Manoj Reddy Manchala

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Education

University of California San Diego **Sept 2023 - Mar 2025**

- Master of Science in Mechanical Engineeirng (Specialized in **Robotics**)
- **Key Courses:** Planning & Learning Robotics, Sensing & Estimation in Robotics, Safety for Autonomous Systems
- **Graduate Student Researcher** - Existential Robotics Laboratory :
  - Engineered a **Deep Reinforcement Learning** framework for **vision-guided autonomous navigation** of an Ackermann-drive vehicle, enabling efficient maneuvering in complex, obstacle-rich environments.
  - Developed a physics-based custom simulation environment with **MuJoCo/DM Control** for realistic training.
  - Designed a **3D convolution-based feature extractor** for depth image processing, enabling **spatiotemporal** feature learning across sequential frames, outperforming 2D CNNs in capturing motion dynamics.
  - Implemented a **graph neural network** (GNN)-based feature extractor, modeling **point clouds as structured graphs** to enhance 3D object classification and spatial reasoning, significantly improving scene understanding.
  - Achieved a **23%** increase in navigation success rate and a **17% reduction in collision rates** by replacing CNN-based perception with a GNN-driven spatial feature extractor, leading to superior scene understanding.
- **SLAM Projects** :
  - Developed a **Visual-Inertial SLAM** system via an Extended Kalman Filter (EKF) prediction, integrating IMU & stereo camera data to accurately estimate the robot's trajectory & landmarks.
  - Crafted a LiDAR-based SLAM system for a differential-drive robot, performed point cloud registration via **Iterative Closest Point** (ICP) & **Pose Graph Optimization** with loop-closure detection enhancing trajectory accuracy, generating detailed occupancy maps and texture maps.
- **Motion Planning** :
  - Formulated a **dynamic programming** approach for a 'Door & Key' navigation, formulating the task as a Markov Decision Process, demonstrating effective path planning for both known and random maps.
  - Implemented **A*** & **RRT** to solve navigating through various complex 3D environments with static obstacles.
  - Engineered a trajectory tracking control system for a differential-drive robot using **Generalized Policy Iteration** & **Certainty Equivalent Control** with minimal trajectory deviations while avoiding obstacles.
- **MPC for Uneven Terrains** :
  - Engineered a **Model Predictive Control** formulation for ground robots, enabling safe navigation on complex terrains with friction and elevation variations based on a customized dubins car model.
- **Comma.ai Calibration Challenge** :
  - Devised a **Conv-LSTM network** integrating **optical flow** features with RGB images to predict vehicle pitch & yaw from monocular camera inputs, achieving **MSE of 21.72%** & robust to varying environmental conditions.
- **Mobile Manipulator** :
  - Developed a control system for a mobile manipulator robot (youBot) in MATLAB and **CoppeliaSim**, implementing kinematics simulation, **trajectory generation** and PI control strategy for precise autonomous navigation and **object manipulation** in a simulated environment.

Technical Skills

Tools	MuJoCo, PyTorch, TensorFlow, OpenCV, Git, Simulink, Fusion 360, ADAMS LaTeX
Programming	Python, ROS, MATLAB, R, Arduino

Work Experience

Research Assistant - IIT Bombay **Apr 2022 - Jan 2023**

- Supervised the development of a land moving pesticide sprayer within a budget of **2000 USD**.
- Employed Fusion 360 & ANSYS to design and stress-test the 3D model, ensuring structural integrity.
- Developed a Simulink model of the EV, simulating crucial parameters such as range, power, and torque.

Business Leadership Trainee - FARE Labs Private Limited **Jul 2021 - Feb 2022**

- Created a repository of segment segregated clients to be targeted through detailed Market Research.
- Led a team of five to implement Website development plan & marketing strategies driving **15% revenue growth**.
- Secured strategic client partnerships, projected to generate **$250,000** in recurring annual revenue.

Research Internship - Varroc Tech Center **Nov 2019 - Dec 2019**

- Simulated & Evaluated multiple state-of-charge estimation techniques for Li-ion batteries, prioritizing model-based approaches like PI observers, **Sliding Mode observers**, and **Kalman filters**.