

RITWIK SHANKAR

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EDUCATION

Indian Institute of Technology Kanpur

Master of Technology in Aerospace Engineering

Specialisation in UAS & Reinforcement Learning

GPA: 9.83/10

Uttar Pradesh, India

Aug. 2025 – April 2026

Indian Institute of Technology Kanpur

Bachelor of Technology in Aerospace Engineering

With Minor in Machine Learning

GPA: 8.93/10

Uttar Pradesh, India

Aug. 2021 – May 2025

RESEARCH INTERESTS

- **ML & Vision-based Control**
- Rotorcraft Dynamics & Optimisation
- Hardware-Level Embedded Programming
- **Bipedal locomotion via Reinforcement Learning**
- Motion Planning & Robot Localisation
- Design Optimisation through iterative methods

PUBLICATION(S)

1. **R. Shankar**, C. Prachand, J. Singh, A. Abhishek, K.S. Venkatesh, "Vision-Based Landing of UAV on Simulated Ship Deck with Roll Pitch and Sway Motions", 2025 Vertical Flight Society, Forum 81
2. **R. Shankar***, C. Prachand*, A. Abhishek, K.S. Venkatesh, "GRU-based Heave Prediction and Landing Window Estimation for Autonomous UAV Shipboard Landing", Manuscript under preparation
3. 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

RESEARCH EXPERIENCE

Graduate Research Associate/Thesis | Helicopter and VTOL Laboratory

Sept.'25 – Present 🌐

Role: RL optimised Vision-based UAV Landing- Guide: Dr. Abhishek, Indian Institute of Technology Kanpur, India

- Built a **PX4-compatible RL stack** in IsaacSim with a parallelisable PX4-like cascaded controller for Quadrotors
- Demonstrated landings on a moving platform under sinusoidal motion up to **0.2 Hz** frequency & **55 cm** amplitude
- Extended the policy to heave-dominant (Z-axis) motion using GRU-based RL with privileged critic information
- Derived a descent-phase **CBF** from relative clearance and stopping margin to guarantee crash-proof landing

SURF@Caltech | AMBER Lab

May'25 – Aug'25 🌐

Role: Bipedal locomotion using RL - Guide: Dr. Aaron Ames, California Institute of Technology Pasadena, USA

- Built a manager-based RL training stack from scratch for a **bipedal robot in Isaac Lab** driven by **PPO**
- Utilised Extrapolated-CoM based Linear Inverted Pendulum reduced order model to generate future foot points tracked by a custom IK solver built on **CusADi** & **Pinocchio** to implement a model-based classical controller
- Engineered reward functions to generate walking gaits using both **baseline** and **LIP-enhanced** RL pipelines
- Mathematically defined gait stability metrics & performed a full-scale **reward ablation study** comparing model-free & model-based controller paradigms in terms of **Robustness, Performance & Sampling Efficiency**

Undergraduate Research Associate | Helicopter and VTOL Laboratory

Jan. 2024 – March 2025

Role: ML+CV-based control- Guide: Dr. Abhishek, Indian Institute of Technology Kanpur Kanpur, India

- Developed a **vision-based** autonomous landing pipeline for a **UAV quadcopter** on a moving platform
- Employed fractal **ArUco** markers to allow minimal-error vision-based control for motion tracking till touchdown
- Designed a hybrid **GRU + EKF**-based model to predict real-time heave motion at **20Hz** from a 40-second time window, achieving 6-second ahead predictions within $\pm 11\%$ **average error** tested on a **NVIDIA Jetson** GPU.
- Implemented a **Quadratic Programming (QP)** solver on the predictions to compute a time & velocity constrained optimal UAV trajectory & integrated a **Control Barrier Function** for safe descent commitment
- Validated the entire pipeline via hardware experiments (11/11 Successes) after validating it in **ROS2 & Gazebo**

Design optimisation & control engineer | Endure Air Systems

May 2024 – Jul 2024

Role: Control & Design Optimisation

Noida, India

- Developed an advanced **multidisciplinary design optimization** tool for customisable rotor-crafts using **BEMT**
- Redesigned Sabal-10 into a 10-litre **agricultural drone** & validated improved performance via field-experiments

SELECTED PROJECTS

Ship deck estimation using DL | EE798Z MATHEMATICAL ENG. & PHYSICS USING ML

Guide: Dr. Sandip Tiwari, Cornell University

Aug. 2024 – Dec. 2024

- Developed & compared various time-series prediction models—including statistical (**ARIMA**) & deep learning architectures (**RNN, LSTM, GRU & TCN**)—to estimate ship deck heave movements for autonomous landing
- Developed a script to systematically train & compare **GRU/LSTM models** via PyTorch on a GPU cluster
- Applied **information theory & dimensionality reduction**; integrated an **EKF** & sea-state model to physics-inform **GRU/LSTM** for heave prediction improving baseline performance yielding avg. **error** of $\pm 11\%$

