

RUIJIE FU

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EDUCATION

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

Expected 2023
May 2020

WORK EXPERIENCE

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

- Automated a 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 in place of previous manual effort
- 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
- Integrated OCR functionality in **python** to highlight user-searched words in scanned PDF documents resulting from claim operations

Software Engineer Intern (SLAM) - CowaRobot – Shanghai, China July 2021 - March 2022

- Developed key components of an efficient LiDAR data processing framework that quickly and accurately assembles large numbers of map segments into a complete map, enabling autonomous mobile robots to communicate and coordinate their movements
- Improved the sequence SLAM process by implementing a hierarchical structure incorporating parallel graph isomorphism, which resulted in over 10 times increase in the speed of image-to-point cloud matching, allowing real-time localization capabilities
- Streamlined and maintained over 10,000 lines of **C++** code, including merging between historical **github** versions and managing multiple versions of the **docker** environment
- Trained, tested and improved a deep neural network in **PyTorch** on a private collected city-scale dataset to produce spherical convolutional LiDAR features, and evaluated the performance of these features using difference matrix and precision-recall curves

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 - Biorobotics Lab – Pittsburgh, PA February 2017 - Present

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

ARPA-E in-pipe SLAM (simultaneous localization and mapping)

- Contributed to 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

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

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

- Developed 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
- 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

Lead 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

- Ruijie Fu**, Ross Hatton, Howie Choset, "Geometric Motion Planning for Systems with Cyclic Shape Spaces", in manuscript.
- 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.

SKILLS

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

Relevant Classes: Algorithm design; Parallel programming; Machine learning; Computer vision; Computer graphics; Graph theory; Topology; Combinatorics; Probability; Abstract algebra; Discrete differential geometry; SLAM; Math fundamentals of robotics