Jiuzhou Lei

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Education

University of Pennsylvania   **Aug. 2021 – May 2023**
Master of Science in Robotics, GPA: 3.73/4.00   *Philadelphia, PA*

University of Pittsburgh   **Aug. 2019 – May 2021**
Bachelor of Science in Mechanical Engineering, GPA: 3.87/4.00   *Pittsburgh, PA*

Sichuan University   **Sep. 2017 – June 2019**
Bachelor of Engineering in Mechanical Engineering, GPA: 3.81/4.00   *Chengdu, China*

Research and Work Experience

Research Assistant   **August 2023 - Present**
University of Pennsylvania, School of Engineering, Kumar Lab   *Philadelphia, PA*

- Enhanced quadrotor autonomy by extending a LiDAR-only autonomous flight feature. Integrated lidar-inertial odometry for robust state estimation, conducted precise parameter tuning, and executed thorough flight tests to ensure reliability.
- Implemented a centralized pose graph optimization algorithm to estimate robot trajectory and landmark poses for autonomous fine-grained metric-semantic mapping using a team of aerial robots in under-canopy forest environments.
- Built up a Metric-Semantic SLAM (MS-SLAM) framework for heterogeneous robot teams, enabling real-time autonomous mapping of 3D environments, with demonstrated performance on aerial and ground robots in large-scale indoor-outdoor scenarios.

Mechanical Engineering Intern   **June.2021 - Aug.2021**
Sunstrong International Industrial Ltd.   *Guangdong, China*

- Mechanical equipment design and validation with CAD softwares.

Research Projects

Versatile Real-Time Metric-Semantic SLAM for Multi-Robot Navigation and Exploration   **Dec. 2023**

- Developed a versatile metric-semantic SLAM framework for autonomous UAVs and UGVs to address challenges in collaborative SLAM for heterogeneous robots with varied perception modalities, large pose graph computational burdens, and semantic environment understanding by using sparse object-level features with semantic information to enhance localization and mapping.
- Extended the framework for multi-robot scenarios, implementing decentralized pose-graph optimization and communication structure for efficient object observation transmission.
- Introduced a loop closure algorithm considering global object layout information for drift correction and map merging between robots.
- Conducted extensive experiments, including using a quadrotor for outdoor mapping and ground robot for exploration of a three-floor building.

Metric-Semantic Mapping and Diameter Estimation in Forest with Aerial Autonomy   **Aug. 2023**

- Involved in a forest mapping project, developed metric-semantic mapping algorithm for autonomous UAVs to monitor forest growth. Addressed challenges in accurate tree position measurement and diameter profile maintenance using 3D LiDAR data.
- Implemented centralized factor graph optimization for trajectory estimation and mapping for a multi-robot system.

LiDAR-only Autonomous flight   **Aug. 2022**

- Developed LiDAR-only autonomous flight feature for quadrotor autonomy system, enhancing capabilities beyond stereo cameras. Integrated lidar-inertial odometry for operation in diverse lighting conditions, conducted thorough parameter tuning, and executed rigorous flight tests to ensure stable and reliable performance.

Course Project: Quadrotor Autonomy Stack   **April 2022**
- Developed the dynamic model of a quadrotor and implemented a **PD controller** and an **A*-based path planning** algorithm in **python** to successfully navigate the quadrotor and avoid obstacles in complex indoor environments.
- Implemented a min-snap **trajectory optimization** algorithm in **python** to ensure smooth and rapid motion for the robot.
- Built and tested a filter-based visual-inertial odometry (VIO) system that integrates information from an IMU and a stereo camera, and demonstrated its performance in simulation.

Innovative Experimental Teaching on Heat Transfer by Using Infrared Imager   **Jan. 2019**
- Established an experiment teaching model for heat conduction and heat radiation using infrared imagers. Designed the experiment to find the relationship between temperature and thermal radiation intensity by collecting thermal images of different materials under different temperatures.

Publication

- Xu Liu*, **Jiuzhou Lei***, Ankit Prabhu*, Yuezhan Tao, Igor Spasojevic, Pratik Chaudhari, Nikolay Atanasov, Vijay Kumar, FastSemanticSLAM: Versatile Real-Time Metric-Semantic SLAM for Multi-Robot Navigation and Exploration. (**Estimated to be submitted to Transaction on Robotics in December**)

- Ankit Prabhu*, Xu Liu*, Igor Spasojevic, Yuwei Wu, Yifei Shao, Dexter Ong, **Jiuzhou Lei**, Corey Green, Pratik Chaudhari, Vijay Kumar, Robots in the Wild: Fine-Grained Metric-Semantic Mapping and Diameter Estimation in Forests with Autonomous Uavs. DOI: http://dx.doi.org/10.2139/ssrn.4518294 (**Under Review**)

- Du Yi, Xu Zhefan, **Lei Jiuzhou**, Lin Senbao, Innovative Experimental Teaching on Heat Transfer by Using Infrared Imager, Research and Exploration in Laboratory, 2020, 39(06): 207-210

Technical Skills

Programming: Python, C++, C
Tools/Frameworks: GitHub, Git, ROS, PyTorch, CMake, Linux, OpenCV

Teaching and Mentoring

Linear Algebra, Ordinary differential equation, Coding with Python   **July. 2022 – Aug. 2022**
Teaching Assistant   *University of Pennsylvania*
Thermodynamics   **Jan. 2021 – May 2021**
Teaching Assistant   *University of Pittsburgh*
One-on-one academic writing   **Sep. 2017 – May 2019**
Mentor   *Sichuan University*

Awards, Scholarship, Honor

Honor Student at the Swanson School of Engineering   Academic Year 2019 and 2020
Dean's List at Sichuan Unversity   Academic Year of 2017 and 2018
Undergraduate Excellence Scholarship Second Prize   Academic Year 2018
Undergraduate Excellence Scholarship Third Prize   Academic Year 2017