

RUIJIE FU

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EDUCATION

Carnegie Mellon University, Master of Science in Robotics
Carnegie Mellon University, Bachelor of Science in Discrete Mathematics

May 2024
May 2020

WORK EXPERIENCE

Research Engineer (perception) – Mountain View, CA Jan 2024 - Present

- Improved accuracy and sped up **PyTorch** code in the mapping system that are used to generate **TensorRT** binaries by ~5%, and built up goldens and targeted testing system to evaluate the performance of each binary and prevent regression
- Independently developed from scratch and continuously maintained a pipeline to efficiently process full resolution image signals using only 42ms per frame, in the meantime providing an average of 30% more keypoints than the old pipeline
- Developed a fully autonomous framework to efficiently catch bugs and edge cases in the localization and mapping component of code by running nightly deterministic tests on new commits
- Reduced the wall dilation on map during edge cleaning by an average of 0.7 voxels by refining the training pipeline

Research and Development Analyst II - Geico – Bethesda, MD July 2023 - Dec 2023

- Developed an autonomous regression pipeline for monitoring fluctuations in quote data with ~160k attribute combinations, enabling swift detection (~9 hrs machine time) and proactive response to changes in quote mix from prior carriers
- Created a pipeline using **SQL**, **R**, and **python** to calculate a monthly policy retention indicator that enables efficient data refreshment (<5mins for one month of data), and generated a Power Pivot monthly report that enables further retention rate survival analysis

Teaching Assistant - CMU Robotics Institute – Pittsburgh, PA August 2018 - January 2019

- Utilized **ROS** communication and developed code in **Matlab** for a project that enables a Raspberry Pi controlled forklift robot to autonomously distinguish pallets from walls, plan an efficient cubic spiral path to pick up pallets, and navigate to a designated area
- Explained essential concepts such as particle filters and triangulation to students and guided them through the mobile robot project

RESEARCH EXPERIENCE

Research Assistant - CMUAirLab – Pittsburgh, PA January 2019 - March 2020

- Designed and implemented a tightly coupled simultaneous localization and mapping (**SLAM**) algorithm in **C++** for aggressive motion in indoor environments based on LOAM, leveraging the unique flower-shaped scan pattern of Livox LiDAR
- Implemented a hierarchical structure incorporating parallel graph isomorphism, which improved the sequence SLAM process, resulting in over 10 times increase in the speed of image-to-point cloud matching, allowing real-time localization capabilities
- Extended the traditional 2D sequence matching to 3D by replacing the exhaustive search with an autoencoder-based architecture
- Developed an algorithm in **C++** to create highly accurate 3D meshes from point cloud data utilizing RRT and Poisson reconstruction

Research Assistant - Biorobotics Lab – Pittsburgh, PA February 2017 - Present

ARPA-E in-pipe SLAM

- Implemented a **C++** framework based on VINS-MONO to overcome constraints induced by the lack of good features inside pipes
- Achieved accurate localization and mapping inside gas pipes, with an average of 1% longitudinal drift in robot localization
- Enabled real-time, colored 3D reconstructions of pipe surfaces with an average error of 0.16% in pipe diameter

Learning-based Metal Corrosion Prediction

- Led a team of five people in designing and deploying an autonomous system to collect high-quality images in a temporal sequence of carbon steel corroding under constant salt water mist, which filled a gap in the existing public dataset on timed metal corrosion
- Applied data augmentation techniques to generate a large number of unbiased small image patches for training and testing
- Created a highly efficient, light-weight network architecture in **PyTorch** based on seq2seq convolutional LSTM to predict corrosion and defects on metal pieces based on sampled images

High Degree-of-freedom Robot Locomotion

- Significantly improved the energy efficiency of snake robots by 24% with a variational optimization method that enables them to perform new behaviors such as navigating pipes and uneven terrains; the developed theories are included in main publications below
- Developed code in both **Matlab** and **Python** to optimize the efficiency of robot gaits, and implemented simulated snake movement in **PyBullet** as well as real snake robot executions with the optimized gaits

Flight Programmer - CMU Planetary Robotics Lab (Iris Lunar Rover) – Pittsburgh, PA January 2019 - March 2020

- Designed and constructed critical flight software modules, and co-designed teleoperation software structure for the lunar rover set to launch next year using Magicdraw, ensuring seamless operation and stability during lunar exploration

MAIN PUBLICATIONS

- Chunge Bai, **Ruijie Fu**, Xiang Gao, "Colmap-PCD: An Open-source Tool for Fine Image-to-point cloud Registration", IEEE International Conference on Robotics and Automation (ICRA) 2024.
- Ross Hatton, Et al. "The Geometry of Optimal Gaits for Inertia-dominated Kinematic Systems", IEEE Transactions on Robotics (**TRO**).
- Shuoqi Chen, **Ruijie Fu**, Ross L. Hatton, Howie Choset, "Towards Geometric Motion Planning for Systems on Cylindrical Surfaces", International Conference on Intelligent Robots and Systems (**IROS**) 2021.
- Tianyu Wang, Baxi Chong, Yuelin Deng, **Ruijie Fu**, Howie Choset and Daniel I. Goldman, "Generalized Omega Turn Gait Enables Agile Limbless Robot Turning in Complex Environment", IEEE International Conference on Robotics and Automation (ICRA) 2022.

SKILLS

Programming languages: Python, C++, Rust, SML, Javascript, R, Matlab, SQL, Arduino; **Machine Learning:** Pytorch, Tensorflow; **Robotics software:** ROS, Pybullet, Gazebo, MagicDraw; **Other:** PowerBI, selenium, AWS, Linux, github, docker