Rahul Rustagi

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Education

Georgia Institute of Technology Atlanta, GA
Master of Science (Thesis) in Electrical and Computer Engineering
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

- Control of Multi-Agent Systems
- Reinforcement and Robot Learning
- Hardware-Level Embedded Programming
- Image Processing and Vision-based Control
- Constrained Optimization
- 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**, UAS Track (Accepted)
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
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

Research Experience

Helicopter and VTOL Laboratory, Indian Institute of Technology Jan 2024 – Jul 2024
Research Assistant | Role: Optimisation and Machine Learning - Guide: Dr. Abhishek 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 XY deck tracking till touchdown
- Constructed a 3-layered **LSTM** model predicting vertical deck motion at **20Hz** with maximum error of **1.78 cm**
- Implemented **QP Solver** to calculate a time & velocity constrained trajectory by using predicted platform motion

Advanced Robotics Optimisation and Control Laboratory, Carleton University May 2023 – Jul 2024
Research Intern | Role: Navigation and Vision-Based Guidance - Guide: Dr. Chao Shen 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**, **iris-LaMa**
- Calculated **ATE** and **RTE** accuracy metrics using **evo** for mentioned localisation algorithms with max error $\leq$ **1m**

Wireless Sensor Network and IoT Laboratory, Indian Institute of Technology May 2022 – Dec 2022
Research Assistant | Role: Reinforcement Learning - Guide: Dr. Rajesh Hegde 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 **27Hz** 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 Jul 2022 – May 2023
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