

# Haoyi Wang

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## Education Background

### Washington University in St. Louis

*Thesis-Based Master of Science in Electrical Engineering (Honors Program)*

St. Louis, the U.S.

8/2024 – Present

### Washington University in St. Louis

*HKUST-WashU Joint Education Program*

St. Louis, the U.S.

8/2023 – 5/2024

### Hong Kong University of Science and Technology

*Bachelor of Engineering in Computer Engineering*

Hong Kong

8/2020 – 8/2023

### University of California, San Diego

*Exchange Student*

San Diego, the U.S.

9/2022 – 12/2022

## Relevant Coursework:

Learning in Robotics, Motion Planning, Formal Methods, Linear Dynamic Systems, Nonlinear Dynamic Systems, Deep Reinforcement Learning, Large-Scale Optimization, Machine Learning and Pattern Classification, Probability and Stochastic Processes, Autonomous Aerial Vehicle Control, System Modeling, Analysis and Control, Electro-Robot Design

## Publications

- ◇ **Haoyi Wang**, Licheng Luo, Yiannis Kantaros, Bruno Sinopoli, Mingyu Cai. *Deadlock-Free Hybrid RL-MAPF Framework for Zero-Shot Multi-Robot Navigation*, arXiv:2511.22685, submitted to L4DC 2026.

## Research Experience

### Integrated Embodied Multi-Agent Task and Motion Planning Framework

Riverside, CA, the U.S.

*Supervisor:* Prof. Mingyu Cai

5/2025 – Present

Outcome: An integrated embodied multi-agent task and motion planning system for complex, dense households. First-stage work: *Deadlock-Free Hybrid RL-MAPF Framework for Zero-Shot Multi-Robot Navigation*, L4DC 2026, under review.

- ◇ Developed a comprehensive multi-agent framework integrating Large Language Model (LLM) based task planning with reinforcement learning motion planning and obstacle avoidance for embodied AI applications, enabling decomposition of high-level instructions into executable sub-tasks while achieving efficient collision-free navigation in dynamic multi-agent environments.
- ◇ Integrated computation-based Multi-Agent Path Finding (MAPF) algorithms as a safety-guaranteed fallback mechanism for extreme cases where RL policies fail to generalize, such as multi-agent deadlock scenarios, ensuring feasible solutions under all operational conditions.
- ◇ Conducted comprehensive validation experiments in a near photo-realistic interactable simulation environment, to evaluate the framework's performance across diverse embodied multi-agent task sequences requiring coordination between multiple autonomous agents.

### Human Behavior-Informed Framework for Safe Robot Motion Planning

St. Louis, the U.S.

*Supervisor:* Prof. Bruno Sinopoli & Prof. Yiannis Kantaros

9/2024 – 4/2025

Outcome: A robot path planning system to achieve safe planning in Human-Robot Interactions.

- ◇ Developed a human action prediction system that combines active human characteristics sensing with reachability analysis, to provide probabilistic guarantees for human possible trajectory coverage.
- ◇ Designed a Model Predictive Control (MPC) system, which integrated human characteristic probing and forward reachability analysis of human actions, providing safe motion planning for robots under human-robot interactions with uncertainty quantification.
- ◇ Conducted experiments in driving simulation environments, validated the algorithm's performance, and performed comparison tests.

### Human Trajectory Prediction in the Interaction between Human and Unmanned Vehicles

St. Louis, the U.S.

*Supervisor:* Prof. Bruno Sinopoli & Prof. Yiannis Kantaros

1/2024 – 5/2024

Outcome: A human trajectory prediction system for Human-Robot Interaction.

- ◇ Developed predictive algorithms for human movement in human-robot interaction, employing deep learning techniques to estimate an individual's forthcoming position and trajectory.
- ◇ Integrated predictive human trajectory algorithms with robotic path planning to ensure safe and efficient collaborative interactions between humans and robots.

### Transfer Learning in Deep Reinforcement Learning: Self-Supervised Learning for Policy Adaptation

St. Louis, the U.S.

*Supervisor:* Prof. Bruno Sinopoli

8/2023 – 4/2024

Outcome: Reports and a poster presentation delivered at the department's research symposium.

