

# Soham Kulkarni

📞 +1 (424) 440-4665 · sohamkulkarniprof@gmail.com · stochasticcritic.github.io · GitHub stochasticcritic · LinkedIn sohamkulkarni11  
403 Landfair Ave, Apt 401, Los Angeles, CA 90024

## Education

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**University of California, Los Angeles (UCLA)**  
*Master of Science (MS) in Computer Science*

Sep 2023 – June 2025

**Indian Institute of Technology (IIT) Hyderabad**  
*Bachelor of Technology in Electrical Engineering (Minor in Entrepreneurship)*

Aug 2019 – May 2023

## Publications & Preprints

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- S. Kulkarni, R. Dhar, Y. Cui. *Learning from the Best: Smoothness-Driven Metrics for Data Quality in Imitation Learning*. ICML 2025 DataWorld Workshop, Vancouver, Canada, July 2025.

## Technical Skills

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**Programming:** Python, C++, MATLAB · **Software/Tools:** Git, Docker, ROS/ROS2, CUDA, wandb, roboflow, SolidEdge, Autodesk Fusion · **Libraries:** PyTorch, TensorFlow, OpenCV, scikit-learn, pandas, TensorRT, robosuite, HuggingFace, ZED/Realsense SDK · **Simulators:** MuJoCo, IssacSim, Unity, Gazebo, rViz, PyBullet, AirSim

## Research Experience

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**Benchmarking Data Quality in Imitation Learning [M.S. Thesis]**  
*Under Dr. Yuchen Cui, UCLA Robot Intelligence Lab (URL)*

Los Angeles, CA

Sep 2024 – Ongoing

- Developed a smoothness-based data evaluation framework with two trajectory-level data evaluation metrics: TED (Cartesian space) and SAL (frequency domain).
- Achieved up to **16%** success gain using just 1/6th of the data on robomimic benchmarks, and up to **20%** gain using half of the real-world data (and **16%** using one-fourth real data).
- Showed that the quality metrics generalize across different data collection modalities like: kinesthetic, VR, and Space-Mouse (Li et al. '25).
- Used operator-level scores to rank demonstrators, labelled data-collection effort, and analyzed how human data quality correlates with downstream policy performance.

**Stereo Vision and Planning for the ARTEMIS Humanoid [RoboCup 2024 Winner]** *Eindhoven, Netherlands*  
*Under Dr. Dennis Hong, RoMeLa, UCLA*

Jan 2024 – Jul 2024

- Created a “proximity” package for near-field planning at 60 Hz using connected-components analysis + union-find on stereo depth maps to detect the closest obstacles.
- Extracted obstacle features (width, height, distance, angle) and transformed them into robot and field reference frames for use by localization and mid-level planning modules.
- Deployed adaptive depth thresholding to suppress ground/self detections and designed a HALO fallback mode for safe (and consistent) navigation under occlusions and clutter.

**Bimanual Robot Manipulation on AgileX Cobot Magic**

Santa Clara, CA

- Developed a ROS-based teleoperation stack (Piper SDK) with 15 Hz control, multi-camera feedback, and joint state monitoring for a bimanual setup.
- Collected teleoperated demonstrations and trained Diffusion Policy on visual and proprioceptive inputs for table-top manipulation tasks.
- Deployed 16-step vision-based closed-loop inference with ~2.1s real-time inference, debugging stability issues on real hardware.

**Humanoid Fall Recovery Controller (in MuJoCo)**

Los Angeles, CA

- Designed hierarchical FSM architecture with capture-point based reflex cascade (ANKLE→HIP→STEP) achieving 62% standing/38% balancing under 500N perturbations with <200 Nm torque peaks.
- Implemented full-body dynamic balance using five coordinated strategies (ankle, hip, arms, torso, stepping) with CP-error gating across standing/balancing/stepping/emergency states.
- Developed trajectory-free fall mitigation pipeline with impact absorption, tripod recovery, and scripted stand-up sequences; validated against encoder dropout, terrain compliance, and random-walk disturbances up to 0.35m CP deviations.

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**Reinforcement Learning for Autonomous Navigation on Uncertain Terrain**  
Under Dr. M. Vidyasagar, FRS (IIT Hyderabad)

Hyderabad, India  
Jun 2021 – May 2022

- Modeled UGV navigation on unstructured, uneven terrain as a DeepRL task and implemented an end-to-end A3C pipeline in simulation (Gazebo).
- Integrated user-defined obstacle placement and 3D occupancy mapping; implemented a dynamic obstacle scheduler during training to encourage early exploration.
- This curriculum design led to a **14%** increase in navigation success rate for a Pioneer mobile robot.

