Pranay Mathur

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RESEARCH INTERESTS AND SKILLS

Robot Operating System, Computer Vision, Deep-Learning, C, C++, Python, Java, MATLAB, PyTorch, TensorFlow, CUDA, Linux, Github

EDUCATION

M.S Robotics — Georgia Institute of Technology — **Aug 2022 – May 2024***

B.E Electronics and Instrumentation — BITS Pilani, K.K Birla Goa Campus — CGPA 8.87/10 (Dept. Rank 3) — **Aug 2017 – July 2021**

EXPERIENCE

MathWorks — *Engineering Development Group Intern* | Natick, MA **May 2023 – Aug 2023**

- Added and integrated features into the Simulink Test Toolbox scheduled for release in the MATLAB & Simulink R2024a version
- Improved performance achieving a 70% speed-up over original time in the C++ and MATLAB back-end of the toolbox
- Worked in JavaScript on the front-end of a project which ranked 2nd of 100+ teams in the company-wide Hackathon

Google Summer of Code — *Open-Source Developer* | Remote **June 2022 – Aug 2022**

- Built a **Landmark Mapping** algorithm for path-finding in a scale **autonomous race-car** exploiting known camera intrinsics
- Used 3D multi-view geometry and known geometry of the landmarks to project their position from image space into the world frame
- Used model compression of EfficientDet to **improve inference** speed to **22 FPS** on a Raspberry Pi with Coral Edge TPU accelerator

Addverb Technologies — *Graduate Engineer Trainee, Mobile Robotics* **|** India **Aug 2021 – July 2022**

- Prototyped **appearance-based Navigation** of ground-based robots using semantic-scene understanding and ML for image retrieval
- Performed system integration of autonomous mobile-robots (**AMR**) with **cloud control** based capabilities over **5G** networks
- Deployed a system for augmenting LiDAR based **SLAM** and executing **recovery behaviour** in mobile robots deployed in warehouses

TechnoYantra (acquired by Acceleration Robotics) **—** *Intern* | India **Jan 2021 - Aug 2021**

- Developed a **localization** algorithm using Extended Kalman Filter (EKF) for fusion of pose estimates from **fiducial tags** and particle-filter based LiDAR SLAM for robot deployment in healthcare institutions, agriculture and warehouses

University of Nevada, Reno — *Undergraduate Researcher* **|** Reno, NV **July 2020 - Jan 2021**

- Developed a generalizable Resource-Aware algorithm for deployment of **Visual Inertial Odometry** algorithms on computationally constrained aerial vehicles under the guidance of **Prof. Kostas Alexis**
- **Released and maintain two packages in ROS and ROS2** incorporated into **ROS-perception** and presented the work as a **Lightning Talk** at a **ROS Conference - ROS World 2020**

KPIT Technologies — *Technical Intern* **|** India **May 2020 - July 2020**

- Worked and published results on **multi-modal sensor fusion** based Object Detection using 3D LiDAR, monocular RGB camera and a RADAR which **improved detection** performance on occlusion and low illumination in **self-driving cars**

CSIR - Central Electronics Engineering Research Institute, Pilani — *Research Intern* **|** India **May 2019 - July 2019**

- Implemented RTAB-Map **SLAM** for **Autonomous Navigation of Quadcopters** using PX4 and ROS in **visually-degraded and GPS denied** environments using an RGBD camera
- Implemented **non-linear optimization** based multi-sensor fusion and probabilistic noise removal as pre-processing for vision frontend

PUBLICATIONS

Sparse Image based Navigation Architecture to Mitigate the need of Precise Localization in Mobile Robots
Pranay Mathur, Rajesh Kumar, Sarthak Upadhyay - arXiv, 2022

Resource-aware Online Parameter Adaptation for Computationally-constrained Visual-Inertial Navigation Systems
Pranay Mathur, Nikhil Khedekar, Kostas Alexis - IEEE-RAS International Conference on Advanced Robotics, 2021

A Generalized Kalman Filter Augmented Deep-Learning based Approach for Autonomous Landing in MAVs *(Best Paper Award)*
Pranay Mathur, Yash Jangir, Neena Goveas - IEEE International Symposium of ACA on Intelligent Robotics and Industrial Automation, 2021

Multi-Sensor Fusion-Based Object Detection Implemented on ROS
Pranay Mathur, Ravish Kumar, Rahul Jain - Springer International Conference on Machine Learning and Autonomous Systems, 2021

BCI Controlled Quadcopter using SVM and Recursive LSE Implemented on ROS
Kshitij Chhabra, **Pranay Mathur**, Veeky Baths - IEEE International Conference on Systems, Man and Cybernetics, 2020

