Zhefan Xu

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EDUCATION

Carnegie Mellon University — Pittsburgh, PA
Doctor of Philosophy, Mechanical Engineering (Robotics) — May 2026 (Expected)
Ph.D. Minor, Machine Learning
Advisor: Professor Kenji Shimada
GPA: 3.93/4.0

Carnegie Mellon University — Pittsburgh, PA
Master of Science, Mechanical Engineering - Research — May 2021
GPA: 3.96/4.0

University of Pittsburgh — Pittsburgh, PA
Bachelor of Science, Mechanical Engineering (Joint Program) — May 2019
GPA: 3.98/4.0

Sichuan University — Chengdu, China
Bachelor of Engineering, Mechanical Engineering — May 2019
GPA: 3.93/4.0

RESEARCH INTERESTS

Robot Learning and AI Robotics: Developing deep learning, reinforcement learning, and artificial intelligence methods to enable autonomous robots to perform complex tasks.
Robot Planning and Perception: Designing computationally efficient planning and perception algorithms for robot navigation and obstacle avoidance in dynamic environments.
Field Robots: Developing robotic systems for various industrial applications, including construction site inspection, exploration of unknown environments, and reconstruction.
Multi-Robot Systems: Coordinating heterogeneous robot teams of UAVs (Unmanned Aerial Vehicles) and UGVs (Unmanned Ground Vehicles) for complicated tasks.

SKILLS

Programming Languages: C++, Python, ROS, PyTorch, TensorFlow, Matlab, Java.
Robotics: Path Planning, Trajectory Optimization, Object Detection, SLAM, VIO.
Machine Learning: Machine Learning, Reinforcement Learning, Vision Language Model.

WORK EXPERIENCE

Cruise LLC
The Behaviors Team — San Francisco, CA
PhD Intern, AI Robotics — June 2024 - Aug. 2024

- Working on the behavior and intent planning of the autonomous vehicle.
- Designing the visual language model-based (VLM) method to solve AV failure cases.

RESEARCH EXPERIENCE

Deep Reinforcement Learning-based Autonomous Navigation for Aerial Robots
Computational Engineering and Robotics Lab (CERLAB) at CMU — Pittsburgh, PA
Project Team Leader — Jan. 2024 - Sept. 2024

- Designed the Isaac Gym reinforcement learning simulator for UAV navigation and collision avoidance tasks with over hundreds of robots for parallel data collection.
- Implemented and trained the Proximal Policy Optimization (PPO) algorithm using PyTorch and TorchRL to achieve autonomous navigation and collision avoidance.

Automnous Robotic Inspection for Tunnel Construction Sites
Computational Engineering and Robotics Lab (CERLAB) at CMU — Pittsburgh, PA
Project Team Leader — Sept. 2021 - Sept. 2023

- Led the team to successfully complete autonomous inspection flights in a large tunnel construction site for TOPRISE CO., LTD and Obayashi Corporation in Otaru, Japan.
- Developed an autonomous inspection framework including planning, perception, and 3D reconstruction for tunnel shape measurement using the unmanned aerial vehicles.

Lightweight UAV Dynamic Obstacle Detection and Tracking
Computational Engineering and Robotics Lab (CERLAB) at CMU — Pittsburgh, PA
Project Team Leader — Jan. 2023 - Jul. 2023

- Developed a lightweight 3D dynamic obstacle detection algorithm by ensemble multiple efficient but low-accuracy detectors for small UAVs, exceeding benchmark results.

Efficient UAV Navigation using Vision-aided Planning and Mapping
Computational Engineering and Robotics Lab (CERLAB) at CMU — Pittsburgh, PA
Project Team Leader — May. 2022 - Dec. 2022

- Designed the vision-aided trajectory optimization with the proposed dynamic map to achive safe navigation in dynamic environments using a customized quadcopter.

Supermarket Misplaced Products Detection with Deep Learning
CyLab Biometric Center at CMU — Pittsburgh, PA
Research Assistant — May 2020 - Oct. 2020

- Implemented and trained the RetinaNet and the Mask R-CNN in PyTorch using the mmdetecion codebase on the Walmart shelf dataset to detect products on the shelf and achieved over 0.9 mAP and outperformed our previous segmentation model.

Robotic Exploration and Mapping of Dynamic Environments
Computational Engineering and Robotics Lab (CERLAB) at CMU — Pittsburgh, PA
Project Team Member — Sept. 2019 - May 2021

- Developed a novel autonomous exploration algorithm for the unmanned aerial vehicle in dynamic environments which outperforms the state-of-the-art planners.

PUBLICATIONS

NavRL: Learning Safe Flight in Dynamic Environments [pdf] 2024
Zhefan Xu, Xinming Han, Haoyu Shen, Hanyu Jin, and Kenji Shimada
Submitted to IEEE Robotics and Automation Letters (**RA-L**) 2024.

