

Shreyas Kumar

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EDUCATION

Indian Institute of Engineering Science and Technology (IEST)

Bachelor of Technology in Mechanical Engineering

GPA: 8.6/10.0, Distinction

Kolkata, India

June 2025

RESEARCH EXPERIENCE

Human-interactive Robotics (HiRo) Lab

advised by Prof. Ravi Prakash

Indian Institute of Science, Bengaluru, India

Jul 2024 - Present

- Under collaboration with Prof. Jihong Zhu from University of York University

- Developing a framework to enable robust and force-aware assistive robot-dressing task in scenarios with moving human arms.

- Under collaboration with Prof. Fares J. Abu-Dakka from New York University, Abu Dhabi

- Developing a real-time task parameterized policy transport framework employing Kernelized Movement Primitives (KMPs).

- Building a semantic keypoint extraction pipeline that derives task-relevant parameters directly from scene-level object representations to enable scene-agnostic skill generalization.

- Under collaboration with Prof. Anh Nguyen from University of Liverpool

- Led a large-scale data collection effort comprising 9000 real-world demonstrations to establish a benchmark for complex grasping tasks requiring semantic understanding across grasp phases [1].

- Developed a teleoperation and data acquisition framework on the Franka FR3 – wrote custom C++ ROS controllers, integrated multi-camera RGB-D sensing, and automated extrinsic camera calibration within a reproducible, synchronized data logging pipeline.

- Derived an analytical expression for closed-form solution of the Hamilton-Jacobi-Bellman (HJB) equation. [2]

- Developed Certified Gaussian Manifold Sampling (CGMS) [3], enabling safety-certified reinforcement learning (RL) for Variable Impedance Control (VIC) with Lyapunov stability and torque-aware constraints and formalized its robust adaptation under external disturbances and model uncertainties by guaranteeing input-to-state stability (ISS).

- Introduced PACER [4], an Imitation Learning (IL) algorithm that learns latent task phases to align demonstrations and filter local corruptions for stable learning from few (≤ 5) imperfect demos—currently benchmarking against SoTA F1/10th algorithms.

IITGN Robotics Lab

advised by Prof. Harish P.M.

Indian Institute of Technology, Gandhinagar, India

Jan - Jun 2025

- Grasping at the Edge of Instability (Bachelor Thesis) [5]

- Investigated the mechanics of force-production tasks in robotic grasping of compliant objects, showing how deformation induced torque coupling leads to a bifurcation-type loss of equilibrium when contact forces exceed a critical threshold.

- Derived a closed-form stability condition characterizing the transition from stable force application to sudden grasp failure.

- Extended the theoretical framework to both motor-driven and tendon-driven robotic hands, analyzing how redundancy influences force generation, and derived a redundancy optimization algorithm to maximize stable force production under compliance-induced constraints.

- Proposed a novel control framework to empower low-cost, velocity-controlled manipulators with object-level compliance and force closure grasps—capabilities typically reserved for torque-controlled systems. [6]

- Developed a bimanual snap-fit assembly framework for delicate tasks by integrating (i) SnapNet, a CNN-GRU attention network trained solely on joint velocity data, (ii) a unified dynamical-system based dual-arm coordination scheme, and (iii) an event-triggered VIC to absorb (otherwise damage-inducing) residual impact energy during contact events. [7], [8]

IITGN Robotics Lab

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Indian Institute of Technology, Gandhinagar, India

Jun - Jul 2024

- Proposed and implemented (i) adaptive null-space control, (ii) path-dependent object impedance control, and (iii) sensor fusion via Extended Kalman Filter (EKF) to enable real-world experiments of a novel Iterative Learning Control (ILC) based approach [9] for rapid task generalization in robotic grasping and manipulation tasks.

Control System & Instrumentation Lab

advised by Prof. Roshni Maiti

IEST, Kolkata, India

Jan - Mar 2024

- Designed a fuzzy predictor with Lyapunov-based adaptation for real-time disturbance estimation, integrated the predictor with a fast terminal sliding mode controller to reject the estimated disturbances and ensure finite-time convergence. [10]

