Adarsh Modh

Robotics| Computer Vision| Machine Learning

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Education

University of Pennsylvania — *Philadelphia, PA*

Master of Science in Electrical and Systems Engineering — *May 2020*

Coursework - Control Systems, Estimation & Localization in Robotics, Machine Learning, Deep Learning, Machine Perception, Data Mining, Convolutional Neural Networks for Visual Recognition, Reinforcement Learning

S.V. National Institute of Technology — *Surat, India*

Bachelor of Technology in Electrical Engineering — *May 2017*

Coursework - Digital Signal Processing, Micro-controllers and Embedded Systems, Mathematics - Linear Algebra, Vector Calculus, Probability

Skills

Programming Languages	Python, C++, MATLAB, Embedded-C
Software Frameworks	PyTorch, OpenCV, OpenAI Gym, ROS, Gazebo, Docker, Linux, SLURM
Embedded System Design	Hardware Prototyping for Sensor & Peripheral Interface, Programming 8-bit & 32-bit Micro-controllers (ARM Cortex-M4)

Experience

GRASP Lab - University of Pennsylvania — *Philadelphia, PA*

Graduate Researcher, Project: **Geometric Methods in Vision and Learning**, Dr. Kostas Daniilidis — *March 2019 - PRESENT*

- Specifically contributing on problems in Multiview Geometry like Matching, Triangulation, Tracking, Reidentification.
- Currently working on a method for establishing Multi-view correspondence (3D consistent IDs) for birds inside the aviary by estimating similarity between them. which is calculated by leveraging information from geometric (sampson error) and visual models (leg-band detector).
- Contributed to the problem of 3D pose and shape estimation of Birds by fitting an articulated 3D mesh model to keypoints and masks on a multiview dataset using optimization techniques (inspired from SMPLify - a method for estimating 3D Human Pose and Shape) UPenn Aviary

Robotics Research Center - IIIT — *Hyderabad, India*

Research Assistant, Project: **Planning & Control for Autonomous Vehicles**, Dr. Madhava Krishna — *July 2017 - June 2018*

- Developed a motion planning framework which generates optimized collision-free trajectories for obstacle avoidance and lane merging.
- Designed a mid-level-controller for the autonomous car which regulates the higher-level planner commands to the lower-level controller.
- Built the Drive-by-Wire System - lower level control of steering, braking & throttle commands.
- Simulation Videos | Demonstrations on Driverless Car

Aerospace Engineering - IISc — *Bangalore, India*

Summer Research Intern, Project: **Vision-supported autonomous landing of drones**, Dr. Radhakant Padhi — *May 2016 - Aug 2016*

- Solved the problem of 3D localization on an AR.Drone by implementing an EKF to fuse information from a kinect and onboard sensors.
- Proposed a bio-inspired guidance algorithm based on Tau theory (*time-to-collision*) for precision soft landing of the drone.
- Demonstration Videos

Projects

Morphology-agnostic Visuomotor Robotic Control

- A novel approach which works within 20 seconds on a robot and with minimal prior knowledge of the robot's morphology. The method can be broadly divided into 2 parts - Self-Recognition (Learning) and Visual Servoing (Control).
- Self-Recognition: Learning the Model from a random exploration dataset consisting of action-observation pairs.
- Visual Servoing: Using the learned model to control the robot to perform tasks like 3D point reaching and trajectory following.

Object Detection

- Implemented YOLO-v1 to predict bounding boxes and classes over a dataset comprising of Pedestrians, cars and traffic signals.
- Implemented MASK R-CNN on the COCO dataset for detecting People, Animals, Vehicles. This involved implementing a 2 stage framework by first training a Backbone Region Proposal Network and then training the Regressor, Classifier and Mask Heads.

Deep Reinforcement Learning

- Learnt the dynamics for Pendulum-v0 environment in OpenAI gym using Model-Based Learning and then getting the optimal solution with a graph based planner A* over a discretized state-action space.
- Implemented algorithms like DQN and REINFORCE for solving environments like CarRacing-v0 and CartPole-v1.

Estimation and Localization

- Implemented an Unscented Kalman Filter for estimating the orientation of the Robot in quaternions using data from the IMU.
- Implemented a Landmark-based EKF-SLAM using the GPS, LiDAR and the Odometry (wheel encoders) data from the Victoria Park Dataset.