Zhefan Xu

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EDUCATION

Carnegie Mellon University — Pittsburgh, PA
Doctor of Philosophy, Mechanical Engineering — May 2025 (Expected)
Minor, Machine Learning
Advisor: Professor Kenji Shimada
GPA: 3.92/4.0

Carnegie Mellon University — Pittsburgh, PA
Master of Science, Mechanical Engineering — May 2021
Advisor: Professor Kenji Shimada
GPA: 3.96/4.0

University of Pittsburgh — Pittsburgh, PA
Bachelor of Science, Mechanical Engineering — 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

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.

PUBLICATIONS

Heuristic-based Incremental Probabilistic Roadmap for Efficient UAV Exploration in Dynamic Environments [pdf] 2023
Zhefan Xu*, Christopher Suzuki*, Xiaoyang Zhan, Kenji Shimada
Submitted to *IEEE International Conference on Robotics and Automation* (**ICRA**) 2024.

Quadcopter Trajectory Time Minimization and Robust Collision Avoidance via Optimal Time Allocation [pdf] 2023
Zhefan Xu, Kenji Shimada
Submitted to *IEEE International Conference on Robotics and Automation* (**ICRA**) 2024.

Low computational-cost detection and tracking of dynamic obstacles for mobile robots with RGB-D cameras [pdf] 2023
Zhefan Xu*, Xiaoyang Zhan*, Yumeng Xiu, Christopher Suzuki, Kenji Shimada
Submitted to *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.

RESEARCH EXPERIENCE

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

- 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.
- Prototyped, designed, and manufactured autonomous quadcotpers.
- Implemented the autonomous navigation system for unmanned ground vehicles and designed coordination algorithms for heterogeneous robot teams.

Supermarket Misplaced Products Detection with Robotic Vision
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.
- Implemented and trained the deep learning classification model for the Walmart price label classification sent the model to the sponsor company for the market application.
- Integrated the product detection and classification algorithm with the entire robotic system for misplaced product identification and detection.

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.
- Created and maintained the ROS package for the quadcopter simulation environments.
- Implemented and tested the proposed exploration algorithm in both a UAV simulation environment and on a real Turtlebot robot successfully.

TEACHING EXPERIENCE

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.
- Mentored five project teams specializing in robotics and computer vision applications, with a focus on Generative Adversarial Networks (GAN).
- Designed homework assignments centered around the ADAM optimizer, prepared, and assessed all assignments throughout the semester.

AWARDS

The 2nd Prize Comprehensive Scholarship, Sichuan University	Oct. 2018
Award for Outstanding Student, Sichuan University	Oct. 2018
Dean's List Scholarship, Sichuan University	Jul. 2018
The 3rd Prize Comprehensive Scholarship, Sichuan University	Sept. 2017
The 2nd Prize Comprehensive Scholarship, Sichuan University	Sept. 2016
Award for Outstanding Student, Sichuan University	Sept. 2016
Dean's List Scholarship, Sichuan University	Sept. 2016
Award for Outstanding Volunteer, Sichuan University	Jun. 2016

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)

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

- Conference registration and human arrow.

SKILLS

Programming Languages: C++, Python, Matlab, Java.
Robotics: ROS, Gazebo, Solidworks, 3D Printing, Soldering.
Machine Learning: PyTorch, TensorFlow.