

Siddharth Singh

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Summary

I specialize in developing robotic solutions for real-world environments, emphasizing computational efficiency in long-horizon planning tasks. My research leverages human demonstrations, diffusion models, and hierarchical learning to create scalable, efficient systems. With expertise across the complete solution stack, I bring in-depth knowledge spanning mechatronics, product design, and computer vision, all grounded in a solid theoretical foundation. My extensive teaching experience further reflects my commitment to knowledge sharing and academic leadership.

Education

2021 – **University of Virginia**, Mechanical & Aerospace Engineering

Doctoral Student, Advisor: *Prof. Cindy Chang*

Research: Robotic Learning, Task & Motion Planning, Multi-Agent Systems

2018 – 2020 **University of Pennsylvania**, Mechanical Engineering & Applied Mechanics

Master's Science & Engineering

Focus: Robotics, Control Theory, Mechatronics

2014 – 2018 **University of Delhi (NSIT)**, Manufacturing Process & Automation Engineering

Bachelor's in Engineering

Thesis: Non-Linear MPC for Electro-hydraulic Actuated Active Suspension System

Skills

Research Areas Robotic Manipulation, Reinforcement Learning, Long Horizon TAMP, LfD, Motion Planning, Predictive Control, 3D Reconstruction, Photometric Stereo

Programming Languages Python, C, C++

Softwares & Tools Matlab, L^AT_EX, SolidWorks, Simulink, CoppeliaSim, RViz, Gazebo, PyTorch, TensorFlow

Robotic Frameworks ROS/ROS2, PyBullet, NavStack, RtabMap, MoveIt, RelaxedIK

Robots & Hardware UR5/5e/10e, Kinova Gen-3, ClearPath Husky, Custom built UGVs, Intel Realsense (D435i, T265, L515), Zed-2, Ouster OS1/2, ESP32, Arduino

Publications

- [J1] **Singh S.***, Yu T.*, Chang Q., Karigiannis J., Liu S., Hybrid Robot Learning for Automatic Robot Motion Planning in Manufacturing, **Equal Contribution, Under Review*
- [C1] **Singh S.**, Xu T., Chang Q., Collaborative motion planning for multi-manipulator systems through Reinforcement Learning and Dynamic Movement Primitives. *Accepted to ICRA, IEEE 2025*
- [J2] Xu T.*, **Singh S.***, Chang Q., Generalizing kinematic skill learning to energy efficient dynamic motion planning using optimized Dynamic Movement Primitives. **Equal Contribution, Robotics and Computer-Integrated Manufacturing, Volume 94, 2025, 102983, ISSN 0736-5845, <https://doi.org/10.1016/j.rcim.2025.102983>*
- [J3] **Singh S.**, Chang Q., Yu T., Hierarchical Learning for Robotic Assembly Leveraging LfD. *Under Review, 2024*
- [J4] Smith W., Qin Y., **Singh S.**, Burke H., Furukawa T., Dissanayake G., A Multistage Framework for Autonomous Robotic Mapping with Targeted Metrics. *Robotics 2023, 12, 39. <https://doi.org/10.3390/robotics12020039>*
- [C2] Smith K., Lothrop H., **Singh S.**, & Furukawa T., Design of a Photometric Stereo Based Depth Camera for Robotic 3D Reconstruction, 2023 International Conference on Precision Engineering and Mechanical Manufacturing, Atlanta, Georgia, USA, January 11-14, 2023
- [C3] **Singh S.**, Smith K. & Furukawa T., Photometric Stereo Enhanced Light Sectioning Approach for Microtexture Road Profiling, Proceedings of the ASME 2022 IDTEC/CIE Conference. St. Louis, Missouri, USA. August 14–17, 2022.

Projects

- 2023-2023 **Deploying LfD based Motion Planning for Industrial Robots**, Graduate Research Assistant, UVA/ARM Institute.
Successfully developed a PyBullet environment and implemented LfD based motion planning method for robotic bolting in automotive welding; worked in collaboration with General Motors, Siemens & GE Research funded by ARM Institute; the final deliverable is successfully validated on a GM manufacturing line.
- 2021-2023 **High Resolution 3D Reconstruction**, Graduate Research Assistant, UVA/Honda.
Developed a mobile photometric stereo based robotic scanning apparatus for high resolution 3D reconstruction; Devised a novel adaptive approach to overcome diverse reflectance criteria in real-world scenes; Designed and developed a mobile road profiling setup for generating 3D profile upto 30 μm resolution for Honda Research; Fused feature matching to reconstruct large surfaces **[C1, C2]**.