PUBLICATIONS

* Denotes Equal Contribution, † In Advising Capacity

- [1] H. Zhang et al., “Gripper-aware vision language action models for robotic grasping,” Under Review in IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) 2026.
- [2] A. Vyas, **S. Kumar**, J. Kumar Mohanta, and R. Prakash, “Closed form hjb solution for continuous-time optimal control of a non-linear input-affine system,” Under Review in 8th Annual Learning for Dynamics and Control Conference (L4DC) 2026.
- [3] **S. Kumar** and R. Prakash, “Safe reinforcement learning for variable impedance control via gaussian barrier sampling,” Under Review in IEEE International Conference on Robotics and Automation (ICRA) 2026. arXiv: [2511.16330 \[cs.R0\]](https://arxiv.org/abs/2511.16330). [Online]. Available: <https://arxiv.org/abs/2511.16330>.
- [4] **S. Kumar** and R. Prakash, “PACER: Progress-aligned curation for error-resilient imitation learning,” in *Workshop on Making Sense of Data in Robotics: Composition, Curation, and Interpretability at Scale at CoRL 2025*, 2025. [Online]. Available: <https://openreview.net/forum?id=gaYyBvP2Rz>.
- [5] S. Barat*, **S. Kumar***, and H. J. Palanthandlam-Madapusi, “Grasping at the edge of instability,” In Preparation for The International Journal of Robotics Research, 2025.
- [6] S. Dubey, Y. Kashiv, **S. Kumar**†, R. Kumar, and H. J. Palanthandlam-Madapusi, “Velocity-based admittance-impedance control with contact compliance modeling for robust dual-arm manipulation,” Under Review in IEEE International Conference on Robotics and Automation (ICRA) 2026.
- [7] **S. Kumar**, S. Barat, D. Das, S. Jain, R. Kumar, and H. J. Palanthandlam-Madapusi, “Towards coordinated dual-arm snap-fit assembly skill for delicate applications,” 2025 IEEE-RAS 24th International Conference on Humanoid Robots (Humanoids) Late Breaking Report.
- [8] **S. Kumar**, S. Barat, R. Kumar, and H. J. Palanthandlam-Madapusi, “A coordinated dual-arm framework for delicate snap-fit assemblies,” Under Review in IEEE Transactions on Automation Science and Engineering, 2025. arXiv: [2511.18153 \[cs.R0\]](https://arxiv.org/abs/2511.18153). [Online]. Available: <https://arxiv.org/abs/2511.18153>.
- [9] S. Barat, S. Patidar, D. Das, **S. Kumar**, S. Jadav, and H. J. Palanthandlam-Madapusi, “Iterative learning for manipulation and grasping against unknown resistance fields that is generalizable to arbitrary trajectories,” Under Review in Autonomous Robots, 2024.
- [10] **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](https://doi.org/10.1109/ICC64753.2024.10883745).

RELEVANT INTERNSHIPS

Black Coffee Robotics

Robotics Software Intern

Remote

Oct - Dec 2024

- Developed an autonomous pick-and-place framework in Gazebo using ROS and MoveIt! on a custom robot built directly using URDF for package handling on moving conveyor belts.
- Wrote a proprietary C++ Gazebo plugin for simulating Vacuum Gripper.
- Built a custom training environment in Isaac Lab using Kinova Gen3 7 DoF Manipulator to fine-tune OpenVLA.

Indian Space Research Organization

Control Intern

Space Applications Center, Ahmedabad, India

May - Jun 2024

- Built a Python framework using Kane's dynamic analysis method for Quadcopter simulation
- Developed a real-time momentum observer and adaptive force estimator for dynamic manipulation tasks in microgravity, enabling accurate force tracking ($IAE \leq 2.0 \text{ N}\cdot\text{s}$ over 10 s trials) during contact, lift, and manipulation phases.

Strider Robotics

Robotics Perception Intern

ARTPARK, Bangalore, India

Dec 2023 - Feb 2024

- Implemented ArUco-SLAM, an algorithm for localization using node graphs 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

- ◊ Received GAABESU Research Award 2025 (10 of 720 graduating students).
- ◊ Received a prize money of \$500 under the 1965 ME Alumni Award for Technical Excellence 2025.
- ◊ Awarded a travel grant by IEEE CSS for Indian Control Conference 2024.
- ◊ Prize money of \$500 at the 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 2023' and received a \$1000 grant for research in Robotics and Artificial Intelligence.
- ◊ Secured a global critical design review rank of 25 and an innovation rank of 32 in the ASME Human Powered Vehicle Challenge, 2022.

RELEVANT CERTIFICATIONS & COURSES

Kinematics of Mechanisms and Robots | Numerical Methods in Engineering | Probability and Statistics | Partial Differential Equations | Modeling and Control of Mechanical Systems | Robotics | Data Mining | [Machine Learning](#) | [Python Basics](#) | [Underactuated Robotics](#) | [Deep Reinforcement Learning](#) | [Deep Learning for Computer Vision](#)

ACADEMIC CONTRIBUTIONS & OUTREACH

- ◊ Delegate reviewer at ICRA 2026.
- ◊ Tutor at IITGN Robotics Summer School 2025.
- ◊ Mentor at Robot Kinematics for Engineers Workshop 2024 (conducted by IITGN).

SKILLS

Languages Python, C/C++, MATLAB

Frameworks ROS/ROS2, MoveIt!, Gazebo, MuJoCo, Isaac Lab, Mathematica

Libraries OpenCV, PyTorch, Mink, Pandas, Numpy

Prototyping SolidWorks, 3D Printing, CNC Lathe and Milling, Laser Cutting