

# Pranay Mathur

pranay.mathur@gatech.edu | [in](#) pranay-mathur1998 | [G](#) Matnay | [@](#)matnay.github.io | +14049335405

## RESEARCH INTERESTS AND SKILLS

Computer Vision, SLAM, Deep-Learning, Robot Operating System, C++, Python, Tensorflow, OpenCV, Linux, MATLAB, Github, Java, LATEX

## EDUCATION

M.S Robotics	Georgia Institute of Technology	Aug 2022 – 2024 (Exp.)
B.E Electronics and Instrumentation	BITS Pilani, K.K Birla Goa Campus	Aug 2017 – July 2021

## EXPERIENCE

Engineering Development Group Intern — MathWorks May 2023 – Present

- Added feature to the Simulink Test Toolbox scheduled for release in MATLAB & Simulink 2024a
- Improved performance of features in the toolbox achieving a 20% speed-up over original time

Developer — Google Summer of Code June 2022 - Present

- Built a path-finding algorithm for an **autonomous vehicle** using **Efficient-Det** architecture and **mapped landmarks** exploiting known camera intrinsics and landmark geometry
- Ported Efficient-Det to TFlite and **improved inference** speed to **22 FPS** on a Raspberry Pi using Coral Edge TPU

Graduate Engineer Trainee — Addverb Technologies, Noida Aug 2021 – July 2022

- Worked on **appearance-based Navigation** of ground-based robots using semantic-scene understanding
- Integrated autonomous mobile-robots with **5G cloud-control** based capabilities using web-sockets and ROS
- Deployed system for augmenting LiDAR based **SLAM** and executing **recovery behaviour** in mobile robots

Intern — Technoantra, Pune Jan 2021 - Aug 2021

- Developed a **localization algorithm** using EKF based fusion of pose estimates from **fiducial tags** and particle-filter based LiDAR SLAM

Undergraduate Researcher — University of Nevada, Reno, USA 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 **ROS-World 2020**

Technical Intern — KPIT Technologies, Pune May 2020 - July 2020

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

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

- Implemented RTAB-Map **SLAM** for Autonomous Navigation of Quadcopters using PX4 and ROS in **visually-degraded GPS denied** environments using an RGBD camera
- Implemented multi-modal sensor fusion and visual noise-removal using classical image processing

## 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**  
Pranay Mathur, Yash Jangir, Neena Goveas - IEEE International Symposium of Asian Control Association 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** - BITSAA International,  
**Teaching Assistant** – Computer Vision, Principles of User Interface Software, Signals and Systems, Microelectronic Circuits

## COURSES

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

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### Human-Motion Prediction: With great power comes great res-pose-ability

Jan 2023 – May 2023

- Worked on Convolutional Seq-to-Seq models for human-motion prediction on computationally-constrained systems
- 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 classification and Recursive LSE
- Worked with Processing3, Python, Emotiv, Robot Operating System (ROS), mavros
- Received the prestigious Prof. Suresh Ramaswamy Memorial Award

### Human Machine Teaming — DRDO

Jun 2018 - Apr 2019

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

- Contributed to a project on Human Machine Teaming and swarm robotics for the Defence Research and Development Organization ([Certificate](#))
- 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 10<sup>th</sup> 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 IMU for stabilization of aircraft in adverse operating conditions
- Used an MPU 6050 Inertial Measurement Unit and an Arduino Mega 2560 microcontrollers