

# Siddharth Singh

PH.D. CANDIDATE IN ROBOTICS · UNIVERSITY OF VIRGINIA

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## Summary

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I am a Ph.D. candidate at the University of Virginia, researching on developing solutions that can generalize to real-world environments. My research encompasses learning based methods, classical methods and/or a combination of both. With expertise across the complete robotics motion planning stack, I bring in-depth knowledge spanning mechatronics, product design/fabrication, and computer vision additional to my knowledge and experience in control theory and planning, all grounded in a solid theoretical foundation. My extensive teaching experience further reflects my commitment to knowledge sharing and academic leadership.

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

## Education

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### University of Virginia

PH.D., MECHANICAL AEROSPACE & ENGINEERING

Charlottesville, VA, US

Jan 2021 – Dec 2025 (Expected)

- Advisor: Prof. Cindy Chang
- Research: Robotic Learning, Task & Motion Planning, Multi-Agent Systems

### University of Pennsylvania

M.S.E, MECHANICAL ENGINEERING

Philadelphia, PA, US

Aug 2018 – May 2020

- Research: Predictive Control for Learning based Systems
- Focus: Robotics, Control Theory, Mechatronics

### Netaji Subhas Institute of Technology (NSIT)

B.E., MANUFACTURING PROCESS AND AUTOMATION ENGINEERING

Delhi, India

Aug 2014 – May 2018

- Advisor: Prof. Vineet Kumar and Dr. Pradeep Khanna
- Thesis: Non-Linear MPC for Electro-Hydraulic Actuated Active Suspension System

## Skills

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**Programming Languages:** Python, C, C++, HTML, CSS, MATLAB

**Softwares & Tools:** Simulink, RViz, Gazebo, SolidWorks, Fusion 360, OnShape,  $\text{\LaTeX}$ , Git

**Library & Packages** PyTorch, Tensorflow, RtabMap, MoveIt, RelaxedIK, PyBullet, MuJoCo, Genesis, VMAS

**Robotic Frameworks:** ROS/ROS2, NavStack

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

## Work Experience

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2021–Now **Graduate Research Assistant**, Mechanical & Aerospace Engineering, UVA

2023–2023 **Data Science R&D Intern**, CCC Intelligent Solutions, *Remote*

2020–2020 **Graduate Research Assistant**, Electrical & Systems Engineering, University of Pennsylvania, Philadelphia, PA

2019–2019 **Li-ion Battery Research Intern**, Bosch Research, Sunnyvale, CA

2018–2020 **Lab Assistant**, Mechanical Engineering & Applied Mechanics, University of Pennsylvania, Philadelphia, PA

## Publications

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### JOURNALS

- [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, Preprint: <https://arxiv.org/pdf/2502.19340>*
- [J2] Xu T., **Singh S.** & Chang Q., Collaborative Multi-Agent Closed-Loop Motion Planning for Multi-Manipulator Systems, *Under Review*
- [J3] 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>*.
- [J4] **Singh, S.**, Chang, Q. & Yu, T. (2025), Hierarchical Learning for Robotic Assembly Tasks Leveraging Learning from Demonstration. Advanced Robotics Research, 1: 2400024. <https://doi.org/10.1002/adrr.202400024>
- [J5] 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>

### CONFERENCES

- [C1] **Singh S.**, Xu T. & Chang Q., Collaborative motion planning for multi-manipulator systems through Reinforcement Learning and Dynamic Movement Primitives, ICRA, IEEE, Atlanta, GA, USA, Jun 19-23, 2025, Pre-print: <https://doi.org/10.48550/arXiv.2410.00757>
- [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. <https://doi.org/10.1117/12.2675449>
- [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. <https://doi.org/10.1115/DETC2022-91154>

### WORKSHOPS

- [W1] Smith W., **Singh S.**, Rudy J & Guan Y., Whole Body Planning of Mobile Manipulators Leveraging Lie Theory based Optimization, *Workshop on Mobile Manipulation: Emerging Opportunities & Contemporary Challenges*, RSS, June 21, 2025, Los Angeles, CA, USA

## Projects

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### Deploying LfD based Motion Planning for Industrial Robots

UVA/ARM Institute

#### GRADUATE RESEARCH ASSISTANT

Aug 2023 – Dec 2023

- Successfully developed a PyBullet environment and implemented LfD based motion planning method for robotic bolting in automotive manufacturing line.
- Worked in collaboration with General Motors, Siemens & GE Research funded by ARM Institute; the final deliverable is successfully validated on a GM manufacturing line.

### High Resolution 3D Reconstruction

UVA/Honda

#### GRADUATE RESEARCH ASSISTANT

Jan 2021 – Jan 2023

- 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 up to 30  $\mu\text{m}$  resolution for Honda Research; Fused feature matching to reconstruct large surfaces [C2, C3].

### Multi-robot Maintenance

UVA/ONR

#### GRADUATE RESEARCH ASSISTANT

Jan 2021 – Jun 2022

- 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 [J4].

## Assured Autonomy

### GRADUATE RESEARCH/RESEARCH ENGINEER

UPenn

Jan 2020 – Oct 2020

- System Identification for Underwater Unmanned Vehicle (UUV) in simulation.
- Validated a Neural-Network based system identification approach.
- Designed a cascaded PID controller for low-level control of UUV actuators.

## NSIT Solar Car

### TEAM LEAD/ENGINEERING LEAD

NSIT

May 2015 – May 2018

- **Led a team of 30 students** to fabricate India's fastest single-seater solar electric vehicle.
- Developed novel negative die-based in house CFRP fabrication technique.
- **Raised \$30,000** from government and private agencies.
- Project received special recognition from the Hon' Prime Minister of India's Office.