AWARDS AND POSITIONS OF RESPONSIBILITY

Best Paper Award - IEEE IRIA, **Mantra Innovator of the Year** - CEL, BITS Goa, **Prof. Suresh Ramaswamy Memorial Award for Best Project**- BITSAA International, **Teaching Assistant** – Computer Vision, Principles of User Interface Software, Signals and Systems, Microelectronic Circuits

COURSES

Computer Vision, Deep-Learning, Data Structures and Algorithms, Object Oriented Programming, Microprocessors and Interfacing, Digital Image Processing, Signals and Systems, State Estimation and Localization for Self-Driving Cars, Linear and Non-Linear Control Systems

PROJECTS

Long-Horizon Imitation Learning by watching Human Play Data **Aug 2023 – Present**
Faculty Advisor: Dr. Danfei Xu, Assistant Professor at Georgia Tech and Research Scientist at NVIDIA AI

- Working on building novel algorithms to advance SOTA in robot **policy learning** through human demonstration and behavior cloning
- Trained baseline methods and built a transformer based architecture implemented on the ALOHA bimanual robotic platform

Long-Horizon planning of Next-best-view of NeRFs **Aug 2023 – Present**
Faculty Advisor: Dr. Danfei Xu, Assistant Professor at Georgia Tech and Research Scientist at NVIDIA AI

- Working on building novel algorithms to perform sparse reconstruction of neural radiance fields
- Implementing and evaluating multiple baselines to compare our proposed approach

Human-Motion Prediction: With great power comes great res-pose-ability (GitHub) (Report**)** **Jan 2023 – May 2023**
Faculty Advisor: Dr. Zsolt Kira, Assistant Professor at the School of Interactive Computing

- Worked on **Transformers and Convolutional Seq-to-Seq models** for human-motion prediction on computationally-constrained systems implemented in PyTorch
- Achieved comparable performance to several baselines implemented in the fairmotion library at reduced computational costs

Drone Delivery Using SLAM and Object Avoidance (GitHub) **May 2019 - July 2021**
Faculty Advisor: Dr. Sarang C. Dhongdi, Assistant Professor, Dept. of EEE

- Developed an algorithm for autonomous navigation of drones in GPS-denied environments using RTAB- Map V-SLAM and an RGBD camera
- Developed custom computer vision algorithms using CNN based attention maps for obstacle recognition and avoidance implemented in Tensorflow and OpenCV
- Selected for funding by the EEE Dept. and Sandbox Fabrication Lab, BITS Goa

Autonomous Landing of MAVs using a Kalman Filter and Faster-RCNN (Paper) **Jan 2021 - July 2021**
Faculty Advisor: Prof. Neena Goveas, Associate Dean & Prof. BITS Goa

- Developed an algorithm for autonomous landing of MAVs exploiting transfer learning to eliminate the need for fiducial markers on landing sites
- Used the Faster-RCNN architecture implemented in Tensorflow along with a Kalman Filter based controller deployed using the PX4 stack and mavros

Drone Control using Brain Wave Mapping (GitHub) (Paper) **Dec 2018 - July 2021**

Faculty Advisor: Dr. Veeky Baths, Associate Professor, BITS Goa

- Fabricated a BCI based Quadcopter using SVM based classification and Recursive Least Square Estimation for robust control
- Built framework using Processing3, Python, Emotiv, Robot Operating System (ROS), and the PX4 flight control stack
- Received the prestigious Prof. Suresh Ramaswamy Memorial Award for the project

- **Human Machine Teaming — DRDO** (Certificate) **Jun 2018 - Apr 2019**

Faculty Advisor: Prof. Neena Goveas, Associate Dean and Prof. BITS Goa

- Contributed to a project on Human- Machine collaboration and swarm robotics for the Defence Research and Development Organization
- Simulated a mission-plan involving a swarm of quadcopters on RotorS
- Deployed using ROS (Robot Operating System), Python, RotorS and Gazebo

Project Kratos – Mars Rover (LinkedIn) (GitHub) **Dec 2017 - Jun 2019**
Faculty Advisor: Dr. Toby Joseph, Dept. of Physics, BITS Goa

- Contributed in building a Mars Rover that ranked 10th of 25 teams in the Indian Rover Challenge
- Lead the communication sub-system and implemented a scheduling algorithm to transmit multiple camera and data feeds with minimal latency
- Set up Communication Networks using the Ubiquiti Networks Platform and automated processes using BASH scripting in Linux

Stabilisation of UAVs using Gyroscope and Accelerometer (GitHub) **Dec 2017 - Jun 2018**

- Implemented a PID controller using gyroscope and accelerometer data from an Inertial Measurement Unit (IMU) for stabilization of aircraft in adverse operating conditions
- Used an MPU 6050 Inertial Measurement Unit and an Arduino Mega 2560 microcontroller