Abhimanyu Suthar

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Education

New York University   Expected May 2025
Master of Science in Robotics and Mechatronics   *Brooklyn, New York*
- **Relevant Coursework:** Robot Localization and Navigation, Foundations of Robotics, Reinforcement Learning and Optimal Control, Mathematics for Robotics, Deep Learning, Advanced Mechatronics

Research Experience

Agile Robotics and Perception Laboratory, NYU Tandon School of Engineering   June 2024 – Present
Graduate Research Assistant   *Brooklyn, New York*
- Proposed and led a novel research direction exploring **3D Gaussian Splatting (3DGS)** for scene extension, focusing on spatial and temporal consistency.
- Enhanced feature matching pipeline by integrating **Mast3r** with **COLMAP**-compatible output formats, enabling robust Structure from Motion initialization.
- Performed large-scale empirical testing of **30+** diverse image sequences, characterizing failures and success conditions for 3D Gaussian splatting.
- Enhanced novel view synthesis quality by **27.7%** (**18 dB** $->$ **23 dB PSNR**) using Depth-Anything V2 priors, advancing photorealism in drone-captured sequences.

Defense Research and Development Organization, Government of India   June 2022 - August 2022
Robot Software Engineer   *Bengaluru, India*
- Conducted analysis in scenarios where there was a loss of GNSS signals, quantifying key performance metrics such as position error and trajectory deviation
- Implemented a SLAM pipeline leveraging IMU and odometry data, reducing localization drift by **25%** during GNSS signal loss in desert environments
- Simulated GNSS outage scenarios in **Gazebo/ROS 2**, validating SLAM robustness across desert/urban environments

Projects

Training a Quadrotor for Obstacle Avoidance using PPO
- Implemented custom OpenAI **Gym environment** in Python for a 2D quadrotor system, incorporating **non-linear dynamics** and **gravity compensation**
- Designed multi-component reward function integrating **target reaching**, **collision avoidance**, and **boundary constraints**, validated across 30+ initial conditions
- Developed complete training pipeline using **Stable-Baselines3** for policy optimization, achieving reliable navigation in constrained environments with **multiple obstacles**

Architectural Approaches for 3D Gaussian Synthesis
- Implemented three neural architectures from scratch: **VAE, VQVAE, diffusion transformer** for generating 3D Gaussian primitives
- Designed custom loss functions incorporating geometric and appearance constraints for improved 3D primitive quality
- Created efficient training pipeline to processprocessing large-scale ShapeSplatsV1 dataset which has **65k 3D objects.** datasets using **NYU's HPC infrastructure**

Vision Based Pose Estimator for MAV
- Developed vision-based pose estimation leveraging geometric cues such as AprilTags, homography for robust state estimation in visually degraded environments.
- Enhanced motion estimation by detecting image keypoints and applying RANSAC for robust velocity calculation, resulting in reliable state estimation despite visual noise.

Multi-Robot Dataset Validation
- Developed data validation pipeline integrating **LiDAR odometry** and **global mapping** for multi-robot pose estimation.
- Implemented **Open3D**-based analysis tools to evaluate raw **LiDAR point cloud** registration, achieving mean fitness scores of $>$ **0.70** across diverse scenarios.
- Validated ground truth by comparing **GPS**, **LiDAR odometry**, and **rosbag** trajectories, achieving consistent trajectory alignment with mean **RMSE** of **0.0469m** for House and **0.0453m** for forest environments.

Technical Skills

Languages: C++, Python, MATLAB
Tools: OpenCV, PCL (Point Cloud Library), PyTorch, Docker, Git, ROS 2, SLURM
Concepts: Computer Vision, 3D Reconstruction, SLAM, Synthetic Data Generation, Deep Learning, Sensor Fusion, Robot Kinematics and Dynamics, State Estimation, Trajectory Optimization