVITIES

Conference/Journal Peer Reviewer

- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- IEEE Conference on Decision and Control (CDC)
- IEEE Conference on Control Technology and Applications (CCTA)
- IEEE Transactions on Neural Networks and Learning Systems
- IEEE Transactions on Aerospace and Electronic Systems
- IEEE Transactions on Network Science and Engineering
- Annual Reviews in Control
- Nonlinear Dynamics

TECHNICAL SKILLS

Programming: Python, MATLAB, C/C++, Julia

Research Software: PyTorch, ROS, PyBullet, Gurobi, IPOPT, CVX, LaTeX, Linux