Ansh Sanjaykumar **Shah**

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Education

BITS Pilani, Pilani Campus

Pilani, India

MSc. in Physics and BE. in Mechanical Engineering : **CGPA: 7.54/10** *Jul. 2018 - May. 2023*

- **Electives**: Engineering Optimization, Non-linear Dynamics & Chaos, Pattern Recognition, Vibrations & Controls, Mathematical Methods of Physics, Computer-Aided Design, Reverse Engineering & Rapid Prototyping, Automotive Technology, Theory of Relativity, Intro to Astronomy & Astrophysics

Experience

RRC, IIIT Hyderabad under Prof. Madhava Krishna

Hyderabad, India

Research Associate *Jan. 2023 - Present*

- **Centralized Multi-Agent SLAM with Findernet** for **MathWorks**:
  - Created a Centralized Multiagent SLAM pipeline and conducted qualitative analysis on posegraph optimisation using various optimizers: Gauss-Newton, Levenberg-Marquardt, Graduated Non-convexity + LM.
  - Implemented and integrated Findernet, deep learning based loop detection and closure system, into a custom centralized multi-agent SLAM pipeline using the GTSAM library.
  - This project elevated my knowledge on different kind of optimisation techniques and deep learning architecture structures. The culmination of this project was submitted to MathWorks. **[GITHUB] [FINDERNET]**
- **Distributed Decentralized Multi-Agent SLAM** system for **DRDO (Defence Research & Development Organization)**:
  - Improved posegraph optimisation in VINS-MONO, a popular Visual Inertial Odometery system by replacing Ceres Solver with GTSAM. This increased the optimisation speed by 6 folds and increase the outlier rejection capabilities of due to state of the art outlier rejection method GNC(Graduated Non-Convexity). Loop detection and closure threshold was relaxed by replacing ORB descriptors with NetVLAD descriptors to increase loop closures relying on robust outlier rejection.
  - Implemented a communication tool box using web sockets to establish communication between drones to transfer relevant information for distributed decentralized SLAM. A collaborative mapping toolbox was created to collect information from all drones and reconstruct a meshed map using Voxblox.
  - This work introduced me to the research front of swarm communication and planning protocols. It also enriched my knowledge on posegraph optimisation and vision based techniques for loop closure detection and registration. The culmination of this project was submitted to DRDO, securing important funds for the lab. **[GITHUB]**
- **Teaching Experience**: Created study material and Delivered lectures on the topic of **Graph Based SLAM** in the Mobile Robotics course at IIIT Hyderabad, under the guidance of Prof Madhava Krishna. Also, created tutorials for the GTSAM library, facilitating hands-on graph slam exercises in the class.**[TUTORIAL]**

Maybank

Banglore, India

Full Stack Developer Intern *Jul. 2022 - Dec. 2022*

- Developed modular components for PESTOS, an in-house corporate loan origination system, using Spring MVC, Spring Boot, and React.js, replacing an inflexible IBM system. The in-house solution, tailored to banking workflows and bureaucracy, now serves as a customizable product for other banks.
- Improved on workflows by creating and implementing additional steps and pages for relevant information display. Developed modular information windows for efficient data presentation. Created front-end React modules and backend tables, along with Spring MVC web services, to seamlessly integrate and facilitate these workflow changes.
- Provided guidance to a junior intern, imparting knowledge about the product and mentoring her in acquiring skills such as React.js, Spring MVC, and other tools essential for the role.
- During the internship, I learned the importance of coding by convention for streamlined team collaborations. Additionally, I honed my general coding skills, further refining my abilities in this professional setting. **[INTERNSHIP LETTER]**

Apress

Technical Reviewer of the book: Deep Reinforcement Learning in Unity by Abhilash Majumder *Aug. 2020 - Sep. 2020*

- Validated Unity and Reinforcement Learning code, executed package installations, and conducted manuscript proofreading. **[PREFACE]**

Plastic Water Labs Private Limited

Research Intern *May. 2020 - Jun. 2020*

- Developed Machine Learning models and simulated a factory environment using Unity and TensorFlow for the identification and segregation of broken water bottles on a production line.
- Explored Augmented Reality/Virtual Reality (AR/VR) and implemented small-scale projects in Reinforcement Learning using the Unity ML toolkit.
- Conducted got an opportunity to be a technical reviewer of the book "Deep Reinforcement Learning in Unity", drawing upon knowledge gained during the internship experience. **[INTERNSHIP LETTER]**

Projects

Quadruped
Pilani, India

Treasurer and Robotics Engineer, Team BITS Robocon — *Feb. 2019 - May 2021*

- Successfully led a project pitch for Team BITS Robocon to BITSAA(BITS Alumni Association) to acquire a sum of approximately $15000.
- Worked on designing and 3D printing the prototypes of quadruped. Researched about different designs and materials for 3D printing.
- Researched on different gait patterns and incorporated reinforcement learning into the research thread under Prof Amit Rajnarayan Singh, Mechanical Department, BITS Pilani. **[GITHUB]**

Autonomous Drone
Pilani, India

Treasurer and Robotics Engineer, Team BITS Robocon — *Feb. 2019 - May 2021*

- Spearheaded the development of Autonomous drone project at Team BITS Robocon for a new research thread and a DRDO project proposal, addressing communication restoration in earthquakes and hurricanes using tethered drones.
- Assembled the drone which consisted of basic drone parts, PixHawk, Raspberry Pi, and Depth Sensors. Worked on establishing communication between Raspberry Pi/Intel NUC and PiwHawk using MAVLink to add additional functionality like collision avoidance and more complex planning and mapping task.
- Conducted research on constant force springs and AC power systems to transmit power through the tether for the tethered drone project.
- Executed GPS and Altitude checkpoints based automated flights, utilizing Pixhawk. **[GITHUB]**

Flipkart Grid 3.0 Robotics Challenge
Pilani, India

Computer Vision and ROS Head — *Jul. 2021 - Sep. 2021*

- Problem Statement : To develop central monitoring/navigation system (such as a camera or multiple cameras) should be used to understand the arena and the position of the robots and instruct robots on action to be taken.
- Implemented a multi-robot localization and planning system using a single. Used aruco codes for precise robot localisation and implemented path planning algorithms in multi-robot scenario. Also embedded my teams work into ROS packages for modularity.
- Advanced to round 2 of the Flipkart Grid Challenge 3.0. This project helped me refine my skills on ROS and computer vision which i learned in a course Pattern Recognition. **[VIDEO] [CERTIFICATE]**

Micromouse
Pilani, India

Robot design and Controls Head — *Jun. 2019 - Feb. 2020*

- Took part in multiple competition as a hobby. Implemented Path Planning Algorithms like Dijkstra and A* with different heuristics
- Implemented Kalman Filter to get better odometry estimates and account for wheel slipping. Used an IMU and the wheel encoders. Developed multiple prototypes to deal with traction and maneuverability problems.
- This project refined my skills on robot building, algorithm implementation and code debugging. **[GITHUB]**

CRONUS: A Quadrupedal + Holonomic Drive surveillance bot
Pilani, India

Apogee Design Challenge — *Nov. 2019*

- Cronus is a design idea of a surveillance robot. It's a cyborg of Quadruped and Holonomic drive mechanisms. Developed for technical design competition with a team of three.
- Worked on deigning and manufacturing of the robot from chassis building to electronic system. The robot consisted of 4 DC motors, 8 Servos as manipulators.
- Implemented OpenCV based person recognition and tracking on a raspberry pi and the mobile platform with complex drive mechanics. **[GITHUB]**

Awards

2021 **Silver Medal,** The 2021 University Physics Competition