

HIMANI SINHMAR

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EDUCATION

Ph.D. *Aerospace Engineering, Cornell University* (Aug'19 - Aug'24)
Specialization in Robotics, Minor in Computer Science

Bachelor and Master of Technology *Indian Institute of Technology Bombay* ('14 - '19)
Specialization in System and Controls, Major in Aerospace Engineering, Minor in Physics

PROFESSIONAL EXPERIENCE

Postdoctoral Research Associate *Princeton University* (Sept'24 - present)
[Leonard Lab](#)

Research Internship *Mitsubishi Electric Research Laboratories (MERL)* (May'23 - Aug'23)
[Control and Autonomy Group](#)

RESEARCH FOCUS

I develop theoretically grounded and decentralized control frameworks for resource-constrained robotic systems, with a focus on the mathematical modeling of collective intelligence and the engineering of multi-agent coordination. By integrating tools from nonlinear opinion dynamics, control theory, formal methods, and reinforcement learning, my work enables safe, scalable, and adaptive autonomy in dynamic, uncertain, and infrastructure-limited environments.

Research Interests: Control for Autonomy, Collective Intelligence, Resource-Constrained Robots

Robotic Platforms: Mobile manipulator [Stretch Robot](#), [Crazyflie](#) UAV, and Mobile robot [iRobot Create](#)

Programming Languages: C++, Python, MATLAB, C#

Tools: Unity Game engine, Robot Operating System (ROS), ANSYS, SolidWorks

AWARDS

- Caltech EAS Trailblazers Award 2024 (3% acceptance)
- Robotics Science and Systems Pioneers 2024 (15% acceptance)
- MRC Future Leader in Robotics and AI 2025
- Institute Undergraduate Research Award 2018 at IIT Bombay
- Graduate Resident Fellowship, Cornell 2022-2024

INVITED TALKS

- Invited talk on “Control with Guarantees for Minimalist Multi-Robotic Systems” : Princeton May'24, CSAIL MIT Jan'24, CMU Jan'24, UPenn Feb'24, Brown Feb'24
- Invited talk on “Provably Correct Controllers for Minimalist Robotic Swarm” Cornell, Jan'23
- Guest Lecture on “Building Micro Robots for Encapsulating Biological Systems” Introduction to Computational Science and Engineering (ENGRI 1510) Cornell University, May'22
- Poster Presentation “Navigating the Unknown: Minimalistic Robotic Swarm and Stealthy Evaders” Northeast Robotics Colloquium (NERC) 2023, Yale University

PEER-REVIEWED PUBLICATIONS

11. Donggeon David Oh, Justin Lidard, Haimin Hu, **Himani Sinhmar**, Elle Lazarski, Deepak Gopinath, Emily S. Sumner, Jonathan A. DeCastro, Guy Rosman, Naomi Ehrich Leonard, Jaime Fernández Fisac *Safety with Agency: Human-Centered Safety Filter with Application to AI-Assisted Motorsports*, [Paper] Robotics: Science and Systems 2025
10. Marcus Greiff, Stefano Di Cairano, **Himani Sinhmar** *Motion Planning and Control with Multi-Stage Construction of Invariant Sets*, US Patent, Pending, Filed March 2024
9. **Himani Sinhmar**, Hadas Kress-Gazit, *Multi-Source Encapsulation With Guaranteed Convergence Using Minimalist Robots*, [Paper] Distributed Autonomous Robotic Systems (DARS) 2024
8. **Himani Sinhmar**, Hadas Kress-Gazit, *Decentralized Control of Minimalistic Robotic Swarms For Guaranteed Encapsulation Behavior*, [Paper] International Conference on Intelligent Robots and Systems (IROS) 2022
7. **Himani Sinhmar**, Hadas Kress-Gazit, *Guaranteed Encapsulation of Targets with Unknown Motion by a Minimalist Robotic Swarm*, [Paper] Transactions on Robotics (T-RO) 2023
6. **Himani Sinhmar**, Marcus Greiff, Stefano Di Cairano *Practical and Safe Navigation Function Based Motion Planning of UAVs*, International Conference on Robotics and Automation (ICRA'24)
5. Marcus Greiff, **Himani Sinhmar**, Avishai Weiss, Karl Berntorp, Stefano Di Cairano *Invariant Set Planning for Quadrotors: Design, Analysis, Experiments*, Transactions on Control Systems Technology (TCST) 2024
4. Qingkun Liu*, Wei Wang*, **Himani Simhmar**, Itay Griniasty, Jason Z. Kim, Jacob T. Pelster, Parag Chaudhari, Michael F. Reynolds, Michael C. Cao, David A. Muller, Alyssa B. Apsel, Nicholas L. Abbott, Hadas Kress-Gazit, Paul. L. McEuen, Itai Cohen *Electronically configurable microscopic metasheet robots*, Nature Materials 2024
3. Pallavi Sinha, Srikant Sukumar, **Himani Sinhmar**, *Consensus of networked double integrator systems under sensor bias*, [Paper] International Journal of Adaptive Control and Signal Processing 2022
2. **Himani Sinhmar**, Srikant Sukumar, *Distributed model independent algorithm for spacecraft synchronization under relative measurement bias* [Paper], 5th CEAS Conference on GNC 2019
1. **Himani Sinhmar**, Vinod Kumar, *Relative Autonomous Navigation Without Communication Between Spacecraft Using Line of Sight Measurements* [Paper] IEEE/CSAA GNC Conference August 2018

