Miheer Diwan

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Education

Worcester Polytechnic Institute

Master of Science in Robotics Engineering — GPA: 3.87   *Worcester, MA*

Mukesh Patel School of Technology Management & Engineering, NMIMS University

Bachelor of Technology in Mechatronics Engineering (Minor: Robotics & IoT) — GPA: 3.46   *Mumbai, India*

Skills

Robotics : Perception, Localization, Deep Learning, ADAS, Aerial Robotics, State Estimation, Sensor Fusion, Calibration

Software : Python, C++, ROS/ Gazebo, OpenCV, PyTorch, TensorFlow, CUDA, TensorRT, NumPy, SciPy, PCL, Open3D, scikit-learn, Matplotlib, MATLAB/ Simulink, Docker, Linux, Git, LaTeX, SolidWorks, Blender, CoppeliaSim

Hardware : DJI Tello EDU, Jetson Orin Nano, Arduino, Raspberry Pi, Yaskawa Motoman MH5, Rapid Prototyping

Architectures : YOLO, CNN, R-CNN, VGG16, ResNet18, DenseNet, LSTM, TCN, HomographNet, Transformers, NeRF

Experience

Graduate Researcher, *Perception and Autonomous Robotics (PeAR) Group*   **Aug 2023 – Dec 2023**
- Developed a **Generative**, **Procedural environment** for quadrotor simulation and learning using Blender software.
- Employed **RRT*** algorithm and **Minimum Snap Trajectory** generation to navigate a dense, simulated forest.
- Designed a **Model Predictive Control** for precise trajectory tracking and traversal of optimal trajectories.

Graduate Researcher, *Embedded Computing Lab | Github*   **May 2023 - July 2023**
- Developed **voxel-based** obstacle segmentation algorithm for autonomous vehicles on the **KITTI Stereo 2015** dataset.
- Employed **RANSAC plane fitting** to segment roads in KITTI **point clouds** and refined drivable regions with **ICP**.
- Estimated **absolute depth** from disparity maps and reconstructed 3D traffic scene using **stereo photogrammetry**.

Co-Head: Design & Simulation Department, Team Technotix, MPSTME   **2019 – 2021**
- Headed a team of 15 people to develop four mobile robots: Arrow-Shooting robot and Ball-Throwing robot.
- Secured **India National Finalist** positions in ABU Robocon 2020 and 2021, with a flawless score in the Design Phase.

Projects

Sim-2-Real Mini Drone Racing | *Github*
- Trained a **custom neural network** using synthetic data and **domain randomization** to autonomously segment windows in the real world with an accuracy of **92 %** and determined the 3D pose with **Perspective-n-Point** (PnP).
- Leveraged **Optical Flow** and Spatial Pyramid Network (SPyNet) to navigate arbitrarily shaped gaps in walls.
- Deployed the network on **DJI TelloEDU** with a **latency of 10ms** using **TensorRT** and **Jetson Orin Nano**.

EinsteinVision: Autonomous Vehicle Perception Stack | *Github*
- Developed a **perception stack** and **3D visualization** for autonomous vehicles using custom **monocular** images.
- Used **YOLOv8** for **Object Detection** and **Instance Segmentation** for vehicles, traffic signs, and pedestrians.
- Trained Cross Layer Refinement Network (CLRNet) on **TUSimple dataset** with a 97.8 % accuracy to detect lanes.
- Estimated per-pixel relative depth using **Intel's MiDaS depth model** and reconstructed 3D scene in **Blender**.

Vision-Based Localization using Non-linear Kalman Filters | *Github*
- Performed robust quadrotor pose estimation in 3D space by using Quadrotor Dynamics and **Extended Kalman Filter**.
- Developed a **vision-based observation model** to get pose-estimates from **AprilTags** and improve prediction accuracy.

Structure from Motion (SfM) | *Github*
- Extracted and matched monocular camera image features using **SIFT** descriptors and **RANSAC** algorithm.
- Estimated camera poses from Fundamental matrix and the Essential matrix based on **Epipolar geometry** constraints.
- Leveraged **PnP** to align camera poses and **triangulation** to determine camera poses adhering to Cheirality Condition.
- Performed **3D scene reconstruction** by refining camera poses using **Bundle Adjustment** and the Visibility matrix.

Neural Radiance Fields (NeRF) and Gaussian Splatting | *Github*
- Implemented the original NeRF method to synthesize novel views by optimizing a continuous volumetric scene function.
- Evaluated performance against SOTA Gaussian Splatting for **real-time** radiance field rendering on **custom dataset**.

AutoCalib: Robust Camera Calibration | *Github*
- Devised a robust camera calibration algorithm using **Zhang's** method to estimate camera intrinsics and extrinsics.
- Predicted distortion coefficients and minimized distortion errors of the camera, employing **Non-linear optimization**.