Hemanth Raj Tekumalla

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EDUCATION

Northeastern University ***Sep 2024 - May 2026***
Master of Science in Robotics **Boston, MA**
Relevant Coursework: Mobile Robotics, Reinforcement Learning, Robotics Sensing and Navigation, Algorithms

National Institute of Technology ***Dec 2020 - Apr 2024***
Bachelor of Technology in Electrical Engineering **Rourkela, India**
Coursework: Control Systems, Power Electronics, Analog & Digital Electronics, Embedded Systems, Basic Programming, Mathematics I & II

SKILLS

Programming	Python, C++, Bash/Shell, MATLAB
Library & Framework	ROS 2, OpenCV, PyTorch, YOLO, Scikit-learn, NumPy, Pandas, Matplotlib
Hardware & Tools	Raspberry Pi, Linux, LaTeX, Git, GitHub, Gazebo, LabView, Proteus, Ansys, Simulink

WORK EXPERIENCE

Embedded Systems Laboratory, Northeastern University ***Nov 2024 - Present***
Research Assistant **Boston, MA**
Advisor: Dr. Gunar Schirner

- Developed and optimized control systems for fiber optic manipulation for Multiphoton microendoscopy and engineered evaluation frameworks to assess fiber optic control performance.
- Developed a Gaussian-based iterative evaluation approach, which processed, and validated laser pulse data, modeling contributions to quantify information per grid cell and find the highest resolution for a given pulse dataset.
- Evaluated five scanning patterns using the developed framework, identifying the spiral scanning pattern as the most effective, achieving up to 14% higher resolution than the next best-performing pattern.
- Formulated an optimization algorithm to disable 36% of laser pulses in a spiral scanning pattern, reducing photobleaching and achieving a pulse-to-pixel ratio of 0.7211.
- Collaborated with cross-functional teams to integrate evaluation methodologies into the endoscopy system, utilizing Git and GitHub for version control to manage and track collaborative development effectively.
- Explored reinforcement learning-based control techniques for fiber optic control to enhance imaging resolution, system performance, and actuator efficiency by learning optimal control strategies through iterative training and simulation.

Centre for Robotics and Security in Internet of Things, IIIT Pune ***May 2023 - July 2023***
Research Intern - Robotics **Pune, India**
Advisor: Dr. Ranjith Ravindranathan Nair

- Leveraged computer vision and deep learning frameworks for the detection and tracking of humans in the camera feed of a robot in a Cyber-Physical System.
- Implemented pre-trained YOLOv8 deep learning models using PyTorch for object detection, utilized OpenCV for image preprocessing, and integrated DeepSORT to enable robust object prediction and tracking with unique IDs across frames.
- Integrated Lidar and camera-based perception to dynamically estimate human pose relative to the robot, enhancing sensor fusion for improved localization.
- Developed a closed-loop Sliding Mode Control (SMC) algorithm to adjust linear and angular velocities based on feedback from odometry, IMU, and Lidar sensors, achieving precise navigation and real-time target following.
- Validated and optimized the trajectory control algorithm through simulations in Gazebo, leveraging Linux command-line tools for deployment on the TurtleBot3 Waffle-Pi via ROS 2, ensuring safe and controlled movement in real-world environments.
- Enhanced system resilience by implementing an anomaly detection mechanism using a sliding mode observer to estimate robot states and implemented an adaptive threshold algorithm for fault identification in dynamic environments.

PROJECTS

Beacon-Based Localization for Multi-Sensor Fusion SLAM ***Sept 2024 - Dec 2024***

- Adapted a beacon-based localization method within a Multi-Sensor Fusion SLAM framework to address GNSS-denied environments, leveraging strategically placed beacons for accurate pose estimation.
- Implemented and optimized a particle filter algorithm to fuse odometry and beacon distance data, enhancing pose estimation accuracy and SLAM performance.
- Integrated multi-sensor data using ROS 2 and RTAB-Map, enabling precise real-time localization and mapping in complex environments.
- Validated the system in a simulated environment with Gazebo and RViz, demonstrating improved perception, mapping precision, and trajectory estimation compared to traditional SLAM approaches.