**Agile Autonomous Quadrotor Flight [For IROS 2022 Safe Robot Learning Competition]** Hyderabad, India  
Under Dr. M. Vidyasagar (IIT Hyderabad) & Dr. Srikanth Saripalli (Texas A&M) Aug 2022 – May 2023

- Deployed a PPO-based controller in  $SE(3)$  for minimum-time navigation on a Crazyflie quadrotor (pycrazyswarm) under gate and obstacle constraints.
- Designed a reward structure balancing progress, lateral deviation, and collision penalties for safe and smooth flight.
- Demonstrated improved reliability under adaptive control settings with **84%** success, compared to non-adaptive baselines.

**Data-Acquisition Robot for Acoustic Sensing & Localization [Robot Audition]**  
Under Dr. Sumohana Chhannappayya & Dr. K. Sri Rama Murty (IIT Hyderabad)

Hyderabad, India  
Jul 2021 – May 2022

- Developed an all-terrain robot (height up to 1.7m) with an adjustable 8-channel microphone array for 3D sound source localization experiments.
- Implemented robust sound source localization and tracking, streaming multi-channel audio and state estimation over 4G to on-board storage for long-horizon data collection.

## Select Projects

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**Creating Persona Chatbots (with a focus on evaluation) [For CS263 NLP @ UCLA]** Los Angeles, CA

- Used in-context and chain-of-thought prompt tuning on Mistral 7B for persona-aligned open-ended dialogues.
- Evaluated with LLMEval (fluency/coherency), MMLU (reasoning), and HDS-style metrics (toxicity/fairness) to refine persona fidelity and control harmful outputs.

**CRAG Meta KDD Competition [Best Project for CS245 Big Data Analytics @ UCLA]** Los Angeles, CA

- Built an enhanced RAG system with recursive chunking, dense retrieval and reranking (BAAI/bge-reranker-v2-m3) to improve document selection and mitigate hallucinations.
- Classified queries by temporal sensitivity (static, slow-changing, fast, real-time) to adapt retrieval strategy.
- Increased open-ended query accuracy to **42.16%** using GPT-4o-mini with chain-of-thought prompting.

**Effect of Neural Network Pruning on Spurious Correlations [For CS260D Large-Scale ML @ UCLA]** Los Angeles, CA

- Investigated unstructured magnitude pruning effects on neural nets with spurious correlations, comparing supervised (LeNet + JTT) and contrastive learning on SpuCo MNIST.
- Demonstrated last-layer pruning maintains worst-group accuracy up to 70% pruning ratio, outperforming early-layer pruning strategies for fairness-preserving model compression.
- Achieved 83.5% validation accuracy with 90% last-layer pruning in contrastive settings while minimizing spurious feature reliance.

**Motion Planning & Teleoperation Interface [For Netflix's *The Electric State: Cosmo Humanoid*]** Los Angeles, CA

- Developed a 3D planning interface for safe trajectory recording, replay, and teleoperation using Unity and PyBullet.

**SLAM on Victoria Park Dataset [IEEE Summer School: SLAM in Deformable Environments]** Sydney, Australia

- Implemented EKF-based SLAM and non-linear least-squares (graph-based) SLAM on the Victoria Park dataset, comparing trajectory and landmark estimation quality.

**Flipkart Grid 3.0 Robotics Challenge [National Semifinalists]**

Hyderabad, India

- Led a team to develop overhead vision-based swarm robots for pick-and-place and warehouse automation tasks, including multi-robot coordination and task assignment. We were national semifinalists among 9000+ participants.

## DDP-based Solver for Optimal Control for the TALOS Humanoid

*Los Angeles, CA*

- Implemented Differential Dynamic Programming (DDP) solvers (in simulation) for whole-body manipulation, gait planning, and bipedal walking under contact constraints.

## Teaching & Mentoring

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- *UCLA*: Reader for CS 217A (Internet Architecture and Protocols) and CS 162 (Natural Language Processing); conducted office hours and created assignments/quizzes for classes of  $\sim 150$  students.
- *IIT Hyderabad*: Coordinator and mentor of the Robotics Club; participated in Inter-IIT and other national level competitions, mentored students on robotics projects, and conducted hands-on hardware and software sessions.

## Honors & Awards

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- IIT-JEE Advanced All India Rank **2362** among **190,000** shortlisted students from IIT-JEE Mains
- IIT-JEE Mains: **99.5** percentile among **1.1 million** students
- **SA Gold Medal for Innovation** at IIT Hyderabad (Institute-wide, 1 recipient among all UG students) (Apr 2023)
- Robocup Humanoids league **winner** for the Robosoccer challenge (2024)
- Flipkart Grid 3.0 Robotics Challenge: **National Semifinalist** (Team leader for IIT Hyderabad team)
- Awarded the BUILD funding grant for student-led project development (2022).
- SPIRSE Award by IEEE RAS (invited to ICRA 2022)