MANTHAN PATEL

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EDUCATION

ETH Zurich, Switzerland **CGPA: 5.77/6.00**
Robotics, Systems and Control M.Sc. *September 2021- August 2023 (expected)*

Indian Institute Of Technology Kharagpur, India **CGPA: 9.65/10.00**
B.Tech in Mechanical Engineering with micro-specialisation *July 2017- May 2021*
in Entrepreneurship and Innovation

RESEARCH INTERESTS

Computer Vision | SLAM | Path planning | Optimal Control | Field Robotics

HONORS AND AWARDS

2021 **ETH D-MAVT Scholarship** *ETH Zurich*
Awarded scholarship by D-MAVT, ETH Zurich for outstanding academic and co-curricular achievements

2021 **Dr. B C Roy Memorial Gold Medal** *IIT Kharagpur*
Adjudged best all-rounder among all graduating B.Tech students

2021 **Institute Silver Medal (Academic Rank 1)** *IIT Kharagpur*
Highest CGPA in the Department of Mechanical Engineering among graduating B.Tech students

2020 **DAAD WISE Scholarship** *German Academic Exchange Service*
Recipient of the prestigious scholarship to perform a research internship at a German Research Institute

2020 **OP Jindal Engineering and Management Scholarship** *O P Jindal group*
Recipient of the scholarship awarded to 100 students across India for academic and leadership excellence

2019 **27th Intelligent Ground Vehicle Competition (IGVC)** *Michigan, USA*
Secured the second position in the AutoNav Challenge among 40+ participating international teams

TECHNICAL SKILLS

- **Programming** : C, C++, Python, MATLAB, ROS, OpenCV, PCL, Open3D, PyTorch, Linux, Docker
- **Software** : Gazebo, Airsim, Unreal Engine, Git, Solidworks, Cura, Mission Planner
- **Hardware** : Nvidia Jetson TX2/Nano, PixHawk, Ras-Pi, Arduino, Odroid

RESEARCH EXPERIENCE

Map-Fusion for Multi-agent VI-SLAM **ETH Zurich**
Guide: Prof. M Chli, Vision for Robotics Lab *March 2022 - present*

- The goal is to integrate a Visual-Inertial-Odometry front-end to the current state-of-art Collaborative Visual Inertial SLAM framework and improve the loop-closure detection and map-merging strategies

Lidar-directed Object detection in Subterranean environments **ETH Zurich**
Guide: Dr. S Khattak, Robotic Systems Lab *July 2021 - Dec 2021*

- Developed a clustering-based artifact proposal pipeline for SubT environments using Lidar range and intensity
- Deployed on ANYmal-C quadruped to facilitate the long-range object detection using a mounted PTZ camera
- Demonstrated artifact detection upto range of 12 metres on the dataset collected at DARPA SubT Challenge

Mapping of Archaeological Sites using UAVs (Bachelor Thesis) **IIT Kharagpur**
Guide: Dr. A Ahmad *MPI-Intelligent Systems, Tuebingen*
Co-Guide: Prof. A Bandopadhyay *May 2020 - April 2021*

- Developed and open-sourced a novel archaeological simulation environment for AirSim [Link]
- Implemented a collaborative SLAM approach for a team of UAVs and extended it for archaeological mapping
- Demonstrated the collaborative mapping of the Sadra Fort (13th Century Indian Fort) with multiple UAVs
- Implemented an RRT* based informative path-planning approach for autonomous archaeological mapping
- Extended the approach to multi-UAVs using a bounded-distributive strategy for mapping larger sites [Thesis]

Autonomous Ground Vehicle Research Group **IIT Kharagpur**
Guide: Prof. D Chakravarty *Feb 2018 - April 2021*

- Designed and implemented control strategies for efficient path tracking of Ackermann steering based vehicles using optimal control methods like Linear Quadratic Regulator and Model Predictive Control [Link]
- Designed the control systems, localization and sensor integration for Mahindra e2o driverless car [Link]
- Built an autonomous differential-drive robot which could navigate in constrained environment [Link]

Multi-agent Exploration and Mapping in GPS-denied environments **IIT Kharagpur**
Guide: Prof. A Bandopadhyay *August 2019 - April 2021*

- Implemented a receding horizon-based RRT planner to perform information gain-based multi-agent exploration with failure recovery in GPS-denied environments in simulation and real-test platforms [Link]
- Designed and developed a swarm of four UAVs (3 Quadrotors and 1 Hexcopter) for testing and evaluation

