Abhijit Mahalle

amahalle@terpmail.umd.edu | Portfolio | LinkedIn | GitHub | College Park, MD

Domain skills: Robot Perception, Computer Vision, Machine Learning, Robotics Software Development, ROS, Motion Planning

EDUCATION

University of Maryland, College Park — **May 2023**
Master of Engineering, Robotics — **GPA: 3.64/4.0**
Courses: Perception, Path Planning, Robotics Software Development, Machine Learning, Deep Learning, Aerial Robotics, Control Systems

University of Mumbai, India — **May 2018**
Bachelor of Engineering, Mechanical Engg. — **GPA: 8.36/10.0**

SKILLS

Languages and Tools: C++, Python, MATLAB, ROS, Gaezbo, RViz, Linux, Git, Docker, CMake, Travis CI, Coveralls, Valgrind
Libraries: OpenCV, PyTorch, TensorFlow, NumPy, SciPy, sklearn, pandas, GTest, pytest
Deep Learning Architectures: CNN, Autoencoder, RNN, LSTM, GAN

EXPERIENCE

Perception and Robotics Group | ***Research Assistant*** — **June 2022 - Aug 2022**

- Created a real world indoor ground-truth dataset for VIO and SLAM models by fusing data-streams from 3 **event** cameras, classical camera, and 2 **IMUs** for ego-motion, depth estimation, scene segmentation, and optical flow applications.
- Utilized **Vicon** motion capture system to obtain ground truth camera and object poses and **Mujoco** simulator to get per-pixel ground truth depth and segmentation masks.
- Developed a pipeline that **calibrates** event and classical camera simultaneously by reconstructing grayscale images from event-stream using a deep learning network.

Worley | ***Machine Learning Engineer*** — **Jan 2021 - July 2021**

- Developed a **LSTM** based deep learning network to predict the production temperature of distillation columns for inference control and reduced the energy consumption by **14%**.

Jacobs | ***Piping Design Engineer*** — **Sept 2018 - Dec 2020**

- Designed piping systems using CAD tools for fluid transfer within a process plant considering chemical process requirements.

PROJECTS

Structure from Motion — **April 2022**

- Reconstructed a scene by estimating 3D position of 2D features in image sequences using **epipolar geometry**, linear and non-linear **triangulation**, and solving the **PnP** problem to estimate camera pose by minimizing the **reprojection error**.
- Refined the 3D point and camera pose estimates simultaneously using **bundle adjustment** by constructing a **visibility matrix**.
- Improved the performance of an unsupervised learning based SfM model by **7%** by replacing its encoder with **ResNet** and adding **SSIM** parameter in its loss function.

Panorama Stitching — **Feb 2022**

- Stitched multiple images to create a panorama using Harris Corner detection with **Adaptive Non-Maximal Suppression** for feature matching, **RANSAC** for removing outliers, **homography**, and **Poisson's blending** in Python.
- Developed a CNN with supervised and unsupervised approach to estimate homography by generating a custom dataset and using **photometric loss** and achieved a MSE of **55.59**.

Semantic Segmentation — **March 2023**

- Implemented a **CNN-based U-Net** architecture using **PyTorch** to perform **human segmentation** by training the model on images in the **MIT ADE20K** dataset.
- Employed forward hooks from a pre-trained Resnet-152 encoder to relay data to the custom decoder and achieved an **IOU** score of **0.73**.

Decluttering Domestic Robot — **Dec 2021**

- Developed a **ROS** package in modern **C++** in Linux by **Agile Iterative Process** with GitHub **Continuous Integration** and **test-driven development** using **Google Test** for **Tiago** mobile manipulator for indoor search and object manipulation.
- Used **MoveBase** for autonomous navigation, **MoveIt** for manipulator control, and **OpenCV** for filtering and object detection.
- Maintained **software version control** using **Git**, checked build using **Travis CI** and achieved a code coverage of **91%**.

April tag detection and tracking — **Feb 2022**

- Detected, decoded, and tracked an April Tag by background removal using **FFT** and using **Harris corner detection**.
- Superimposed a custom image and placed a **3D** virtual cube on the tag using **homography, calibration**, and **projection** matrices.

Image Denoising — **Dec 2022**

- Developed a **convolutional encoder-decoder** network with **skip connections** using **PyTorch** to remove any type of noise from images by training it on the Smartphone Image Denoising dataset and improved the performance by **10%** over the baseline model.

Robot Path Planning — **May 2022**

- Implemented **BFS, Dijkstra, A***, and **Real Time-RRT*** on **differential-drive** robots in **Python**.