## Presentations

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### CONFERENCE PRESENTATIONS

- S. Singh, T. Xu and Q. Chang, "Collaborative motion planning for multi-manipulator systems through Reinforcement Learning and Dynamic Movement Primitives", ICRA, IEEE, Atlanta, GA, USA, June 19-23, 2025
- S. Singh, K. Smith and T. Furukawa, "Photometric Stereo Enhanced Light Sectioning Approach for Microtexture Road Profiling, ASME IDTEC/CIE Conference. St. Louis, Missouri, USA. August 14-17, 2022

### POSTER PRESENTATIONS

- March 2024** *Leveraging Human Demonstrations for Long Horizon Robotic Assembly* at University of Virginia Engineering Research Symposium, UVA, Charlottesville, VA
- October 2022** *Combining Light Sectioning and Photometric Stereo for High Resolution 3D Reconstruction* at MAE Fall Research Fair, UVA, Charlottesville, VA

### TALKS AND GUEST LECTURE

- February 2025** *Introduction Rotation: Rotation Matrices, Lie-Theory and Quaternions*. Guest Lecture MAE 6210 (Advanced Dynamics) at UVA, Charlottesville, VA
- November 2024** *Jack of all Trades: MPC v/s RL*, STEM Communication Practice at UVA, Charlottesville, VA
- April 2022** *MAE Graduate Seminar- "High Resolution Shape from Intensity"*, UVA, Charlottesville, VA
- March 2022** *MATLAB Tools & Tips for Image Processing* at Link Lab at UVA, Charlottesville, VA
- February 2022** *Link Lab Flash Talk* at Link Lab at UVA, Charlottesville, VA

## Awards and Fellowships

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### Raven Society Fellow

UVA

#### ELECTED BY RAVEN SOCIETY FELLOWS, UNIVERSITY OF VIRGINIA

Fall 2024

Oldest society at the University of Virginia. Elected by the existing members for "Service to the University and Scholastic Achievements"

### SEAS Teaching Fellowship, \$20000

CTE/UVA

#### AWARDED BY UNIVERSITY OF VIRGINIA & CENTER OF TEACHING EXCELLENCE

Fall 2023

For designing and co-teaching a graduate level course "MAE 6210 Analytical Dynamics"

### Link Lab - CCI Interdisciplinary Proposal Writing Competition, \$2000

CCI/UVA

#### AWARDED BY COMMONWEALTH CYBER INITIATIVE (CCI) AND LINK LAB

Fall 2023

For proposal titled "Designing and Developing Texture-Aware Soft Robotics for Enhanced Tactile Perception and Manipulation"

## International Student Citizen Leader Fellowship

CENTER OF CONTEMPLATIVE SCIENCES & INTERNATIONAL STUDIES OFFICE, UVA

Developing a university-wide Pre-orientation program with ISO and ISSP at UVA

UVA

Fall 2023

## Link Lab Flash Talk Awardee

LINK LAB

Presenting a flash talk on "High-resolution Shape from Intensity"

UVA

Sp. 2022

## Teaching Experience

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### TEACHING ASSISTANT

Sp. 2024	MAE 3820, Aerodynamics Lab	UVA
Fall 2023	MAE 6210, Analytical Dynamics, <b>Co-Instructor - CTE Fellow</b>	UVA
Sp. 2023	MAE 2330, Mechanics Lab	UVA
Fall 2022	MAE 6592, Experimental Robotics	UVA
Sp. 2022	MAE 6260, Robotic Autonomy	UVA
Fall 2021	MAE 6592, Experimental Robotics	UVA
Fall 2021	MAE 4620, ME Design Capstone I	UVA

### GRADER

Fall 2024	MAE 2320, Dynamics	UVA
Sp. 2020	ESE 619, Model Predictive Control	UPenn
Fall 2019	ESE 615, Non-Linear Control	UPenn

### CERTIFICATION

#### Center for Teaching & Excellence, c3 Course Design

UNIVERSITY OF VIRGINIA

Certification in course design as a part of CTE Teaching Fellowship

Charlottesville, VA

Summer 2023

## Mentoring

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2020-2023	William Smith, Research Scientist, ARA	M.S., UVA
2021-2023	Julia Rudy, Researcher, Naval Research Lab	M.S., UVA
2022-2023	Gilchrist Johnson, Ph.D. Student at CalTech	B.S., UVA
2021-2022	Hudson Burke, M.S Student at UVA	B.S., UVA
2021-2023	UVA Solar Car, Mentored a team of undergrads to build and participate in the US-FSGP	UVA
2021-2023	Honda/UVA, Mentored two M.S. students to build a mobile Photometric stereo setup	UVA

## Volunteering & Service

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### OUTREACH & VOLUNTEERING

• C'ville High School - Link Lab Volunteering, (UVA)	2025
• International Student Liasion, GESC (UVA)	2023-2024
• International Student Volunteer, GESC (UVA)	2022-2023
• Social Chair, MAE-GSB (UVA)	2021-2022
• Panel Speaker, CALEC TAGS Workshop (UVA)	2023, 2024
• Panel Speaker, ISSP Pre-Arrival Orientation (UVA)	2023, 2024

### JOURNAL & LETTERS PEER REVIEW

- Signal, Image and Video Processing, Springer Nature

- Robotic Automation Letters, IEEE
- Transactions on Automation Science and Engineering, IEEE
- Transactions on Robotics, IEEE

#### **CONFERENCE PEER REVIEW**

- IEEE ICRA - 2021, 2022, 2023, 2024
- IEEE IROS - 2022, 2023
- ASME IDETC/CIE - 2022, 2023