

YUMENG XIU

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RESEARCG INTERESTS

- Perception and path planning, especially real-world applications in robotics and autonomy.
- Reliable learning in control algorithms with formal guarantees.
- Trustworthy AI and optimization

To that end, my recent researches focus on:(1)Vision-based perception and path planning on robots.(2) Developing reliable algorithms for stabilizing large-scale networked systems(see a few projects in my [homepage](#)).

EDUCATION

Carnegie Mellon University

Pittsburgh, PA

Master of Science in Mechanical Engineering (Robotics Track) **GPA:3.94/4.0**

Aug. 2020 - May. 2023

Relevant Coursework: *Numerical Methods in Engineering, Computer Vision, Machine Learning, Deep Learning, Optimization, Linear Control, Robot Localization and Mapping*

Beijing Institute of Technology

Beijing, China

Bachelor of Science in Mechanical Engineering

Aug. 2016 - May. 2020

GPA:3.5/4.0 Major GPA:3.86/4.0 Ranking:15/90

RWTH Aachen University

Aachen, Germany

Summer School, Major in Automation and simulation

Jul. 2017

Relevant Coursework: *Numerical Differentiation, Modeling of ODE, Discretization Methods, Nonlinear Equations*

PUBLICATIONS

1. Zhefan Xu*, Xiaoyang Zhan*, Yumeng Xiu, Christopher Suzuki, Kenji Shimada. Low computational-cost detection and tracking of dynamic obstacles for mobile robots with RGB-D cameras. Accepted by *IEEE Robotics and Automation Letters (RA-L)*. [\[arxiv\]](#)
2. Zhefan Xu, Baihan Chen, Xiaoyang Zhan, Yumeng Xiu, Christopher Suzuki, Kenji Shimada. A vision-based autonomous UAV inspection framework for unknown tunnel construction sites with dynamic obstacles. Accepted by *IEEE Robotics and Automation Letters (RA-L)*. [\[arxiv\]](#)
3. Songyuan Zhang, Yumeng Xiu, Guannan Qu, Chuchu Fan. Compositional Neural Certificates for Networked Dynamical Systems. Accepted by *2023 Learning for Dynamics and Control (L4DC oral)*. [\[paper\]](#)
4. Zhefan Xu, Yumeng Xiu, Xiaoyang Zhan, Baihan Chen, and Kenji Shimada. Vision-aided UAV Navigation and Dynamic Obstacle Avoidance using Gradient-based B-spline Trajectory Optimization. Accepted by *IEEE International Conference on Robotics and Automation (ICRA)*, 2023. [\[paper\]](#)
5. Zhefan Xu*, Xiaoyang Zhan*, Baihan Chen, Yumeng Xiu, Chenhao Yang, and Kenji Shimada. A real-time dynamic obstacle tracking and mapping system for UAV navigation and collision avoidance with an RGB-D camera. Accepted by *IEEE International Conference on Robotics and Automation (ICRA)*, 2023. [\[paper\]](#)

RESEARCH EXPERIENCE

Onboard dynamic-object detection and tracking for autonomous robot navigation with RGB-D camera

Dec. 2022 - Mar. 2023

Advisor: Prof. Kenji Shimada, Computational Engineering and Robotics Lab, Carnegie Mellon University

- Adopted a novel ensemble detection strategy combining multiple computationally efficient but low-accuracy detectors to achieve real-time and high-accuracy detection.
- Proposed a feature-based data association method to prevent tracking mismatches.
- Implemented the constant-acceleration Kalman filter for better obstacle state estimation.

Compositional Neural Certificates for Networked Dynamical Systems

Jul. 2022 - Dec. 2022

Advisor: Prof. Guannan Qu, Carnegie Mellon University

- Proposed methods for stabilizing power systems based on ISS Lyapunov neural certificate, by collecting certificates of small subsystems to constitute a compositional certificate of the entire dynamical system.
- Developed Centralized neural controllers and Lyapunov functions to verify the global stability in power systems, designed decentralized neural controllers and Lyapunov functions that could be used across different subsystems.
- Utilized the Pandapower tool for modeling and simulation of multiple power system cases.

A real-time dynamic obstacle tracking and mapping system for UAV navigation and collision avoidance with an RGB-D camera

Jun. 2022 - Sep. 2022

Advisor: Prof. Kenji Shimada, Computational Engineering and Robotics Lab, Carnegie Mellon University

- Designed a real-time dynamic obstacle tracking and mapping system for quadcopter using an RGB-D camera.
- Proposed a region proposal detector that utilized depth-image to obtain static obstacle representation. Executed Kalman filter for velocity prediction. Developed a continuity filter for dynamic obstacle tracking.
- Employed Markov chain rule to generate path libraries for dynamic obstacles, considering the collision between future paths and environment, the trajectory with the highest probability of collision-free will be sampled.

Vision-aided UAV Navigation and Dynamic Obstacle Avoidance using Gradient-based B-spline Trajectory Optimization

May. 2022 - Aug. 2022

Advisor: Prof. Kenji Shimada, Computational Engineering and Robotics Lab, Carnegie Mellon University

- Presented a gradient-based B-spline path planner utilizing the robot's onboard vision that applied a circle-based guide-point algorithm and receding horizon distance field iteratively to generate the collision-free trajectory.
- Established the CAD model of drone and ROS simulation platform based on real-world data.
- Set up a real aerial robot platform. Conducted multiple physical experiments to verify the great performance of the proposed planner in different scenarios.

SELECTED COURSE PROJECTS

3D Reconstruction For Tunnel Inspection Based On RGB-D Data

Sep. 2022 - Dec. 2022

Instructor: Prof. Michael Kaess, Robotics Institute, Carnegie Mellon University

- Conducted physical experiments in real tunnels for RGB-D image dataset collection using a real aerial robot.
- Experimented with SFM, NeRF, Open3d methods for 3D tunnel reconstruction.

Variance reduction in stochastic gradient descent

Mar. 2022 - May. 2022

Instructor: Prof. Guannan Qu, Electrical and Computer Engineering, Carnegie Mellon University

- Implemented SAGA algorithm in strongly convex cases compared to GD, SGD, SAG and SVRG. SAGA achieves better convergence rates than SGD, SAG and SVRG, with less computation cost than GD.
- Outperformed SGD in non-convex neural network cases, with a convergence rate 10 times faster than SGD

TECHNICAL SKILLS

Programming Languages Python (Numpy, Pandas, Scipy), C/C++, Matlab

Framework/Tools Pytorch, OpenCV, ROS, AutoCAD, SolidWorks, Git, ABAQUS, NXUG, CloudCompare

HONORS & AWARDS

- 2020 Beijing Institute of Technology FastGear Third Prize Scholarship 03/2020
- Third Prize, Century Cup Creative Competition, BIT 05/2018
- Beijing Institute of Technology the Second Prize Scholarship 09/2018,09/2019
- Member of Student Science Association, BIT 2016-2017