- 2021-2022 **Multi-robot Maintenance**, Graduate Research Assistant, UPenn.
Led a 6-member team to develop a multi-robot team for the inspection and maintenance; developed motion planning, navigation, and vision stack; developed mobile-manipulator planner and controller for visual servoing [J3].
- 2015-2018 **NSIT Solar Car**, Team Lead/Engineering Lead, NSIT.
Led a team of 30 students to fabricate India's fastest single-seater solar electric vehicle; developed novel negative die CFRP fabrication technique; **raised \$30,000** from government and private agencies; project received special recognition from the Hon' Prime Minister of India's Office

Work Experience

- June 2023 - **CCC Intelligent Solutions**, *Data Science R&D Intern*, Charlottesville, VA.
Aug 2023 Designing streamlined software system for image based Labour Hour and Repair Cost prediction using AI tools
- Jun 2020 - **University of Pennsylvania**, *Research Engineer*, Philadelphia, PA.
Oct 2020 Developing a MPC for long-horizon motion planning and cascaded PID controller for low-level actuator control of an Unmanned Underwater Vehicle in simulation
- Jun 2019 - **Bosch Research LLC**, *Li-ion Battery HIL Testing Intern*, Sunnyvale, CA.
Aug 2019 Developed a Matlab software pipeline for data processing with interactive GUI for analysis of experimental data of Hardware-in-loop Li-ion battery cycling testing
- Oct 2018 - **University of Pennsylvania**, *Lab Assistant*, Philadelphia, PA.
Dec 2019 Building interactive CAD models of experimental setup mechanisms; worked with lab manager to design new experimental setups; maintained lab inventory and supplies

Teaching

Teaching Assistant

- Fall 2023 MAE 6210 (UVA) - Analytical Dynamics - (**Co-Instructor**)
Fall 2023 MAE 2330 (UVA) - Mechanics Lab
Fall 2022 MAE 6592 (UVA) - Experimental Robotics
Spring 2022 MAE 6260 (UVA) - Robotic Autonomy
Fall 2021 MAE 6592 (UVA) - Experimental Robotics
Fall 2021 MAE 4620 (UVA) - ME Design I
Spring 2021 MAE 4710 (UVA) - Mechatronics

Grader

- Spring 2024 MAE 2320 (UVA) - Dynamics
Spring 2020 ESE 619 (UPenn) - Model Predictive Control
Fall 2019 ESE 615 (UPenn) - Non-linear Control

Awards & Fellowships

- Fall 2024 Raven Society Fellow (UVA)
- Fall 2023 SEAS Teaching Fellowship (UVA)
- Spring 2023 Link Lab/CCI Interdisciplinary Research Proposal (\$2000)
- Fall 2022 International Student Citizen Leader Fellowship (UVA)
- Spring 2022 Link Lab Flash Talk Awardee (UVA)

Talks & Posters

- March 2024 Leveraging Human Demonstrations for Long Horizon Robotic Assembly - *UVA Engineering Research Symposium (Poster)*
- Oct 2022 Combining Light Sectioning and Photometric Stereo for High Resolution 3D Reconstruction - *MAE Fall Research Fair (Poster)*
- August 2022 Photometric Stereo Enhanced Light Sectioning Approach for Microtexture Road Profiling - *ASME IDTEC/CIE (Presentation)*
- Feb 2022 Structure from Intensity: High Precision 3D Reconstruction - *Link Lab Flash Talks (Awardee)*
- Feb 2022 Structure from Intensity: High Precision 3D Reconstruction - *MAE Graduate Seminar Speaker*

Service & Volunteer

Journal Peer Review

- Robotic Automation Letters, IEEE
- Signal, Image and Video Processing, Springer Nature
- Transactions on Automation Science and Engineering, IEEE

Conference Peer Review

- ICRA, IROS, IDETC/CIE, ASEE 2023
- ICRA, IROS, IDETC/CIE 2022
- ICRA 2021

Volunteering

- International Student Liaison, GESC (UVA) 2023-2024
- International Student Volunteer, GESC (UVA) 2022-2023
- Social Chair, MAE-GSB (UVA) 2021-2022
- Panel Speaker TAGS Workshop, CALC-UVA 2022-2024
- Link Lab - C'Ville High School Mentorship (UVA) 2025