Rahul Rustagi

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Education

Georgia Institute of Technology
Master of Science (Thesis) in Electrical and Computer Engineering — Atlanta, GA
Specialisation in: Systems and Controls — *Aug. 2024 – May 2026*

Indian Institute of Technology, Kanpur — **GPA: 9.2/10**
Bachelor of Technology in Aerospace Engineering — Uttar Pradesh, India
With Minors in: Machine Learning, Computer Systems, English Literature — *Aug. 2020 – May 2024*

Research Interests

- Swarm Control of Multi-Agent Systems
- Reinforcement Learning and Optimal Control
- Hardware-Level Embedded Programming
- Optimisation and Trajectory Generation
- Image Processing and Vision-based Control
- Motion Planning and Robot Localisation

Publications

1. C. Prachand, R. Rustagi, R. Shankar, J. Singh, A. Abhishek, K.S. Venkatesh, "Vision-Based Autonomous Ship Deck landing of an Unmanned Aerial Vehicle using Fractal ArUco markers", 2025 AIAA SciTech Forum (Under Review)
2. A. Singh, R. Rustagi, R. M. Hegde, "Lifetime Improvement in Rechargeable Mobile IoT Networks Using Deep Reinforcement Learning," in IEEE Transactions on Circuits and Systems II: Express Briefs, doi: 10.1109/TCSII.2024.3370686
3. A. Singh, R. Rustagi, S. Redhu, R. M. Hegde, "Mobile Energy Transmitter Scheduling in Energy Harvesting IoT Networks using Deep Reinforcement Learning," 2022 IEEE 8th World Forum on Internet of Things, pp. 1-6, doi: 10.1109/WF-IoT54382.2022.10152078

Research Experience

Project Staff Associate | Helicopter and VTOL Laboratory — Jan 2024 – Jul 2024
Role: Optimisation and Machine Learning - Guide: Dr. Abhishek, Indian Institute of Technology — *Kanpur, India*

- Devised pipeline to predict optimal landing time of an Unmanned Aerial Vehicle on a stewart (ship-like) platform
- Employed **fractal ArUco** markers to allow error-free **vision-based control** for horizontal tracking till touchdown
- Constructed a light **LSTM** model from scratch to predict heave motion at **20Hz** with maximum error of **1.78 cm**
- Tested the model on **GPU** for accurately predicting **2 seconds** of platform heave motion for **sea state 3** motion
- Implemented **QP Solver** to calculate a time & velocity constrained trajectory by using predicted platform motion

Visiting Robotics Researcher | MITACS GRI — May 2023 – Jul 2024
Role: Navigation and Vision-Based Guidance - Guide: Dr. Chao Shen, Carleton University — *Ottawa, ON*

- Devised a pipeline to stabilise and improve robot's position estimates in an **unaware dynamic environment**
- Built an algorithm to use **vision pose estimates** to filter out unstable **AMCL** estimates in moving environment
- Compared localisation accuracy of my algorithm against benchmark algorithms like **AMCL**, **als-ros**, **irisLAMA**
- Calculated **ATE** and **RTE** accuracy metrics using **evo** for mentioned localisation algorithms with max error **1.2m**

Research Assistant | WSN and IoT Laboratory — May 2022 – Dec 2022
Role: Reinforcement Learning - Guide: Dr. Rajesh Hegde, Indian Institute of Technology — *Kanpur, India*

- Employed Reinforcement Learning algorithm to learn priority charging order in low-powered **IoT** environment
- Constructed a **vectorized gym** environment and simulated a network of **10 IoT nodes** using **pybullet** physics
- Devised a reward function by bookeeping a **Age of Charging** metric of each node to learn a weighted importance
- Trained TD3-PG, DDPG and PPO algorithms with TD3-PG converging **20%** faster to optimal and higher reward