RESPONSIBILITIES

- **Reviewer** for *IEEE Transactions on Robotics*, *IEEE Transactions on Automatic Control*, *Springer Autonomous Robots*, *The International Journal of Robotics Research*, *IEEE Robotics Automation Letters*, *Robotics: Science and Systems*, *ICRA*, *IROS*
- **Website and Publicity Chair**, Robotics: Science and Systems Pioneers 2025
- **Session Chair** for: *Swarm Robotics* IROS 2022, *Navigation Technology* IEEE/CSAA GNC 2018
- **Teaching Assistant**: Autonomous Mobile Robots, Spaceflight Mechanics, Dynamics and Control
- **Chief Editor** for department newsletter [Lift-Off](#) (2016-17)
- **Co-organizer** for the International conference on *Next Generation Skills Development and Challenges in Aeronautical and Aerospace Industry* with Aeronautical Society of India

RESEARCH EXPERIENCE

Practical and Safe Motion Planning of UAVs

(Summer'23)

Research Intern with [Dr. Marcus Greiff](#), Mitsubishi Electric Research Labs (MERL)

- Developed a reference governor-based motion planning framework by introducing a refined artificial potential function for non-convex free spaces, enabling certifiably safe real-time operation of a Crazyflie UAV in cluttered environments with polyhedral obstacles and significant input disturbances.

Hardware Algorithm Co-Design for a Morphing Soft Robot

(Fall'19 - Fall'21)

Advisor Prof. [Hadas Kress-Gazit](#), Cornell University

- Created a physics-based simulator using C# scripts and Unity game engine for control synthesis of optimal gaits for micrometer-sized sheet robots (MetaBots) that could form 3D surfaces from 2D actuation patterns, cycle among different shapes, and locomote

Decentralized Control for a Minimalistic Robotic Swarm

(Spring'21 - Spring'24)

Project with Prof. [Hadas Kress-Gazit](#), Cornell University

- Developed provably safe decentralized control strategies ensuring complex desired swarm behavior for robots devoid of memory, localization, and communication abilities

Cooperative Control Under Bias in Measurements

(Summer'18 - Summer'19)

Thesis with Prof. [Srikant Sukumar](#), IIT Bombay, Received *Institute Undergraduate Research Award*

- Created an adaptive control law, utilizing collective initial excitation-based results and Lyapunov stability theory to achieve exponential consensus and accurate bias estimation for bipartite network graphs

Learning for Task Allocation and Motion Planning

(Spring'23)

Project with Prof. [Sanjiban Choudhury](#), Cornell University

- Developed automated task allocation and execution for a heterogeneous multi-robot team using imitation learning, demonstrating the effectiveness of DAgger and Q-learning policies in object collection tasks within 10,000 randomly generated maze scenarios with static obstacles and diverse agent capabilities.

Motion Planning, Localization, and Mapping for iRobot Create [\[github\]](#)

(Spring'20)

Project with Prof. [Hadas Kress-Gazit](#), Cornell University

- Implemented **SLAM** and motion planning algorithms, including **sampling-based methods**, roadmaps, and potential functions, alongside **EKF and particle filters** for state estimation, to enable goal navigation and collision avoidance on the iRobot Create platform using LiDAR and RGB-D data

Task and Motion Planner for Robot Manipulation [\[github\]](#)

(Spring'22)

Project with Prof. [Tapomayukh Bhattacharjee](#), Cornell University

- Developed and implemented a reactive planner on the **Stretch Robot** that autonomously generates physically feasible motion plans based on high-level task specifications and object affordances.

IMU Alignment of a Store Dropped from Aircraft

(Summer'18)

Research Internship with [Dr. Aditya Paranjape](#), Imperial College London

- Developed an in-flight IMU transfer-alignment algorithm for accurate position and attitude estimation of dropped payloads across all flight phases, integrating sensor fusion and state estimation using a fifteen-state Kalman filter within the INS/GPS framework.

Autonomous Navigation for Spacecraft Rendezvous

(Fall'17)

Research Co-op with [Control Dynamics & Simulations Group, ISRO](#)

- Developed an algorithm for autonomous spacecraft navigation, using Line of Sight measurements (LOS) to estimate relative position, attitude, and angular rates, offering a **robust alternative** to traditional gyro-based methods and mitigating errors caused by gyro data loss or communication delays