CUDA optimized Inverse Kinematics Solver for Bipedal gait generation

cusadi

Guide: Dr. Aaron Ames, California Institute of Technology

April 2025

- Accelerated Inverse Kinematic solving & gait generation by reproducing CusADi to get an eightfold speedup
- Engineered a differential IK solver by building a custom CasADi (SX) graph atop Pinocchio's kinematics API

Comprehensive EVTOL Design | AE668 COMP. AEROMECH. & CONTROL OF UAVs

VFS

Guide: Dr. Murali Damodaran, National University of Singapore

Jan. 2025 – May 2025

- Sized an **8-rotor tilt-eVTOL** using BEMT with a parameter-ablation over rotor radius, RPM, Cruise speed, etc
- Performed ANSYS-Fluent CFD quantifying bi-wing interference & analysed helicopter-mode structural deflection
- Built a cascaded attitude-stability controller (outer P, inner PID) with tilt-angle gain scheduling & motor-mixing

4 DoF Parallel Manipulator | Helicopter and VTOL Laboratory

Stewart-Platform

Guide: Dr. Abhishek, Indian Institute of Technology Kanpur

Aug 2023 - Nov 2023

- Designed a **Novel** 4 DoF parallel-manipulator for ship deck emulation **costing 10%** of existing market alternative
- Utilised MPU-6050 IMU & encoder fusion with an **STM-32 microcontroller** for robust & optimal control

CL-QP Satellite Attitude Stabilisation | AE642 Satellite Dynamics and Attitude Control

AE642

Guide: Dr. D. K. Giri, Indian Institute of Technology Kanpur, India

Aug 2025 – Nov. 2025

- Formulated nadir-pointing attitude stabilisation for Low Earth Orbit with magnetorquer actuation in LVLH frame
- Designed a receding-horizon **Control Lyapunov (CL)–Quadratic Program (QP)** MPC while minimising quadratic effort with a discrete CLF condition across horizon obtaining average pointing error to be **0.4%**

TECHNICAL SKILLS

Robotics: Isaac Lab, MuJoCo, ROS, Gazebo, OpenCV, QGroundControl, PX4, MAVROS, MAVLink, ArduPilot

Programming: C/C++, Python, MATLAB, Javascript

Frameworks: SolidWorks, Arduino IDE, TensorFlow, PyTorch, Pinocchio, Simulink, Ansys, LabVIEW

Developer Tools & Utilities: Git, Bash, Visual Studio, PyCharm, CUDA, $\text{\LaTeX}$

AWARDS, GRANTS AND SCHOLARSHIPS

- Received the **Piasecki Scholarship by VFS (Twice)** in UG (amongst ten recipients worldwide) & Masters
- Received **IndiaAI Fellowship** (Twice) from the Indian government (MeitY) given to only **Ten** UG students in India
- Received the **Academic Excellence Award** by IIT Kanpur for **outstanding academic display** in 23-24
- Received the Prestigious **Skylark award** & Scholarship given to only One UG student from final & pre-final year
- Secured **All India Rank 2624** in JEE Advanced 2021 from an initial applicant pool of over 1 million students.

COURSEWORK

Core engineering : Data Structures and Algorithms, Linear Algebra and ODEs, Helicopter Theory, Measurements and Data Analysis, Aerospace Structures, Dynamics, Autonomous Unmanned Aerial Systems

Machine Learning: Deep Reinforcement Learning, Introduction to Machine Learning, Image Processing(A* grade), Mathematical Physics & Engineering using Machine Learning (A* grade), Neural Networks & Deep Learning (*Online*)

Controls : Non Linear & Adaptive Controls, Non Linear Systems, Aircraft Controls Systems, Modern Controls, Optimal Space Flight Control, Controls of UAV

POSITION OF RESPONSIBILITIES | LEADERSHIP EXPERIENCE

Coordinator at Aeromodelling Club, Science and Technology council

Aeromodelling/github-pages

- Organized and led multiple workshops for school students and underprivileged children, introducing them to aerospace engineering concepts and hands-on aeromodelling, fostering early interest in STEM fields

Captain of College Football Team

May 2023 – Present

- Led a contingent of 16 members to participate in national & state level competitions representing institute