Shreyas Kumar

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EDUCATION

Indian Institute of Engineering Science and Technology (IIEST) June 2025
B.Tech. in Mechanical Engineering GPA: 8.6/10.0, Distinction

RESEARCH EXPERIENCE

Human-interactive Robotics (HiRo) Lab Jul 2024 - Present
advised by: Prof. Ravi Prakash Indian Institute of Science Bangalore

- Developed Gaussian Barrier Sampling [1], enabling safety-certified reinforcement learning for Variable Impedance Control (VIC) with Lyapunov stability and torque-aware constraints.
- Achieved robust adaptation by guaranteeing input-to-state stability (ISS) under external disturbances and model uncertainties.
- Introduced PACER [2], a method that learns latent task phases to align demonstrations and filter local corruptions for stable imitation from few imperfect demos.

IITGN Robotics Lab Jun - Jul 2024, Jan - Jun 2025
advised by: Prof. Harish P.M. Indian Institute of Technology Gandhinagar

- Empowered low-cost, velocity-controlled manipulators with object-level compliance and force-closure grasps–capabilities typically reserved for torque-controlled systems–through a control framework robust enough for dynamic tasks like (bimanual) throwing.
- Developed an end-to-end bimanual snap-fit assembly framework integrating SnapNet, a novel CNN-GRU attention network trained solely on joint velocity data, with a unified DS-based multi-arm coordination scheme and event triggered impedance ramp down to absorb residual energy. [3], [4]
- Studied robotic squeezing task posed as a control problem, evaluated the role of GDI and redundancy, and transformed required control inputs from task space into tendon space. [5]
- Worked on rapid task generalization in robotic grasping using a novel Iterative Learning Control (ILC) based approach [6], combining adaptive null-space control, path-dependent object impedance control, and sensor fusion via EKF for real-world deployment.

Control System & Instrumentation Lab Jan – Mar 2024
advised by: Prof. Roshni Maiti IIEST

- Designed a fuzzy predictor with Lyapunov-based adaptation for real-time disturbance estimation, integrated with a fast terminal sliding mode controller to reject the estimated disturbances and ensure finite-time convergence. [7]

PUBLICATIONS

* Denotes Equal Contribution

[1] **S. Kumar**, K. Swaminathan, and R. Prakash, "Safe reinforcement learning for variable impedance control via gaussian barrier sampling," In Preparation for ICRA 2026.

[2] **S. Kumar** and R. Prakash, "Pacer: Progress-aligned curation for error-resilient imitation learning," in *CoRL 2025 Workshop on Making Sense of Data in Robotics*, 2025.

[3] **S. Kumar**, S. Barat, D. Das, S. Jain, R. Kumar, and H. J. Palanthandalam-Madapusi, "Towards coordinated dual-arm snap-fit assembly skill for delicate applications," in *2025 IEEE-RAS 24th International Conference on Humanoid Robots (Humanoids)*, Late Breaking Report (LBR) Paper, 2025.

[4] **S. Kumar**, S. Barat, R. Kumar, and H. J. Palanthandalam-Madapusi, "A coordinated framework for dual-arm snap-fit assembly of delicate components," Under Review in IEEE Transactions on Automation Science and Engineering, 2025.

[5] S. Barat*, **S. Kumar***, and H. J. Palanthandalam-Madapusi, "Grasping at the edge of instability," In Preparation for The International Journal of Robotics Research, 2025.

[6] S. Barat, S. Patidar, D. Das, **S. Kumar**, S. Jadav, and H. J. Palanthandalam-Madapusi, "Iterative learning for manipulation and grasping against unknown resistance fields that is generalizable to arbitrary trajectories," Under Review in Autonomous Robots, 2024.

[7] **S. Kumar**, B. Dash, R. Maiti, and D. Guha, "Adaptive fuzzy predictor based fast terminal sliding mode controller design for two-link robot manipulator," in *2024 Tenth Indian Control Conference (ICC)*, 2024, pp. 302–307. DOI: 10.1109/ICC64753.2024.10883745.

RELEVANT INTERNSHIPS

Black Coffee Robotics Oct - Dec 2024

- Developed an autonomous pick-and-place framework in Gazebo using ROS 2, MoveIt!, and a custom robot using URDF for parcel handling from conveyor belts.
- Wrote a custom Gazebo plugin for Vacuum Gripper.
- Set up a training environment in Isaac Lab using Kinova Gen3 7 DoF Manipulator to fine tune OpenVLA.

Space Applications Center Apr – May 2024
advised by: Mr. Pradeep Ananthanarayanan Indian Space Research Organization

- Developed a real-time momentum observer and adaptive force estimator for dynamic manipulation tasks in microgravity, enabling accurate force tracking during contact, lift, and manipulation phases.

Strider Robotics Jun - Jul 2024, Jan - Jun 2025

- Implemented ArUco-SLAM, an algorithm for localization using node graph of landmarks based on fiducial markers, improved efficiency by 30% through object oriented refactoring.
- Used a particle filter to map the environment by fusing depth data with IMU data.

ACHIEVEMENTS

- ◇ Awarded travel grant of $100 by IEEE CSS for ICC 2024.
- ◇ Received a prize money of $500 under 1965 ME Alumni Award for Technical Excellence.
- ◇ Awarded GAABESU Research Award (10 of 720 graduating students).
- ◇ Prize money of $100 at regional round of Boeing National Aeromodelling Competition, 2023.
- ◇ Awarded with the prestigious IASc-INSA-NASI Summer Research Fellowship, 2023.
- ◇ Shortlisted for the Institute Innovation Council's 'Alpona Banerjee Memorial Endowment Funding Scheme' and received a $1000 funding for research in Robotics and Artificial Intelligence.
- ◇ Secured a global critical design review rank of 25 and an innovation rank of 32 in ASME Human Powered Vehicle Challenge, 2022.

SKILLS

Languages	Python, C/C++, MATLAB
Frameworks	ROS/ROS2, MoveIt!, Gazebo, MuJoCo, Isaac Sim, Mathematica
Libraries	OpenCV, PyTorch, Mink, Pandas, Numpy
Prototyping	SolidWorks, 3D Printing, CNC Lathe and Milling, Laser Cutting