

# HIMANI SINHMAR

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## EDUCATION

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**Ph.D.** *Aerospace Engineering, Cornell University, Advisor: Prof. [Hadas Kress-Gazit](#)* (2019 - 2024)  
Specialization in Dynamics, Controls and Robotics, Minor in Computer Science

**Bachelor and Master of Technology** *Indian Institute of Technology Bombay* (2014 - 2019)  
Specialization in System and Controls, Major in Aerospace Engineering, Minor in Physics

## RESEARCH FOCUS AND SKILLS

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My research focuses on developing verifiable-safe motion planners and controllers for robotic systems with resource-efficient hardware to tackle the practical limitations inherent in the real world. I achieve real-time execution by co-designing the onboard hardware requirements and the control algorithm for a robotic system. I have implemented these strategies on physical platforms such as mobile manipulator [Stretch Robot](#), UAV [Crazyflie 2.1](#), mobile robots [iRobot Create](#), and [Vectors](#).

**Research Interests:** Motion Planning, Manipulation, Control for Autonomy, Autonomous Mobile Robots

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

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

## PEER-REVIEWED PUBLICATIONS

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6. **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)
5. **Himani Sinhmar**, Hadas Kress-Gazit, *Guaranteed Encapsulation of Targets with Unknown Motion by a Minimalist Robotic Swarm*, [[Paper](#)] under revised review for Transactions on Robotics, (TRO 2023)
4. **Himani Sinhmar**, Marcus Greiff, Stefano Di Cairano *Practical and Safe Navigation Function Based Motion Planning of UAVs*, under review in International Conference on Robotics and Automation, (ICRA 2024)
3. **Himani Sinhmar**, Srikant Sukumar, *Distributed model independent algorithm for spacecraft synchronization under relative measurement bias* [[Paper](#)], 5<sup>th</sup> CEAS Conference on Guidance, Navigation and Control, (EuroGNC 19)
2. **Himani Sinhmar**, Vinod Kumar, *Relative Autonomous Navigation Without Communication Between Spacecraft Using Line of Sight Measurements* [[Paper](#)] IEEE/CSAA Guidance, Navigation and Control Conference, August 2018
1. Pallavi Sinha, Srikant Sukumar, **Himani Sinhmar**, *Consensus of networked double integrator systems under sensor bias*, [[Paper](#)] International Journal of Adaptive Control and Signal Processing

## PROFESSIONAL AND RESEARCH EXPERIENCE

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**Practical and Safe Motion Planning of UAVs** (May'23 - Aug'23)

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

- Developed a reference governor-based motion planning framework by introducing a refined practical version of artificial potential functions for non-convex free spaces
- Demonstrated certifiable-safe real-time operation of a [Crazyflie UAV](#), in an environment cluttered with polyhedral obstacles and significant input disturbances

- Task and Motion Planner for Robot Manipulation** [\[github\]](#) (Jan'22 - May'22)  
*Project with Prof. [Tapomayukh Bhattacharjee](#), Cornell University*
- Developed a reactive planner that automatically generates adaptable, physically feasible motion plans for diverse tasks using high-level task specifications and object affordances.
  - Implemented the planner on **Stretch Robot** for a series of reactive manipulation tasks
- Learning for Task Allocation and Motion Planning** (Jan'23 - May'23)  
*Project with Prof. [Sanjiban Choudhury](#), Cornell University*
- Developed automated task allocation and task execution using imitation learning to optimize resource utilization and cost minimization for a heterogeneous multi-robot team
  - Demonstrated the effectiveness of the developed policies in maximizing the collection of objects in maze scenarios with static obstacles and diverse agent capabilities.
  - Created a dynamic learning environment with randomly generated complex maze instances to facilitate the learning and adaptation of the multi-robot team.
- Decentralized Control for a Minimalistic Robotic Swarm** (Mar'21 - present)  
*Project with Prof. [Hadas Kress-Gazit](#), Cornell University*
- Designed provably correct decentralized control algorithms ensuring complex desired swarm behavior for robots devoid of memory and localization abilities
- Motion Planning, Localization, and Mapping for iRobot Create** [\[github\]](#) (Jan'20 - May'20)  
*Project with Prof. [Hadas Kress-Gazit](#), Cornell University*
- Implemented SLAM algorithm on **iRobot Create** capable of navigating to the given goal point while avoiding collisions with static and dynamic obstacles
- Cooperative Control Under Bias in Measurements** (May'18 - May'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
- Control and Simulation Design for a Morphing Robot** (Aug'19 - Aug'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 a micrometer-sized sheet robots (MetaBots) that could form 3D surfaces from 2D actuation patterns, cycle among different shapes, and locomote
- IMU Alignment of a Store Dropped from Aircraft** (May'18 - Aug'18)  
*Research Internship with [Dr. Aditya Paranjape](#)*
- Designed in-flight IMU transfer-alignment algorithm using multi-sensor fusion for INS/GPS integration
  - Created a Matlab-based simulator to generate repeatable test data in the absence of an IMU unit
- Autonomous Navigation for Spacecraft Rendezvous** (May'17 - Dec'17)  
*Research Co-op with [Control Dynamics & Simulations Group, ISRO](#)*
- Developed a novel algorithm for autonomous navigation in the event of gyro failures or communication eruption between the spacecraft using only line-of-sight measurements
- State Tracking and Fault Diagnosis in Nonlinear uncertain systems** (Jan'18 - Apr'18)  
*Project with Prof. [Srikant Sukumar](#), IIT Bombay*
- Developed a sensor bias estimator for state tracking in model reference adaptive control setting
  - Implemented algorithms on a 4<sup>th</sup> order longitudinal dynamics model of an aircraft in a wings-level cruise

## **Pratham - IIT Bombay Student Satellite Team**

(Aug'14 - Apr'15)

*Successfully launched on 26<sup>th</sup> September 2016*

- Assisted in modeling of the satellite body, panels and other onboard components in SolidWorks
- Performed structural and thermal simulations of the satellite in ANSYS
- Collaborated in the designing, modeling and characterization of Cross Yagi antennas
- Established communication link with the LEO satellites, receiving data using off-the-shelf equipments

## **KEY COURSES**

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<b>Robotics</b>	Autonomous Mobile Robots, Robot Manipulation, Learning for robot decision making Formal methods in robotics, Machine learning, Optimal control, Multivariable control, Adaptive control, Non-linear dynamics, Navigation and guidance
<b>Mathematics</b>	Calculus, Data analysis and interpretation, Differential equations, Linear algebra

## **ACHIEVEMENTS AND RESPONSIBILITIES**

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- Awarded the **Institute Undergraduate Research Award**
- Recipient of INSPIRE scholarship for being in the top 1% in Senior Secondary Examination
- **Session Chair** for: *Swarm Robotics* IROS 2022, *Navigation Technology* IEEE/CSAA GNC 2018
- **Reviewer** for *IEEE Transactions on Robotics* and *IEEE Transactions on Control of Network Systems*
- Lead a session on microscopic robots and differential geometry in [EYH](#) conference
- Head Teaching Assistant: Autonomous Mobile Robots, Spaceflight Mechanics, Dynamics and Control
- Graduate Resident Fellow at Willam T. Keeton House, Cornell University
- Chief Editor for department newsletter [Lift-Off](#) (2016-17)
- Presided an International conference on *Next Generation Skills Development and Challenges in Aeronautical and Aerospace Industry* organized by Aeronautical Society of India