- ◇ Conducted an in-depth analysis of the foundational theories behind three critical Reinforcement Learning algorithms: Deep Q-Networks (DQN), Deep Deterministic Policy Gradients (DDPG), and Proximal Policy Optimization (PPO). Evaluated the performance of the algorithms across a wide range of testing environments.
- ◇ Integrating self-supervised learning into deep reinforcement learning to improve policy adaptation by using inverse dynamics, forward dynamics, and rotation prediction as auxiliary tasks to provide training signals during deployment.

- ◇ Validated the approach using the DeepMind Control suite, demonstrating improved generalization and superior performance in visually modified environments compared to traditional RL agents, with up to 29% performance retention in challenging scenarios.

### **Solar Panel Cleaning Robot System**

*Supervisor:* Prof. Ling Shi

**Hong Kong**  
**2/2023 – 8/2023**

Outcomes: An engineering prototype of a solar panel cleaning robot system.

- ◇ Integrated an Ultra-Wideband (UWB) localization system into the solar panel cleaning robot system, delivering high-precision positioning while the robot performs cleaning operations.
- ◇ Constructed the solar panel cleaning robot for deployment in real-world settings, validating the functionality of solar panel cleaning.
- ◇ Evaluated the maneuverability of the solar panel cleaning robot and compared its localization precision against other schemes, e.g., Inertial Measurement Units (IMU).

### **Development of Network Communication System for Locomotion Robots**

*Supervisor:* Prof. Ling Shi & Prof. Man Wong

**Hong Kong**  
**6/2021 – 8/2022**

Outcomes: A high-precision Ultra-Wideband (UWB) localization system for robots.

- ◇ Conducted a comprehensive evaluation of diverse robot positioning technologies, performed a comparative analysis of each option, and selected the UWB approach due to its ability to deliver real-time, centimeter-level accuracy measurements at a comparatively low expense.
- ◇ Performed experiments to test the performance of UWB components, assessing their functionality and effectiveness. Re-developed the UWB communication module to enhance the information density.
- ◇ Implemented a coordinate system utilizing an Anchor-Tag configuration and applied calibration techniques for enhanced precision.
- ◇ Performed real-world testing with robots utilizing the UWB localization system to assess its localization accuracy.

### **Internship Experience**

#### **Hong Kong Center for Construction Robotics**

*Start-up firm co-founder*

**Hong Kong**  
**6/2022 – 12/2022**

- ◇ Founded a start-up company, leveraging cutting-edge technologies, including Artificial Intelligence, Automation technology, and Robotics, to offer innovative solutions within the construction sector.
- ◇ The company aims to develop autonomous robots and human-robot collaboration processes to replace manual processes in multiple work-site scenarios, thereby improving work efficiency and preventing harm to workers caused by traditional construction procedures.
- ◇ Created an underground garage floor painting robot following an extensive market analysis and competitive landscape evaluation, engineering the system to automate the entire floor painting process in underground garages with precision coating application and path optimization algorithms, achieving productivity equivalent to 12 human workers while reducing operational costs and improving coating quality.

### **Honors and Awards**

#### **WashU ESE Honors Program**

Dedicated to graduate students with an excellent grade history and electrical and system engineering research

**2025**

#### **Dean's Select Master's Student Award**

Awarded to exceptional Master's students in the WashU McKelvey School of Engineering

**2024**

#### **Dean's List, Washington University in St. Louis**

Recognized for outstanding academic performance during the 2023–2024 academic year

**2023 – 2024**

#### **Qingdao City Scholarship for Outstanding Students**

Awarded to exceptional students of Qingdao origin with academic excellence at universities in Hong Kong

**2023**

#### **Hung Choh Jan Fong Scholarship**

Awarded to students demonstrating academic excellence and selected to US university exchange programs

**2022**

### **Activities**

#### **WashU Electrical & Systems Engineering Student Advisory Board**

**Position:** Student Advisory Board Member, International Student Ambassador

**2023 – 2025**

#### **HKUST RoboMaster Robotics Competition Team**

**Position:** R&D group member, responsible for designing robot Dart & Launcher

**2020 – 2021**

### **Skills**

- ◇ **Programming:** C, C++, Python, MATLAB
- ◇ **Software & Tools:** PyTorch, OpenAI Gym, Simulink, Solidworks, Keil, 3D Printing
- ◇ **Language:** Mandarin (native), English