

# FNU ABHIMANYU

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## EDUCATION

### Carnegie Mellon University – School of Computer Science

Pittsburgh, PA

Master of Science in Robotics | GPA: 3.61/4.0

August 2023

**Courses Taken:** Computer Vision, Deep Reinforcement Learning and Control, Visual Learning and Recognition, Learning for 3D Vision, Intro to Machine Learning, Geometry-based Methods in Vision

### Birla Institute of Technology and Science, Pilani

Goa, India

Bachelor of Technology in Mechanical Engineering | GPA: 8.52/10

August 2019

**Courses Taken:** Robotics and Mechanism, Control Systems, Modern Control Systems, Computational Physics

## SKILLS

**Programming:** Python (5+ years exp.), MATLAB (4+ years exp.), C++ (2+ years exp.)

**Software and Libraries:** PyTorch, OpenCV, ROS, Pytorch3D, Scikit-image, Numpy, Open3D, CoreML, MUJOCO, Pybullet, TensorFlow, UR-Script, Git, Blender, Gazebo, 3D Slicer, Google Colab, Docker

## RESEARCH EXPERIENCE

### Carnegie Mellon University (CMU)

08/2019 – Till Date

#### Research Staff under the guidance of Dr. Howie Choset, Biorobotics Lab

##### E-waste recycling

- **Develop 3D model** of smartphones using RGB-D sensor for rendering synthetic smartphones images for augmenting smartphone dataset from 75% to 89%.
- Implemented **FastRCNN** and **YOLOv5** in PyTorch to localize and predict 2D bounding-box over smartphones on the conveyor belt in a recycling factory.
- Developed a multi-modal (RGB+X-Ray) CNN-based object classifier (**iCAM**) using an iterative attention module to improve classification score from 89% to 98%. (**IROS'22** and **featured on the Apple Machine Learning forum [LINK]**).
- Formulated a **supervised semantic segmentation pipeline** with contrastive loss to efficiently segment components in e-waste, improving IoU score over vanilla U-Net by 6%.
- Anomaly detection on X-Ray images of smartphones using **SuperPoint** & **SuperGlue** keypoint detection method.
- **Led a research team** of staff, undergraduate and graduate students at CMU to improve the performance of an e-waste recycling plant in collaboration with Apple Inc. (**Highlighted in Apple Environmental Progress Report 2023**).

##### Medical Robotics

- Developed an **unsupervised CNN-based non-linear registration algorithm (U-RAFT)** to predict deformations in ultrasound images under the application of different forces (**Submitted to IROS'23**).
- Developed a PyTorch package using deep learning-based non-linear registration to reduce pixel movement by 78% in lung ultrasound images affected by breathing motion (**Accepted at RAMI workshop ICRA'23**).
- Create **3D reconstruction of vessels** using ultrasound NeRF from ultrasound images.
- Implemented **Segmentation Anything (SAM)** model for segmenting vessel and compared it to **U-Net's** performance.
- Developed and implemented force-controller for automating ultrasound scanning using a UR3e manipulator.
- Reduced human intervention for ultrasound scanning for a Robotics Ultrasound System (RUS) using **Gaussian process regression** and **Bayesian Optimization (Accepted at ICRA'22 [LINK])**.

### Indian Institute of Science (IISc)

06/2018 – 06/2019

#### Research Intern under the guidance of Dr. Shishir Kolathaya, Robert Bosch Center for Cyber Physical Systems

- Implemented a lower-level locomotion controller of a 12 DOF quadruped (Stoch2) for dynamic gaits like galloping and bounding (**[LINK]**).
- Implemented reinforcement learning models on microcontrollers such as RaspberryPi and BeagleBone for real-time control of a 12 DOF quadruped (Stoch1.0).

## COURSE PROJECTS

### Flow prediction for ego-motion using epipolar constraint (CMU)

09/2022 – 12/2022

- Employed the epipolar constraints to improve the performance of flow prediction networks such as **Flownet** and **RAFT** on the KITTI dataset by 45%.
- Developed a weakly supervised method using camera geometry to classify dynamic vs static points in RGB images.

### Predicting deformation in 3D shapes in the presence of an external force (CMU)

02/2022 – 05/2022

- Implemented a **conditional VAE model** to predict deformation in 3D point clouds using Pytorch3D and Open3D.
- Developed an automated pipeline to create a deformed 3D point cloud dataset using ANSYS.

### Novel view generation using NeRF (CMU)

02/2022 – 05/2022

- Implemented a differential renderer module in Pytorch3D and used it to train **NeRF model** on real-world images.

### 6D pose estimation using NVIDIA DOPE (CMU)

07/2021 – 09/2021

- Implemented 6D pose estimation of kitchen appliances using NVIDIA DOPE and improved it using domain randomization.