Zhefan Xu

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EDUCATION

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

Carnegie Mellon University — Pittsburgh, PA
M.S. in Mechanical Engineering - Research — May 2021
- GPA: 3.96/4.0

University of Pittsburgh — Pittsburgh, PA
B.S. in Mechanical Engineering (Joint Program) — May 2019
- GPA: 3.98/4.0

Sichuan University — Chengdu, China
B.Eng. in Mechanical Engineering — May 2019
- GPA: 3.93/4.0

OPEN SOURCE

Active open-source contributor in robotics on ⚕ GitHub, with repositories collectively receiving **3,000+ stars** and **600+ followers**. Maintainer of several widely adopted projects in **robotics navigation, reinforcement learning, autonomous systems, and simulation**, supporting research and practical applications across academia and industry.

SKILLS

Programming: C++, Python, ROS, ROS2, PyTorch, TensorFlow, MATLAB, Java
Robotics: Navigation, Path Planning, Trajectory Optimization, SLAM, Object Detection
AI/ML: Reinforcement Learning, Deep Learning, Vision-Language Models (VLMs)

WORK EXPERIENCE

Waymo LLC — Mountain View, CA
PhD Intern, Planner — May 2025 - Aug. 2025

- Applied Direct Policy Optimization (DPO) to finetune the foundation behavior model on the Waymo Open Dataset with Vision-Language Model (VLM) reasoning traces.
- Designed a VLM-aided finetuning strategy that improved both human preference scores (rater feedback) and average displacement error in trajectory prediction.

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

- Improved behavior planning cost design for more robust immediate pullovers.
- Utilized Vision-Language Models (VLMs) with chain-of-thought reasoning (CoT) and in-context learning (ICL) to correct intent decision in long-tail failure cases.

RESEARCH EXPERIENCE

Reinforcement Learning-based Robot Navigation ⚕ — Pittsburgh, PA
CERLAB at CMU — Sept. 2024 - Mar. 2025

- Developed the NavRL navigation framework, an end-to-end reinforcement learning-based system for robot navigation in dynamic environments, incorporating a policy action safety shield based on the velocity obstacle to ensure safe decision-making.
- Validated the framework through real-world dynamic environment experiments, demonstrating robust navigation performance and effective zero-shot sim-to-real transfer.

Aerial Robot Navigation and Tunnel Inspection ⚕ — Pittsburgh, PA
CERLAB at CMU — Sept. 2021 - Sept. 2024

- 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 unmanned aerial vehicles.
- Designed vision-aided trajectory optimization with a proposed dynamic map to achieve safe navigation in dynamic environments using a customized quadcopter.
- Developed a lightweight 3D dynamic obstacle detection algorithm by ensembling multiple efficient but low-accuracy detectors for small UAVs, exceeding benchmark results.

Supermarket Misplaced Products Detection   Pittsburgh, PA
CyLab Biometric Center at CMU   May 2020 - Oct. 2020
- Trained RetinaNet and Mask R-CNN with MMDetection on the Walmart shelf dataset, achieving 0.9+ mAP and exceeding the previous segmentation model's performance.

PUBLICATIONS   **LV-DOT: LiDAR-visual dynamic obstacle detection and tracking for autonomous robot navigation** [pdf] [code]   2025
Zhefan Xu, Haoyu Shen*, Xinming Han, Hanyu Jin, Kanlong Ye, Kenji Shimada
Submitted to IEEE Robotics and Automation Letters (**RA-L**) 2025.

NavRL: Learning Safe Flight in Dynamic Environments [pdf][code]   2025
Zhefan Xu, Xinming Han, Haoyu Shen, Hanyu Jin, Kenji Shimada
IEEE Robotics and Automation Letters (**RA-L**) 2025.

Intent Prediction-Driven Model Predictive Control for UAV Planning and Navigation in Dynamic Environments [pdf] [code]   2025
Zhefan Xu*, Hanyu Jin*, Xinming Han, Haoyu Shen, Kenji Shimada
IEEE Robotics and Automation Letters (**RA-L**) 2025.

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

Intermediate Deep Learning (CMU 24-788/24-789)   Pittsburgh, PA
Teaching Assistant   Jan. 2025 – May 2025

- Delivered weekly recitations on deep learning concepts and implementation.
- Designed, reviewed, and graded machine learning homework assignments.
- Held weekly office hours to provide support in theory and programming.

Engineering Optimization (CMU 24-785)   Pittsburgh, PA
Teaching Assistant   Aug. 2024 – Dec. 2024

- Developed and evaluated homework assignments on engineering optimization.
- Provided weekly office hours to support students in theoretical and applied topics.

Introduction to Deep Learning (CMU 11-785)   Pittsburgh, PA
Teaching Assistant   Jan. 2020 – May 2020

- Led two recitations and created slides on Convolutional Neural Networks.
- Conducted weekly office hours to address student questions on concepts and coding.
- Mentored five project teams focused on robotics and computer vision applications.
- Designed homework assignments on optimization algorithms such as ADAM.

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)
- IEEE/CAA Journal of Automatica Sinica
- Autonomous Robots (AURO)

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

- Assisted with conference registration, providing guidance and support to attendees.
- Directed participants to session venues and facilitated smooth crowd flow.