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SUMMARY

1. Graduate student in Robotics with a Bachelors in Aerospace Engineering.
2. Primary fields of interest : **Perception, Localization and Mapping, Stochastic Optimization, Generative Deep Learning**.

EDUCATION

- ***Master of Science in Robotics | University of Pennsylvania*** **Aug 2021 – May 2023**
- ***Bachelor of Technology in Aerospace Engineering | SRM Institute of Science and Technology*** **May 2016 – June 2020**

Overall GPA: ***9.52/10***
HONORS: 1. Performance Based Scholarship for 4 Consecutive years 2016-2020
2. Gold Medalist with Rank 1 in Aerospace Engineering during Undergrad

EXPERIENCE

Research Assistant (Kumar Robotics, PERCH Lab) | University of Pennsylvania **Sept 2021 - Present**

1. Working on a novel mapping algorithm that utilizes deep learning for map prediction.
2. The algorithm predicts the map one state (which could be multiple time-steps) forward based on the current belief of the map predictor network. This algorithm can be easily fused with the rest of the robot's SLAM pipeline and promises near real-time performance.
3. The algorithms involve two components; a map predictor network which is typically an LSTM and a Reinforcement learning agent, to model quadrotor dynamics.
4. The tools used for this include ROS gazebo, Nvidia Isaac Gym, C++, Python (tensorflow and pytorch), along with openCV.

Teaching Assistant (Aerial Robotics and Mobility) | University of Pennsylvania **Aug 2021 - Present**

1. Tasked with TA responsibilities for three courses (Aerial Robotics, Mobility and Capstone Project).
2. One of my responsibilities include using MATLAB to debug students' code and to make changes to coursework which includes developing simulations on MATLAB.
3. This position has given me an opportunity to improve upon my skills in aerial robotics, sensing and estimation and mobile robotics.
4. Occasionally, required to develop localization and mapping codes on MATLAB and Python, in order to be able to better explain them to students.
5. Position sometimes involves having to translate code from C++ and Python into MATLAB.

Research Intern | Welspun Corp ltd **April 2020-June 2021**

1. Tasked with the development of three Machine vision based Metrology systems and a surface defect detection system.
2. The first system included the development of a real time diameter measurement system (accuracy <0.5mm) for large steel pipes with diameters in range 324-3127 mm.
3. The second system required highly accurate measurement of Ovality and Out-of-Roundness of manufactured pipes.
4. Finally the third system required measurement of Length of pipes (range 8-18m) with an accuracy < 5mm.

Research Intern | Indian Institute of Space Science and Technology **May 2019-July 2019**

1. Tasked with the Design of a 10mN Micro-thruster for Space Applications. Key areas of work included, modelling partial slip at walls of Micro-Nozzle to accommodate rarefied flow.
2. Selection of Propellant for Cold gas thruster. (Nitrogen was chosen)
3. Choice of Solenoid Valve and integration into the Thruster.

Research Intern | Mahindra Automotive ltd **May 2018-July 2018**

1. Tasked with the reduction in the variability of results produced by the TTT (Torque to Turn).
2. Optimizing the LBLT (Long block Leakage Testing Machine) for better estimations of Leakage from engine blocks.
3. Developed some novel Leakage testing methods for Industrial applications. (Transverse Piezoelectric Plugs).

PROJECTS

- ***Autoencoder based Predictive Mapping for autonomous quadrotors (Ongoing)***

1.The aim of this Project was to increase the speed and reliability of mapping of indoor environments. The algorithm developed allowed the robot to predict the map before having seen it.
2.An autoencoder was trained on images of partially occluded floor plans and was tasked with predicting the map of the environment for the next time-step. This approach significantly decreased the time taken to map indoor environments.

- ***Generative Network for representing image data into sparse and low-storage space demanding representation.***

1.The aim of this project is to convert colour image data in a representation that occupies less space. The approach taken for this purpose was to convert images into their respective Laplacian images and train a GAN to translate from the Laplacian to the image itself.
2.The Laplacian of an image occupies lesser amount of space and contains lesser information than the whole image itself. The Laplacian image was chosen as the preferred way of representation because the Laplacian images contain sufficient amount of colour information to allow the GAN to reconstruct the image. Currently other non-image representations are also being considered.

- ***Fully Convolutional Neural Network inspired by Pyramid Scene Parsing Network for Image semantic segmentation.***

1.A Fully Convoluted Neural Network inspired by PSPNet was developed for Image segmentation.
2.Two iterations of the neural network were implemented, one using pre-trained DenseNet201 as backbone and the other using a ResNetV2 architecture implemented from scratch as a backbone.

- ***Development of Real time A.I. assisted Non-contact Diameter Calculation System for Spiral Pipes during Forming.***

1.Developed a real time diameter calculation system using Keras and OpenCV for Welspun Corp Ltd.
2.Obtained accuracy in calculating diameter was < 1 mm operating at >30fps.

- ***Fully Convolutional Network augmented by pre-trained VGG16 for Image Segmentation.***

1.A Fully Convolutional Network was implemented from scratch for Image semantic segmentation.
2.Specific layers from the pre-trained VGG16 were used in the encoder block of the FCN.

- ***Implementation of U-Net augmented with pre-trained MobileNet Architecture for Image segmentation.***

1.A Neural Network was implemented using the U-Net architecture for image segmentation.
2.The network's performance was further improved by transferring layers from a pre-trained MobileNet architecture to the U-Net's encoder.

- ***Synthetic data generation using a Fully Convolutional Autoencoder. (Ongoing)***

1.This project was aimed at generating synthetic data for training neural nets. The data synthesized could potentially be any image data.
2.The images were fed into a pretrained autoencoder and latent vectors/ embeddings were generated. A global optimization routine was then made that produced a family of "displacements" that converted the embeddings from one form to another (to get sensible data). The family of "displacements" was then extrapolated and interpolated to generate new data.

- ***Implementing U-Net and Mask R-CNN for Image segmentation on the Oxford IIIT Pet dataset.***

1.The U-Net architecture was implemented from scratch in tensorflow 2.x and was trained to segment images from the Oxford IIIT Pets dataset. Further Mask R-CNN was implemented for image segmentation, this time transfer learning was leveraged using tensorflow hub.

TECHNICAL SKILLS

- Sensor fusion, Localization and Mapping, Deep Learning and Machine Learning (keras, tensorflow, pytorch, scikit learn, creme), computer vision (OpenCV, simpleCV, glounCV), C, C++ (OpenCV, STL, Eigen, OpenMP), Matlab, Julia.