

Ruirui Ma

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EDUCATION

University of Pennsylvania

May 2025

Candidate for Master of Science in Engineering: Robotics. GPA: 3.95/4.00

- **Relevant Courses:** Control and Optimization in Robotics, Distributed Robotics, Learning for Dynamics and Control, Advanced Robotics, Graph Neural Network, Advanced Machine Perception

Georgia Institute of Technology

May 2023

Bachelor of Science in Computer Engineering, Minor in Robotics. GPA: 3.99/4.00

- **Relevant Courses:** Artificial Intelligence, Machine Learning, Computer Vision, Automation and Robotics, Feedback Control System, Control System Design

Bachelor of Science in Mathematics. GPA: 3.99/4.00

- **Relevant Courses:** Advanced Linear Algebra, Real Analysis, Numerical Analysis, Stochastic Processes, Statistics and Applications, Science-based Data Science

SKILLS

Programming Languages: Python | MATLAB | C | C++ | Wolfram Language

Platforms/ Tools: Pytorch | Pytorch Geometric | GPytorch | OpenAI Gym | Issac Gym | Git | LaTeX | Unity

Hardware: Oscilloscope | Logic analyzer | Microcontroller Unit | Pixhawk Flight Controller

EXPERIENCES

Student Researcher (Master's Thesis), *PRECISE Lab at University of Pennsylvania*

Sept. 2023 – Present

Goal: Multi-robot coverage control in unknown environments with sparse signals.

- Online learning of signal distribution using mixture of gaussian process.
- Upper confidence bound to balance signal coverage and environment exploration.
- Developing informative path planning for better coverage performance and faster convergence.

Research Assistant, *PRECISE Lab at University of Pennsylvania*

May 2023 – Aug. 2023

Goal: Deep reinforcement learning (Deep RL) control policies for agile quadcopter flight in drone racing.

- Deep RL trained quadcopter achieved near-theoretical-limit flight time racing performance.
- Trained quadcopter learned high-speed turning maneuvers on unseen turns in racetracks.

Undergraduate Researcher, *Borg Lab at Georgia Institute of Technology*

May 2021 – May 2023

Goal: Oil paintings by robotic arms.

- Integrated computer vision algorithms into motion planning pipeline for robotic paintings.
- Automated painting data collection process.

Senior Design Lead, *Georgia Institute of Technology*

Sept. 2021 – May 2022

Goal: Autonomous aerial survey drone with wireless charging station.

- Programmed vision-based autonomous landing on a wireless charging station.
- Organized senior design project timelines and work assignments.
- Customized drone with an onboard computer and peripherals.

Teaching Assistant, *Georgia Institute of Technology*

Sept. 2021 – Dec. 2021

Summary: Teaching assistant for the embedded system programming course.

- Hosted office hours and review sessions. Graded student lab assignments.
- Helped students debug hardware/ software projects at lab sessions.

Undergraduate Researcher, *EPIC Lab at Georgia Institute of Technology*

May 2019 – Sept. 2019

Goal: Hip exoskeleton that aids human movements.

- Constructed VR environments in Unity for simulation experiments.
- Programmed Heads-up Display for incoming projectile path prediction and user evasion path indication.

PROJECTS

Learning-Based Approach to Vehicle Routing Problem

Feb. 2024 – Oct. 2024

Collaboration Project with Alelab at University of Pennsylvania

Goal: Approximate solutions to large scale Multi-Vehicle Routing Problem (mVRP).

- Trained graph neural network (GNN) predicted optimal vehicle routing with ~80% accuracy.
- Trained GNN transferable to larger problem sizes with comparable accuracies.

Multi-Agent System Flocking Control

Feb. 2024 – May 2024

Goal: Extended Kumamoto model for multi-agent flocking control in 3d space.

- Extended the coupled-oscillator model for 3d motions.

- Derived distributed control laws for various multi-agent flocking patterns.

Deep Reinforcement Learning Control for Multi-Rotor Aerial Vehicle

Dec. 2023 – May 2024

Independent Study at University of Pennsylvania

Goal: Neural network controller for Multi-Rotor Aerial Vehicle (MAV) with dozens of rotors.

- Customized OpenAI Gym environment and GPU-accelerated parallel training.
- Deep RL trained tracking controller and online path planner for MAVs with up to 64 rotors.

Model Predictive Control for Unicycle Robot

Aug. 2023 – Dec. 2023

Goal: Control algorithms for a novel robot with a double pendulum mounted on a unicycle.

- Model predicted control for robot balancing task around fixed points.

Bipedal Robot Walking Gait

Sept. 2022 – Dec. 2022

Goal: Planar walking gait for bipedal robots.

- Planar walking gait design as solution to constrained optimization problems.
- Fine-tuned walking gait on bipedal robot in real world experiments.

Nonlinear Dimension Reduction Method

Feb. 2022 – May 2022

Goal: Compute mapping from high dimensional data to lower-dimensional embedding.

- Implemented diffusion map to find geometric structure in high dimensional data.
- Diffusion map reduced real image data to interpretable lower-dimensional embedding.