Ruirui Ma

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EDUCATION

University of Pennsylvania 05/2025

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 05/2023

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 | PyBullet | Git | LaTex | Unity

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

EXPERIENCES

Student Researcher (Master's Thesis), *PRECISE Lab at University of Pennsylvania* 09/2024 – 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* 05/2024 – 08/2024

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* 05/2021 – 05/2023

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* 09/2021 – 05/2022

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* 09/2021 – 12/2021

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* 05/2019 – 09/2019

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 02/2024 – 10/2024

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 02/2024 – 05/2024

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 12/2023 – 05/2024

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 tracking controller and artificial potential field online path planner for MAVs with up to 64 rotors.

Model Predictive Control for Unicycle Robot 08/2023 – 12/2023

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 09/2022 – 12/2022

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 02/2022 – 05/2022

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.