

# MU XIE

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## RESEARCH INTERESTS

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Robotics · Safe and Learning-Based Control · Model Predictive Control (MPC) · Mixed-Integer Optimization · Learning-to-Optimize (L2O)

## EDUCATION

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**University of Pennsylvania, Philadelphia, PA**

**M.S.E., Electrical Engineering**

2024.01 - 2025.05

*GPA: 3.78/4.0*

Relative Curriculum: Learning in Robotics, Modern Convex Optimization, Advanced Robotics, F1Tenth Autonomous Racing

**Zhejiang University, Hangzhou, China <sup>1</sup>**

**B.Eng., Electrical Engineering**

2019.09 - 2023.06

*GPA: 3.56/4.0*

Relative Curriculum: Undergrad Math Courses, Signal and System, Machine Learning, Numerical Analysis

**University of Illinois, Urbana-Champaign <sup>1</sup>**

**B.S., Electrical Engineering**

2019.09 - 2023.06

*GPA: 3.26/4.0*

Relative Curriculum: Digital Signal Processing, Digital System, Electronic Circuits, Linear & Feedback Control System

## RESEARCH EXPERIENCE

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**Research Assistant, X-Lab**

2025.05 - Present

*University of Pennsylvania, Philadelphia, PA*

Advisor: Prof. Rahul Mangharam

- Conduct research on safe control and learning-based optimization for autonomous robotic systems.
- Develop differentiable optimization layers and learning-to-optimize methods for mixed-integer model predictive control (MI-MPC).
- Implement and evaluate learning-based controllers on autonomous driving and racing benchmarks.

**Learning-to-Optimize Framework for Mixed-Integer MPC**

2025.09 - Present

*X-Lab, University of Pennsylvania*

- Built a hybrid L2O framework for MI-MPC by combining integer prediction networks with a differentiable QP layer.
- Designed a mixed supervised/self-supervised loss to enhance integer optimality and feasibility.
- Achieved superior solve speed and solution quality on benchmark MI-MPC tasks versus supervised and self-supervised baselines.
- Tools: PyTorch, CVXPYLayer, Gurobi, NumPy

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<sup>1</sup>Dual Degree Enrollment

## Gaussian Process Dynamics with MPPI Control

2025.06 - Present

*X-Lab, University of Pennsylvania*

- Learned nonlinear vehicle dynamics using Gaussian Process regression over multi-dimensional state-control datasets from autonomous racing tasks.
- Integrated GP-based dynamics into Model Predictive Path Integral (MPPI) control to account for model uncertainty in trajectory optimization.
- Evaluated tracking performance and robustness under stochastic disturbances, comparing GP-MPPI to nominal MPC baselines on simulated racing tracks.
- Tools: PyTorch, JAX, NumPy, ROS 2

## PUBLICATIONS

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### A Hybrid Learning-to-Optimize Framework for Mixed-Integer Quadratic Programming

V.-A. Le, M. Xie, and R. Mangharam, 2025. Submitted to Learning for Dynamics and Control (L4DC)

## SELECTED PROJECTS

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### Course Project: F1TENTH Autonomous Racing

2025.01 - 2025.05

*University of Pennsylvania*

- Built a complete ROS 2 stack including perception, planning, and control.
- Implemented wall-following, gap-following, pure pursuit, and MPC controllers with dynamic obstacle avoidance and race-line optimization.
- Developed LiDAR-based localization and vision based vehicle detection.
- Finished 2 time trials and 1 head-to-head race.
- Tools: ROS2, Python, C++

### Course Project: LLM-Guided Navigation for F1TENTH

2024.09 - 2024.12

*University of Pennsylvania*

- Created an LLM-based planner converting natural-language commands to driving primitives and interacting with environment.
- Integrated symbolic reasoning with classical control for interactive autonomous-navigation tasks.
- Validated system in simulation and real F1TENTH environments.

### Course Project: Quadrotor Control Paper Reproduction

2025.01 - 2025.05

*University of Pennsylvania*

- Reproduced nonlinear quadrotor control using cascaded attitude/position controllers.
- Analyzed robustness under parameter uncertainty and external disturbances.
- Developed simple grid-based planners and sensor-fusion routines for trajectory generation.

### Course Project: Image-to-GPS Regression

2024.10 - 2024.12

*University of Pennsylvania*

- Implemented a ViT-based model for geolocation from street-level images.
- Built datasets and benchmarked performance against ResNet-based regressors.
- Tools: PyTorch, OpenCV, NumPy

## TEACHING & INDUSTRY EXPERIENCE

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### Teaching Assistant, Simulation Modeling & Analysis (ESE 5030)

2025.01 - 2025.05

*University of Pennsylvania, Philadelphia*

- Led office hours, assisting students with stochastic modeling and simulation assignments.
- Prepared and graded homework and exam solutions, providing detailed feedback on mathematical answers.

### Internship at Fusion Array Co. Ltd

2023.07 - 2023.12

*Fusion Array Co. Ltd, Hangzhou, Zhejiang*

- Developed FPGA logic and test benches for an ADC chip testing system.
- Worked with high-speed interfaces and data acquisition pipelines to validate chip performance.
- Tools: Verilog HDL, Quartus, Cadence SPB

## TECHNICAL SKILLS

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<i>Programming</i>	C/C++, PYTHON, L <sup>A</sup> T <sub>E</sub> X, MATLAB
<i>Languages</i>	
<i>Development</i>	ROS 2, PYTORCH, JAX
<i>Tool</i>	