PROJECTS

D.R.D.O. SASE's UAV Fleet Challenge **IIT Roorkee**
Mission Strategist, simulation and path planning developer *Oct 2019 - Dec 2019*

- Conceptualized and implemented efficient mission planning strategy, finite state machine and path planning algorithm for a UAV fleet to scan and search described targets in given arena in least time. [Link]
- Contributed to the hardware design and development, simulation and testing of four Quadrotors

Autonomous Agricultural Robot **IIT Bombay**
Control Systems and Embedded Team *Nov 2018 - Dec 2018*

- Developed a low-cost autonomous agri-robot with capabilities of autonomous fruit plucking and seed-sowing
- Designed the controller for the 4-DOF Robotic arm, trajectory tracking and electronic architecture [Link]

RELEVANT COURSEWORK

Vision Algorithms for Mobile Robotics | 3DVision* | Deep Learning for Autonomous Driving* | Probabilistic Artificial Intelligence | Intro to Machine Learning* | Planning and Decision Making for Autonomous Robots | Robot Dynamics | Recursive Estimation* | Dynamic Programming and Optimal Control ** means ongoing course*

COURSE PROJECTS

- **3D Vision**: Working on learning-based methods for the task of reassembly of 3D fractured objects
- **Vision Algorithms for mobile Robotics**: Implemented a Visual Odometry pipeline from scratch in MATLAB along with local Bundle Adjustment and evaluated the pipeline on 3 different datasets. [Link]
- **Planning and Decision Making for Autonomous Robots**: Implemented an RRT-based global planner and MPC-based trajectory tracking for navigation of a spaceship in simulation. [Link]
- **Probabilistic Artificial Intelligence** : Projects on (1) Bayesian Neural Network for classification on MNIST dataset, (2) Constrained Bayesian Optimization using Expected Improvement as the Acquisition function, (3) Advantage Actor Critic method for learning policy to land space-ship in a simulation-environment

LEADERSHIP

2019 - 2020	**Head, Technology Robotix Society**	*IIT Kharagpur*
	Led a 3-tier team of 42 people for organising Robotix'20, India's biggest college robotics fest	
2017 - 2018	**Volunteer, National Service Scheme (NSS)**	*Kharagpur*
	Awarded with silver medal for impeccable social service in the direction of rural empowerment	

TEACHING EXPERIENCE

- **IEEE Winter Workshop Mentor**: Mentored a batch of 40 students in a week-long workshop on concepts of autonomous robotics. Supervised them to solve the problem statement of building a self-balancing robot.
- **KRAIG Mentor**: Designed and delivered classes on basic concepts of robotics and arduino programming to an audience of 150 freshmen as a part of the Kharagpur Robotics and Artificial Intelligence Group

RESEARCH PUBLICATIONS

- **M Patel** (2021)*"Mapping of Archaeological Sites using UAVs"* Bachelor Thesis
- **M Patel**, A Bandopadhyay and A Ahmad (2021).*"Collaborative Mapping of Archaeological Sites using multiple UAVs"* In: 16th Intelligent Autonomous Systems (IAS-16), Singapore Preprint
- A Patnaik, **M Patel**, V Mohta, H Shah, S Agrawal, et al. (2020). *"Design and Implementation of Path Trackers for Ackermann Drive based Vehicles"* ArXiv Preprint
- **M Patel**, et al. (2020).*"A Proposal of FPGA-based Low Cost and Power Efficient Autonomous Fruit Harvester"* In: 6th International Conference on Control, Automation and Robotics, Singapore IEEE Xplore
- **M Patel**, et al. (2019).*"A Prototype of an Intelligent Ground Vehicle for constrained environment: Design and Development"* In: 2nd International Conference on Control and Robot Technology, S Korea ACM Lib

REFERENCES

1. **Dr. Shehryar Khattak** (skhattak@jpl.nasa.gov)
   Robot Technologist, Perception Systems Group, Jet Propulsion Laboratory, USA
2. **Prof. Aamir Ahmad** (aamir.ahmad@ifr.uni-stuttgart.de)
   Tenure-Track Professor, Institute for Flight Mechanics and Controls, University of Stuttgart, Germany
3. **Prof. Aditya Bandopadhyay** (aditya@mech.iitkgp.ac.in)
   Assistant Professor, Department of Mechanical Engineering, IIT Kharagpur, India