Intent Prediction-Driven Model Predictive Control for UAV Planning and Navigation in Dynamic Environments [pdf] 2024
Zhefan Xu*, Hanyu Jin*, Xinming Han, Haoyu Shen, and Kenji Shimada
Submitted to IEEE Robotics and Automation Letters (**RA-L**) 2024.

Heuristic-based Incremental Probabilistic Roadmap for Efficient UAV Exploration in Dynamic Environments [pdf] 2024
Zhefan Xu*, Christopher Suzuki*, Xiaoyang Zhan, Kenji Shimada
IEEE International Conference on Robotics and Automation (**ICRA**) 2024.

Quadcopter Trajectory Time Minimization and Robust Collision Avoidance via Optimal Time Allocation [pdf] 2024
Zhefan Xu, Kenji Shimada
IEEE International Conference on Robotics and Automation (**ICRA**) 2024.

Onboard dynamic-object detection and tracking for autonomous robot navigation with RGB-D camera [pdf] 2023
Zhefan Xu*, Xiaoyang Zhan*, Yumeng Xiu, Christopher Suzuki, Kenji Shimada
IEEE Robotics and Automation Letters (**RA-L**) 2023.

A Vision-Based Autonomous UAV Inspection Framework for Unknown Tunnel Construction Sites With Dynamic Obstacles [pdf] 2023
Zhefan Xu, Baihan Chen, Xiaoyang Zhan, Yumeng Xiu, Christopher Suzuki, Kenji Shimada
IEEE Robotics and Automation Letters (**RA-L**) 2023.

A real-time dynamic obstacle tracking and mapping system for UAV navigation and collision avoidance with an RGB-D camera [pdf] 2023
Zhefan Xu*, Xiaoyang Zhan*, Baihan Chen, Yumeng Xiu, Chenhao Yang, Kenji Shimada

IEEE International Conference on Robotics and Automation (**ICRA**) 2023.

Vision-aided UAV Navigation and Dynamic Obstacle Avoidance using Gradient-based B-spline Trajectory Optimization [pdf] 2023
Zhefan Xu, Yumeng Xiu, Xiaoyang Zhan, Baihan Chen, Kenji Shimada
IEEE International Conference on Robotics and Automation (**ICRA**) 2023.

DPMPC-Planner: A real-time UAV trajectory planning framework for complex static environments with dynamic obstacles [pdf] 2022
Zhefan Xu, Di Deng, Yiping Dong, Kenji Shimada
IEEE International Conference on Robotics and Automation (**ICRA**) 2022.

Autonomous UAV Exploration of Dynamic Environments Via Incremental Sampling and Probabilistic Roadmap [pdf] 2021
Zhefan Xu, Di Deng, Kenji Shimada
IEEE Robotics and Automation Letters (**RA-L**) with ICRA presentation 2021.

Frontier-based automatic-differentiable information gain measure for robotic exploration of unknown 3D environments [pdf] 2020
Di Deng, Zhefan Xu, Wenbo Zhao, Kenji Shimada
Preprint arXiv:2011.05288.

Coordinated aerial-ground robot exploration via monte-carlo view quality rendering [pdf] 2020
Di Deng, Zhefan Xu, Wenbo Zhao, Kenji Shimada
Preprint arXiv:2011.05275.

TEACHING EXPERIENCE

Engineering Optimization (CMU 24-785)
College of Engineering at CMU — Pittsburgh, PA
Teaching Assistant — Aug. 2024 - Dec. 2024

- Designed, reviewed, and graded optimization homework assignments.
- Conducted weekly office hours, providing support in optimization theory.

Introduction to Deep Learning (CMU 11-785)
School of Computer Science at CMU — Pittsburgh, PA
Teaching Assistant — Jan. 2020 - May 2020

- Led two recitations and developed presentation slides on Convolutional Neural Networks and statistics visualization in PyTorch Tensorboard.
- Conducted weekly office hours for 2 hours, offering support and addressing students' inquiries regarding deep learning concepts and programming.

ACADEMIC SERVICES

Academic Journal and Conference Reviewer:

- IEEE Robotics and Automation Letters (RA-L)
- IEEE International Conference on Robotics and Automation (ICRA)
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)
- IEEE International Conference on Automation Science and Engineering (CASE)
- IEEE International Conference on Robotics and Biomimetics (ROBIO)
- IEEE Transactions on Instrumentation and Measurement (TIM)
- IEEE Transactions on Communications (TCOM)

Academic Conference Volunteer:
IEEE/RSJ International Conference on Intelligent Robots and Systems, 2023 Detroit, MI

- Conference registration and human arrow.