

# Sourojit Saha

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## EDUCATION

### Carnegie Mellon University

Pittsburgh, PA

Master of Science in Mechanical Engineering - Research Program - **GPA: 3.88/4.00**

May 2023

**Relevant Coursework:** Planning and Decision-Making in Robotics, Modern Control Theory, Advanced Control System Integration, ML/AI for Engineers, Robot Localization and Mapping

### Birla Institute of Technology and Science

Pilani, India

Bachelor of Engineering in Manufacturing Engineering - **GPA: 8.20/10.00**

May 2020

**Relevant Coursework:** Machine Learning, Data Mining, Mechatronics, Robotics

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## SKILLS

**Programming:** ROS2, ROS, C++, Python, MATLAB, Numpy, PyTorch, Pandas, OpenCV, AWS, Git, Docker, Linux

**Software/Framework :** Simulink, SolidWorks, AutoCAD, Qt Designer, ROS2 Control, ROS2 Nav, ROS2 SLAM Toolbox

**Technologies:** Motion Planning, Control Systems, Computer Vision, Machine Learning, Artificial Intelligence

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## EXPERIENCE

### Swarmbotics.ai, Remote ([Link](#))

Aug 2023 - Present

#### Robotics Engineer (First Engineering Hire)

- Designed **custom multi-robot simulation** on **Gazebo** to test up to **10 robots**; Integrated **Lidar, IMU and Camera plugins**
- Implemented and tested **differential drive** and **Ackermann steering** for custom robot simulation
- Added autonomous mapping and navigation system by integrating **ROS2 Slam Toolbox** and **ROS2 Nav2**
- Utilized **Redd Shepp** motion model and **Regulated Pure Pursuit (RPP)** controller to increase robot speed by **3x**
- Used **ROS2 control framework** to create **custom hardware interface** in **C++** to send PWM signals to wheel motors
- Integrated **Compute Module 4 (CM4), Arduino Uno, Cytron Motor Driver, 24V Motor and Optical Encoder** as part of hardware integration task
- Created **Mux** for controlling multiple robots via **Rviz interface**; Added functionalities for **multiple waypoints, final goal pose** and **manual control**; Tested on a simulation of **4 robots**
- Integrated **3D Lidar scan** with **BEVNet** to create **2D cost map** for off-road navigation

### Carnegie Mellon University, Pittsburgh, PA

Jan 2022 - May 2023

#### Graduate Research Assistant, Biorobotics Lab ([Link](#))

- Developed a **decentralized communication multiplexer** using **ROS** for **multi-robot** inspection operations, enabling **real-time** exchange of information; Tested on a system on **7 robots**
  - Developed "**Make Way**" behavior to allow **collision-free** movement of multiple robots in **narrow passageways**
  - Integrated **Transfer-Control** checks to prevent inadvertent transfer of robot control among operators
  - Identified and developed **contingency behavior** for robots in case of **communication loss** with base-station
  - Improved **AutoCalibration** module, extending the functionality to **multi-robot multi-operator** setup
  - Designed interactive GUI for **Human Robot Interaction (HRI)** using **Qt framework**, enabling multi robot control
  - Performed regular **sensor calibration** of payload housing **RGB/Thermal camera** and **IMU** using **Kalibr Toolbox**
  - Planned and executed **field tests** for demonstrating technical capabilities to sponsors and stakeholders
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## PROJECTS

### Safe Parking for Wheeled Robots (Course: Planning and Decision-making in Robotics) ([Link](#))

Sept 2022

- Developed a **lattice based planner** in **C++** to generate **collision-free** path for safe parking of autonomous wheeled robot in unstructured environments and adversarial situations
- Optimized and deployed the planner on RC trucks for **real time** application to find best parking spot within **1 sec**

### Path Planning for n-DoF Manipulator Arm (Course: Planning and Decision-making in Robotics)

Sept 2022

- Implemented **sampling-based** planning algorithms in **C++** to generate the path of **5-DoF** manipulator arm under **1 sec**
- Optimized the planner to generate **collision-free** path for manipulator arm with arbitrary number of joints (**n-DoF**)
- Evaluated **RRT, RRT\*** and **RRT Connect** planning algorithm on **5-DoF** manipulator arm in simulation

### Drone Control (Course: Advanced Control System Integration) ([Link](#))

Sept 2022

- Created mathematical model of **drone dynamics**; Used this to derive a linearized state space model for **LQR** controller
- Implemented LQR controller on hardware after testing in **MATLAB** and **Pybullet** drone simulation

### Collaborative SLAM (Course: Robot Localization and Mapping) ([Link](#))

Jan 2022

- Designed and developed a **4-step** algorithm to merge heterogeneous sensor maps among multiple robots. Steps involved- sharing point-clouds, feature extraction & matching, global transform computation and map-merging
  - Implemented **GICP** algorithm in **C++** to merge **Lidar** point clouds from **2 robots** to generate a map for multi-robot SLAM
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## PUBLICATIONS

- **Published:** Saha, S. Barriers to Successful Implementation of Sustainable Practices in Small and Medium Enterprises (SMEs). In Industry 4.0 and Advanced Manufacturing (pp. 301-310). Springer, Singapore
- **Submitted to CVPR 2024:** SubT-MRS Datasets: Pushing SLAM Towards All-weather Environments