

Himani Sinhmar | CV

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Research Interests

Motion planning, Autonomous vehicles, Swarm robotics, and Learning.

Peer-Reviewed Publications

Himani Sinhmar, Vinod Kumar, *Relative Autonomous Navigation Without Communication Between Spacecraft Using Line of Sight Measurements*, 8th IEEE/CSAA Guidance, Navigation and Control Conference, August 2018, Xiamen, China [[Paper](#)]

Himani Sinhmar, Srikant Sukumar, *Distributed model independent algorithm for spacecraft synchronization under relative measurement bias*, 5th CEAS Conference on Guidance, Navigation and Control, (EuroGNC 19) [[Paper](#)]

Himani Sinhmar, Hadas Kress-Gazit, *Decentralized Control of Minimalistic Robotic Swarms For Guaranteed Encapsulation Behavior* [Under Review]
International Conference on Intelligent Robots and Systems (IROS 2022)

Academic Qualifications

PhD in Aerospace Engineering
Cornell University

GPA : 3.99/4.00
2019–Present

- Advisor: [Prof. Hadas Kress-Gazit](#)
- Minor degree: Computer Science

Integrated Bachelors and Masters in Aerospace Engineering
Indian Institute of Technology Bombay (IIT Bombay)

GPA : 8.7/10.00
2014–2019

- Minor degree: Physics

Notable Achievements

- **Chaired** a session on Navigation Technology in 2018 IEEE/CSAA GNC conference held in China
- Awarded the **Undergraduate Research Award** for exemplary Bachelor's thesis
- Recipient of INSPIRE scholarship for being in the top 1% in Senior Secondary Examination
- **Presided an International conference** on *Next Generation Skills Development and Challenges in Aeronautical and Aerospace Industry* organized by Aeronautical Society of India

Research Experience

Currently, I am developing provable control algorithms for simple, robust, and reliable swarm robots that achieve task completion with minimal information and restricted individual capabilities.

In addition to this, I am collaborating with [Cohen Group](#), [Apsel Lab](#) and [Laboratory for Molecular engineering](#) to synthesis autonomous micron-scale morphing robots for encapsulating biological systems. These tiny robots would have the ability to be injected into the patient and stop the tumors in their tracks when surgery is not an option.

Simultaneous Localization and Motion Planning (SLAM)

Guide : *Prof. Hadas Kress-Gazit, Cornell University*

Jan'20 - May'20

- Executed SLAM algorithm on iRobot's Roomba robot to navigate to the given goal point while avoiding collisions with both dynamic and static obstacles.

Cooperative Control Under Bias in Measurements

Master's Thesis

Guide : *Prof. Srikant Sukumar, Systems and Control Engg., IIT Bombay*

May'18 - Jun'19

- Developed a Lyapunov based decentralized control algorithm which ensures that a multi-agent system tracks a time-varying trajectory in presence of an unknown sensor bias in relative position measurements
- **Exponential bias estimation** was achieved by using initial excitation based results in adaptive estimation
- Performed simulations for spacecraft formation under bias in the measurement of relative position

In-flight IMU Alignment of a Store Dropped from Aircraft

Research Internship

Guide : *Dr. Aditya Paranjape, Imperial College of London*

May'18 - Aug'18

- Implemented the Kalman filter for **low-cost INS/GPS integration** and multi-sensor fusion providing accurate and speedy estimates of the store states in a fast prototyping environment
- Innovated a self-alignment algorithm capable of working with limited & near-minimal sensor information
- Modeled and validated an IMU Simulator to create repeatable test data in the absence of an IMU unit
- Developed the algorithm to address the Transfer Alignment problem, such that the final algorithm can be used to solve either problem — Self Alignment or Transfer Alignment

Autonomous Navigation for Spacecraft Rendezvous

Research Internship

Control Dynamics & Simulations Group, ISRO, Bangalore

May'17 - Jul'17

- Formulated and simulated an algorithm for autonomous navigation in the event of **gyro failures or communication eruption** between the spacecraft using only line of sight measurements
- Programmed an Extended Kalman filter for relative state estimation of 6 DOF spacecraft
- Developed a high fidelity model to simulate relative motion in perturbed orbital environment
- Designed a PD controller for static thrusters to perform rendezvous of two satellites

Modeling of Turbojet and Ramjet Propulsion System

Bachelor's Thesis

Guide: *Prof. Shripad Mahulikar, Aerospace Engg., IIT Bombay*

Nov'16 - Nov'17

- Developed a methodology to obtain optimal combustion inlet Mach number and temperature for generating maximum thrust in a ramjet for a given flight condition
- Modeled isobaric and variable pressure combustion in jet engine to assess the propulsive efficiency and thrust
- Articulated the model's application to Scramjet engine for generating net positive thrust

State Tracking and Fault Diagnosis in Nonlinear uncertain systems

Guide : *Prof. Sukumar Srikant, Systems and Control Engg., IIT Bombay*

Jan'18 - Apr'18

- Developed a sensor bias estimator accomplishing state tracking in model reference adaptive control setting
- Presented a sensor fault detection scheme for nonlinear systems with unstructured modeling uncertainty
- Implemented algorithms on a 4th order longitudinal dynamics model of an aircraft in a wings-level cruise

Pratham - IIT Bombay Student Satellite Team

Successfully launched on 26th September 2016

Aug'14 - Apr'15

- 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

Self-Balancing Robot

Institute Technical Summer Project, IIT Bombay

May'15 - Jun'15

- Fabricated a model to balance an unstable robotic platform on two wheels using PID Controller
- Incorporated an IMU chip with an Arduino for implementing control algorithm
- Improved stability by fusing calibrated values from the gyroscope and accelerometer with Kalman filter

Technical Skills

Programming	C++, Python, C#, MATLAB, Maple, Mathematica, R, \LaTeX
Softwares	Unity Game engine, ROS, ANSYS, ICEM-CFD, SolidWorks, AutoCAD

Key Courses

Systems & Control	Autonomous Mobile Robots, Machine learning, Non-linear Dynamics, Multivariable Control, Adaptive Control, Optimal Control, Flight Dynamics, Control System Design Techniques, Navigation and Guidance
Mathematics	Calculus, Data Analysis and Interpretation, Differential Equations, Linear Algebra, Numerical Analysis

Position of Responsibility

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| ○ Graduate Teaching Assistant , <i>Autonomous Mobile Robots</i> | <i>Jan'21 - May'21</i> |
| ○ Graduate Teaching Assistant , <i>System Modeling Dynamics and Control</i> | <i>Jul'18 - Nov'18</i> |
| ○ Graduate Teaching Assistant , <i>Spaceflight Mechanics</i> | <i>Jan'19 - May'19</i> |
| ○ Editor , <i>Department Newsletter</i> - <i>Lift-Off</i> | <i>May'16 - May'17</i> |