

# Zhefan Xu

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## EDUCATION

### Carnegie Mellon University

*Doctor of Philosophy*, Mechanical Engineering  
*Minor*, Machine Learning  
Advisor: Professor Kenji Shimada  
GPA: 3.92/4.0

Pittsburgh, PA  
May 2025 (Expected)

### Carnegie Mellon University

*Master of Science*, Mechanical Engineering  
Advisor: Professor Kenji Shimada  
GPA: 3.96/4.0

Pittsburgh, PA  
May 2021

### University of Pittsburgh

*Bachelor of Science*, Mechanical Engineering  
GPA: 3.98/4.0

Pittsburgh, PA  
May 2019

### Sichuan University

*Bachelor of Engineering*, Mechanical Engineering  
GPA: 3.93/4.0

Chengdu, China  
May 2019

## 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<sup>\*</sup>, Christopher Suzuki<sup>\*</sup>, 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<sup>\*</sup>, Xiaoyang Zhan<sup>\*</sup>, 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<sup>\*</sup>, Xiaoyang Zhan<sup>\*</sup>, 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

### Autonomous 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 quadcopters.
- 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 mmdetection 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  
Jan. 2020 - May 2020

Teaching Assistant

- 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.