Rohan Baijal

First Year PhD Student · University of Washington

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Education

2023 - **Ph.D.**, Dept. of Computer Science and Engineering, University of Washington, USA *GPA: 4.0*

May 2023 **Bachelor of Technology**, Dept. of Electrical Engineering, IIT Kanpur, India *GPA: 9.1/10*

May 2019 **Grade XII (CBSE)**, St. Columba's School, New Delhi *Percentage: 98.4%*

May 2017 **Grade X (CBSE)**, St. Columba's School, New Delhi *CGPA: 10/10*

Field of Interest

- Robotics, Bayesian Motion Planning, Reinforcement Learning, Deep Learning, Computer Vision, SLAM & Autonomous Exploration. I want to build agents which safely perform alongside humans!

Publications

Challenges in Close-Proximity Safe and Seamless Operation of Manned and Unmanned Aircraft in Shared Airspace

Project | *Video*

Jay Patrikar, Joao PA Dantas, Sourish Ghosh, Parv Kapoor, Ian Higgins, Jasmine J Aloor, Ingrid Navarro, Jimin Sun, Ben Stoler, Milad Hamidi, ***Rohan Baijal****, Brady Moon, Jean Oh, Sebastian Scherer.* *Workshop, ICRA 2022*

Intelligent Aerial Robotics: From Autonomous Micro Aerial Vehicles to Sustainable Urban Air Mobility and Operation

Research Experience

DARPA RACER

Personal Robotics Lab, UW

Summer Research Intern | *Prof. Byron Boots & Prof. Siddhartha Srinivasa* *May 2022 - August 2022*

- Contributed to the real-world performance of Generalized Lazy Search in the global motion planning stack.
- Theorized and implemented smarter heuristics to make multi-goal A* and lazy search upto 3x faster in offroad conditions.
- Devised geometry-based strategies to select local goal nodes in the local costmap when the actual goal is beyond sensor range to ensure smooth and human-like driving paths.
- Learned field test and safety operations and ran autonomy tests in off-road terrains to evaluate performance of the algorithms in the real world.

Dynamic Replanning via Evaluating and Aggregating Multiple Samples

Personal Robotics Lab, UW

Summer Research Intern | *Prof. Siddhartha Srinivasa* *June 2022 - Present*

- Created a custom 2D research dataset to simulate and mimic different types of terrains cars experience.
- Implemented approximations to deep learning based perception and lidar models to simulate noisy observations.
- Developed a general framework to recover different posterior sampling algorithms and study the performance of Bayesian Dynamic Motion Planning Algorithms.
- Designed metrics to study and characterize the regret performance of algorithms and provide replanning strategies to mitigate the suboptimalities.
- Developed an algorithm DREAMS creates a distribution of cost over multiple samples from the posterior to utilize uncertainty information while retaining computational benefits of posterior sampling.

XPlane ROS

AirLab, Carnegie Mellon University

Summer Research Intern | *Prof. Sebastian Scherer* *May 2021 - Mar 2022*

- Engineered a software architecture for using realistic dynamics of XPlane flight simulator for robotics.
- Developed a ROS wrapper to test Controllers, Path Following and other RL algorithms on the realistic system.
- Extended existing ROSPlane autopilot to enable safe takeoff and path following based on Dubin's theory.
- Studied about PID controllers and developed a GUI utility with plots to ease the process of tuning parameters.
- Added utilities for plotting aircraft & desired path and control responses to visualize the results using RViz & RQT.
- Theorized and implemented Control Barrier Functions to guarantee safety against collision avoidance.

Uncertainty Aware Reinforcement Learning

IITK

Probabilistic ML course project | *Prof. Piyush Rai* *Oct 2021 - Present*

- Proposed an application of Spectral-Normalized Neural Gaussian Process, a principled method for uncertainty estimation in deep learning, to enable reinforcement learning agents to efficiently ask for advice under uncertainty.
- Developed strategies to use uncertainty estimates for providing intervention.

Projects

DRDO UAV Guided UGV

Team Aerial Robotics IITK *Mar 2022*

- Developed a cooperative system of a drone and a ground vehicle (UGV) to enable safe operation and movement of UGV without sensors on a mountain under low visibility conditions like snowy regions.
- Implemented a vision system on the drone to map and approximate the mountain road robustly using Point-cloud based segmentation algorithms and filtering to ensure temporal consistency.
- Enabled informative and guided exploration of road by determining points to traverse using PCA algorithm.
- Developed a lightweight and fast vision-based car detection and estimation system to estimate position and speed of the vehicle and keep it on track determined by the mapped road.

A Study in NF, GANs and VAEs

Course Project, Advanced Topics in Machine Learning — *Supervisor: Prof. Vipul Arora* *Jan - May 2022*

- Performed literature review on modern techniques in Machine Learning and Sampling Techniques.
- Setup experiments to understand and explain the workings of Normalizing Flows, GANs and VAEs.

