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, Robotics, ML for Physical Applications, Parametric System Identification Methods.

Indian Institute of Technology, Bombay **July 2017 - May 21**
- Bachelor of Technology in Mechanical Engineering

PROJECTS

Graduate Student Researcher - Existential Robotics Laboratory **Mar 2024 - Present**
- Engineered a **Deep Reinforcement Learning** framework(PPO/SAC) 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** in simulation by replacing CNN-based perception with a GNN-driven spatial feature extractor, leading to superior scene understanding.
- Deployed PyTorch models onto **NVIDIA Jetson TX2** (F1tenth car) by converting them to **ONNX** & **TensorRT**.

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 in MATLAB & **CoppeliaSim**, implementing kinematics simulation, **trajectory generation**, PI control strategy for precise autonomous navigation & **object manipulation**.

TECHNICAL SKILLS

Programming	Python, ROS, Pandas, Numpy, OpenCV, MATLAB, R, Arduino, LaTeX
Tools/Frameworks	MuJoCo, CUDA, ONNX, TensorRT, Git, PyTorch, TensorFlow, Simulink, Fusion 360, ADAMS

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**.