

ANWAY SHIRGAONKAR

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EDUCATION

Master of Science in Robotics, Electrical and Computer Engineering Concentration

Expected Dec 2024

Northeastern University, Boston MA

GPA 3.9

Courses: Autonomous Field Robotics, Robot Sensing and Navigation, Reinforcement Learning, Computer Vision

SKILLS

Programming/Software : Python, C++, MATLAB, GitHub, Linux

Protocols/Technologies : UART, TCP/IP, CAN, OpenCV, CUDA, GTSAM

Robotics : ROS, ROS2, Mapping (RTAB-Map, Cartographer), Control (MPPI), SLAM, Perception

PROFESSIONAL EXPERIENCE

Manus Robotics, Boston MA

Jun 2023 – Dec 2023

System Development Intern

- Interfaced the Universal Robotics' **UR5e in ROS Noetic** for control of the robotic arm using **MoveIt** for pick and place application
- Achieved **smooth trajectory** execution by setting up **PREEMPT_RT** kernel for **Ubuntu** to get real-time control capabilities
- Developed an **API in Python** to interact with UR5e RTDE interface using the **TCP/IP** protocol for "teach and learn" application
- Configured **ESP-NOW** for gesture-activated, low-latency, and reliable communication between three **ESP32** microcontrollers
- Designed demos which effectively highlight gesture-controlled robots that helped the company attract **potential investors**

The Automotive Research Association of India (ARAI), Pune India

Jul 2021 – Jun 2022

Research intern

- Created a **data encoder** in Simulink which encodes the **control commands** for steering, braking, and acceleration for the **CAN bus**
- Designed and **implemented a PID controller** on the **NXP S32K microcontroller** using **MATLAB**, providing precise steering control
- Interfaced and configured the **drivers for LiDAR, camera, IMU, and GPS** in ROS for a synchronized sensor data acquisition system
- Achieved **time synchronization** using **message_filters** in ROS to handle timestamp discrepancies and ensure reliable data fusion

PUBLICATION

Ananya Trivedi, Sarvesh Prajapati, **Anway Shirgaonkar**, Mark Zolotas, Taskin Padir. (2024). "Data-Driven Sampling Based Stochastic MPC for Skid-Steer Mobile Robot Navigation" [<https://arxiv.org/abs/2411.03289>] submitted to **ICRA 2025**

ACADEMIC PROJECTS

Autonomous Inspection of Insulation by a Quadruped in Tight Spaces

Present

- Working on the navigation and mapping stack of **Unitree Go2 robot** which can inspect for faulty insulation in attics
- Developing a **mapping algorithm** which can overlay thermal images on a **Livox-MID360 LiDAR** point cloud to get a "heat-map"
- Designing an algorithm to accurately **segment out and identify holes** in insulation in the 3D heatmap produced

Pose Estimation of Underwater Images using Factor Graphs

Oct 2024

- Processed low-contrast underwater images with **CLAHE** and tuned **SIFT detector** for uniform feature detection across the image
- Applied **feature matching with RANSAC** on the temporal sequence of 29 images to estimate a **partial affine homography**
- Created a mosaic of this temporal sequence with respect to the first image which had effects of **drift that led to poor results**
- Proposed **non-temporal links** and created a **factor graph** with nodes being the 2D pose and the edges denoting the homography
- Applied **Levenberg-Marquardt optimization in GTSAM** for the global pose of images in the mosaic leading to better results

Data-Driven Stochastic MPC for Skid-Steer Mobile Robot Navigation

Jul 2024

Northeastern University, RIVER Lab

- Modelled the non-linear effects of skid and slip in a skid-steer mobile robot in uncertain terrains by a **Gaussian Process (GP)**
- Developed **GPU-accelerated routines** to compute the predictive mean and variance of the GP using **Numba library** in Python
- Achieved real-time performance by **GPU implementation of GP-MPPI planner** that works at 20Hz on a **Clearpath Jackal** robot
- Conducted **extensive simulations** for GP-MPPI planner in random obstacle avoidance scenarios with a **success rate of 94%**
- **Benchmarked** the performance of GP-MPPI planner on a 100m circular and square path tracking with **average RMSE of 23.6 mm**
- Submitted this work for publication in the International Conference on Robotics and Automation (ICRA) 2025

Autonomous Reconnaissance with Mobile Robot

Mar 2023

Northeastern University

- Implemented **SLAM** using the **Cartographer ROS** package for **autonomous exploration** of unknown environments with Turtlebot3
- Developed a custom **trajectory-based AprilTag detection** algorithm in **OpenCV** and **ROS** with accurate localization of 10/13 tags
- Configured and optimized the **explore_lite** package for frontier-based exploration of a simulated disaster-struck zone
- Implemented pose estimation algorithms to accurately update AprilTag position during a loop-closure event in SLAM