Audio Event Detection and Tagging

Course Project, Machine Learning for Signal Processing — *Supervisor: Prof. Vipul Arora* *Oct-Nov. 2021*

- Implemented ML models like K-class Discriminant and Gaussian Mixture Models for Classification
- Implemented Deep Neural Networks for better classification and RNNs for using temporal information.

IARC Mission 9

Team Aerial Robotics IITK *Nov 2020 - Feb 2021*

- Worked on building a system of drones to navigate and reach a ship.
- Implemented the Trajectories for Fixed-Wing Carrier based on Dubin's Path theory.

Autonomous FPV Racer

Self Project - Team Aerial Robotics IITK *Jan-Feb 2020*

- Developed a software stack for autonomous drone racing through a race course.
- Engineered Computer Vision algorithms and Simple Position Estimation to navigate through frames.

PETcat

Biomimetics Project - Robotics Club *Apr-Jul 2020*

- Worked on perception systems for our Robotic Cat inspired by nature.
- Used modern CNN architectures for Facial and Emotion Recognition.

Decentralized Mechanism Design Using BlockChains

Course Project, Game Theory and Mechanism Design | *Supervisor: Prof. Swaprava Nath* *Oct - Nov 2020*

- Studied parallels between Distributed Algorithmic Mechanism Design and BlockChains and Smart Contracts.
- Used Game Theory to model Normal-Form Games where privacy is a concern while using BlockChains.
- Implemented Private VCG Auctions on BlockChains using Secret Network and Secret Contracts.

GradeIt: Auto-grading using Deep Learning

Advanced Track, ESC101 | *Supervisor: Prof. Piyush Rai* *Sep-Nov 2019*

- Developed an application for auto-grading of True/False questions using Computer Vision and Neural Networks.
- Implemented a back-end system in Node.js to get location of target answer boxes from user in answer sheet.

Achievements

Mar 2022	**2nd Position**, in DRDO's UAV Guided UGV System in Inter IIT Tech Meet 10	*IIT Kanpur*
Mar 2021	**Bronze Medal**, in DRDO's Vision Based Obstacle Avoidance System in Inter IIT Tech Meet 9	*IIT Kanpur*
2020-21	**Academic Excellence Award**, for exceptional performance in the academic year	*IIT Kanpur*
Jul 2019	**Sword of Honour**, Awarded to top student in school for overall excellence	*New Delhi*
Jun 2019	**Top 2%**, Joint Entrance Examination - Advanced, among 230,000 candidates	*India*
May 2019	**99.6 percentile**, Joint Entrance Examination - Mains, among 1.1 million candidates	*India*
2017	**Grade 8 Plectrum Guitar**, Awarded Distinction from Trinity College, London	*India*

Skills

Languages C/C++, Python, JavaScript, Node.Js, GoLang, Rust, Solidity, Shell Script, MATLAB, RISC-V, MIPS

Robotics ROS, OMPL, OpenCV, PX4, Ardupilot, Gazebo, XPlane, rosplane, RViz

Utilities LaTeX, Markdown, Git, PyTorch, Tensorflow, XPlaneConnect, Qiskit, Librosa

Positions of Responsibility

Team Head - Aerial Robotics IITK

Apr. 2021 - Apr. 2022

- Developed the software stack for our custom-built fleet of aerial robots and mentored students in Aerial Robotics.
- Implemented vision and control modules for , localisation and planning.

Extracurricular Activity

- Played Guitar and performed as part of the Music Club, IITK.
- Conducted lectures and competitions related to Programming as part of Programming Club, IITK (2020-21).
- Mentored students on the fundamentals of BlockChains and Number Theory in the year 2020-21.
- Student Guide for 6 incoming freshers on health, academics and extra-curricular activities in 2020-21.

Relevant Coursework

ML/AI/Vision **Introduction to Machine Learning**, **Machine Learning for Signal Processing**, **Advanced Topics in Machine Learning**, **Probabilistic Machine Learning**, **Image Processing*** **Introduction to Reinforcement Learning**

Electrical Engineering Signals, Systems and Networks, Introduction to Electronics, Microelectronics, Control Systems and Analysis, Digital Electronics and Microprocessor technology*, Communication Systems, Power Systems and Electronics, Information Theory, Digital Signal Processing

Computer Science Fundamentals of Computing*, Data Structures and Algorithms, Advanced Algorithms, Computer Organisation, Operating Systems, **Game Theory and Mechanism Design***, **Modern Cryptography***, **Randomized Algorithms**

Mathematics Real Analysis*, Linear Algebra and Ordinary Differential Equations, Complex Analysis, Partial Differential Equations*, Probability and Statistics*

* - Outstanding Performance # - Ongoing Courses **bold - Graduate course**