Selected Projects

MAV Swarm Formation Challenge | Drona Aviation github/interiit11
Skills Acquired: C++, Embedded Programming, OpenCV, Ground Station Communication *Jan 2023 – Mar 2023*

- Built a **ros-independent** pipeline for square pattern formation of 4 Micro Aerial Vehicles using a visual feedback
- **Updated camera driver** by running detection in parallel thereby increasing detection rate from **24Hz** to **55Hz**
- Implemented **multi-threading** to run 4 instances of **position controller** enabling centralized swarm control
- Employed **mutex** deadlocking between threads of controller ensuring synchronous coordination between MAVs

Multi-Payload Delivery Challenge using UAV | Flipkart GRID 4.0 github/shastra23
Skills Acquired: ROS, QGroundControl, PX4, OpenCV, Boost, Arduino IDE *Nov 2022 – Jan 2023*

- Devised an **autonomous** ROS pipeline for a UAV to provide **pickup-drop** service of payloads placed in a field
- Conducted **grid-search** in field using **QGc** and triggered autonomy using **finite state machine** implementation
- Setup an electromagnet as actuator by programming **Arduino Due** allowing autonomous pickup of payloads
- Demonstrated complete pipeline on **Odroid XU4** establishing communication to **Pixhawk** via **Mavlink** protocol

Position of Responsibilities | Leadership Experience

Team Lead at Aerial Robotics, IIT Kanpur github/aerial
Faculty Advisor: Dr. Twinkle Tripathy, Indian Institute of Technology, Kanpur *May 2022 – Jul 2023*

- Led a contingent of 5 members to participate in national level competitions in robotics representing the institute
- Successfully bagged podium finish at the **InterIIT Tech Meet 11.0** and **10.0** to win Silver and Bronze Medal
- Responsible for developing and maintaining the software stack for the team's custom-built fleet of aerial robots
- Conducted workshop on ROS and OpenCV for **200 students** using an interactive programming assignment

Mentorship Experience

Student Guide and Academic Mentor May 2024 – Jul 2024
Undergraduate Counseling Service, Indian Institute of Technology, Kanpur *UP, India*

- Conducted and helped in orientation programme for the undergraduate fresher 2021 batch for smooth onboarding
- Mentored **6 students** and served as a **Point of Contact** providing assistance in adjusting to campus environment
- Led sessions for **50** students clearing doubts and gave individual guidance to **10** freshers for understanding courses

Technical Skills

Robotics: ROS, Gazebo, OpenCV, RViZ, QGroundControl, PX4, MAVROS, MAVLink
Programming: C/C++, Python, MATLAB, Java
Frameworks: Arduino IDE, LabVIEW, MicroCap, TensorFlow, PyTorch
Developer Tools & Utilities: Git, Bash, Docker, Visual Studio, PyCharm, Qt5, LaTeX

Awards, Grants and Scholarships

- Bagged Bronze Medal in Drona Aviation Challenge at Inter IIT Tech Meet 11.0 conducted by IIT Kanpur in 2023
- Won Silver Medal in Silicon Labs Challenge at Inter IIT Tech Meet 10.0 conducted by IIT Kharagpur in 2022
- Awarded Academic Excellence Awards by IIT Kanpur for exceptional performance in 2020, 21, 22 academic year
- Received 100% Scholarship in 2020 for Honors in Math & Comp. Science at Chennai Mathematical Institute, India
- Selected for the MITACS GRI 2023 research grant which is awarded to top 1% of students that apply globally
- Awarded the prestigious INSPIRE Scholarship in 2020 awarded to top 1% scorers in Higher Secondary Examination

Coursework

Machine Learning: Introduction to Machine Learning, Probabilistic Machine Learning, Introduction to Reinforcement Learning, Neural Networks and Deep Learning *(Online)*
Controls : Aircraft Control Systems, Modern Controls, Optimal Space Flight Control
Systems : Embedded and Cyber Physical Systems, Software Development and Operations, Data Structures and Algorithms, Computer Networks