

Sumukh Porwal

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EDUCATION

Worcester Polytechnic Institute (WPI) | Worcester, MA

Master of Science in Robotics Engineering | GPA: 4.0/4.0

August 2024 - May 2026

Coursework: Computer Vision, Motion Planning, Reinforcement Learning, Robot Control, Robot Dynamics

Indian Institute of Technology Tirupati (IIT Tirupati) | Tirupati, India

Bachelor of Technology in Mechanical Engineering | GPA: 8.69/10.0

July 2020 - June 2024

Coursework: Machine Learning, Modeling & Control of Mobile Robots & Manipulators, Attitude Estimation & Control

TECHNICAL SKILLS

Operating System: Windows, Linux

Programming Languages & Tools: Python, C, C++, MATLAB, Bash, LaTeX, Git, Docker, Singularity

Frameworks & Libraries: ROS 1 & 2, PyTorch, TensorFlow, Keras, OpenCV, OMPL, Acados, Taichi, CasADi

Embedded Systems: Jetson Orin NX, Raspberry Pi, Raspberry Pi Pico, Arduino

Simulation & ROS Tools: Gazebo, RViz, MoveIt, Nav Stack, rqt

WORK EXPERIENCE

Aerial-Robot Control and Perception Lab, WPI

Worcester, MA

Graduate Researcher

January 2025 - Present

- Developing a GPU-accelerated Physics-informed Reinforcement Learning with differentiable physics to train neural network control policies for high-speed aerial navigation of a quadrotor using depth image as the sole input.
- Targeting real-time navigation at speeds up to 20 m/s, leveraging backpropagation through differentiable physics.

SeiAnmai Technology Pvt. Ltd.

Delhi, India

Robotics Intern

May 2023 - July 2023

- Led a team to develop an autonomous robot with 95% navigation accuracy, integrating ROS 2 and micro-ROS.
- Designed an ArUco marker detection system, achieving docking precision within 1 cm.
- Enhanced real-time telepresence by implementing internet-based teleoperation within 100 ms latency.
- Optimized performance by refining control algorithms and leveraging Docker for seamless micro-ROS deployment.

PROJECTS

Reactive Collision Avoidance for Safe Agile Navigation

Worcester Polytechnic Institute

February 2025 - Present

- Developed a reactive collision avoidance framework integrating perception, planning, and control using nonlinear model predictive control (NMPC) with adaptive control barrier functions (CBFs) for a quadrotor.
- Designed a neural network-based refinement of noisy RGB-D data and a heuristic optimization strategy to enhance real-time obstacle avoidance for agile quadrotors in diverse environments.

Structure from Motion (SfM) and Neural Radiance Field (NeRF)

Worcester Polytechnic Institute

February 2025 - March 2025

- Developed a SfM pipeline for 3D reconstruction using feature matching, motion recovery, and bundle adjustment to estimate camera positions and 3D points.
- Implemented NeRF to synthesize novel views by optimizing a deep neural network to model scene geometry and appearance from sparse input images.

Learning-Based Collision & Clearance Estimator for Manipulators

Worcester Polytechnic Institute

November 2024 - December 2024

- Implemented a neural network-based heuristic achieving a 50% reduction in collision-checking time compared to geometric methods like the Gilbert-Johnson-Keerthi algorithm.
- Designed a clearance adjustment algorithm, improving planning efficiency by 35% in cluttered environments.

Deep Reinforcement Learning for TurtleBot3 Navigation

Worcester Polytechnic Institute

October 2024 - December 2024

- Implemented DDPG, PPO, TD3, & DQN algorithms achieving obstacle avoidance with 88% accuracy in simulations.
- Built a ROS 2 & Gazebo environment using LiDAR for precise distance sensing and decision-making.
- Conducted performance benchmarking, revealing a 15% improvement in path efficiency for PPO over others.

Perception-aware Model Predictive Control on Quadrotor

Worcester Polytechnic Institute

September 2024 - December 2024

- Integrated YOLACT architecture, achieving 95% accuracy in real-time detection and tracking targets.
- Developed a NMPC using Acados, enabling trajectory tracking with sub-1% error in constrained environments.

Semantic Image Segmentation for Autonomous Vehicles

Indian Institute of Technology Tirupati

May 2024 - August 2024

- Achieved 90% segmentation accuracy using U-Net CNN on CARLA self-driving datasets for navigation tasks.
- Delivered precise object detection by training on 100,000+ labeled samples, enhancing autonomous driving safety.