

Research Interests: Regolith Mechanics, Planetary Defense, Astrodynamics, Spacecraft Mission Design, SmallSats

Teaching Interests: Aerospace Design, Space Systems Engineering, Astrodynamics, Computational Methods for Aerospace Engineering

Education

- 2026 **PhD, Aerospace Engineering**, *University of Maryland, College Park*, Advisor: Prof. Christine Hartzell, Thesis: *Role of Magnetic Forces on Regolith Behavior on Metallic Asteroids with a Residual Magnetic Field*.
Major: Flight Dynamics and Control; Minor: Space Systems
- 2020 **MS, Aerospace Engineering**, *Indian Institute of Technology (IIT) Bombay*, Advisor: Prof. Ravi Banavar, Thesis: *Discrete mechanics and optimal control techniques applied to a reentry launch vehicle*.
- 2020 **BS, Aerospace Engineering**, *Indian Institute of Technology (IIT) Bombay*.

Research Experience

- 2026 - present **Postdoctoral Associate** *Advisor: Prof. Christine Hartzell, UMD*
- Conducting DEM modeling of magnetic granular avalanches on asteroid (16) Psyche to investigate density-driven segregation and magnetic accumulation in crater basins
 - Quantifying plasma wave detection rates for single-spacecraft multi-sensor architectures to detect orbital debris in LEO, while authoring journal articles and technical reports
 - Mentoring incoming graduate researchers on orbital debris detection workflows
- 2025 - 2026 **Graduate Research Assistant** *Advisor: Prof. Christine Hartzell, UMD*
- Modelled CubeSat orbital trajectories to optimize sensor placement using Monte Carlo simulations of the LEO debris environment to maximize detection probability for NASA's NIAC Phase II Project
- 2021 - 2026 **Doctoral Thesis** *Advisor: Prof. Christine Hartzell, UMD*
- Geophysical Characterization*: Conducted multi-scenario avalanching simulations to map the conditions on asteroid 16-Psyche where the magnetic forces dictate the surface morphology
 - Computational Framework*: Developed the first experimentally validated open-source DEM framework to simulate magnetic regolith, established a critical magnetic time-step for numerical stability ([Sikka & Hartzell 2026](#))
 - Analytical Modeling*: Formulated an empirical force model for inter-particle interactions between paramagnetic grains in uniform magnetic fields, tailored for M-type asteroids ([Sikka et al. 2023](#))
- 2019 - 2020 **Master's Thesis** *Advisor: Prof. Ravi Banavar, IIT Bombay*
- Formulated glide-type launch-vehicle re-entry as an optimal control to minimize the total thermal flux for Indian Space Research Organization (ISRO)'s Reusable Launch Vehicle (RLV-TD) Project
 - Compared direct optimization (CasADi in Python) and indirect optimization (Discrete-time Maximum Principle) methods while minimizing the total thermal flux on the vehicle
- 2018 **Bachelor's Thesis** *Advisor: Prof. Ashok Joshi, IIT Bombay*
- Implemented and optimised the Differential Evolution (DE), a genetic algorithm to solve Lambert's problem for a perturbed orbit with an accuracy of determined orbital elements within 10 centimeters
- Summer 2017 **Summer Research Intern** *Advisor: Prof. R. V. Ramanan, IIST, Thiruvananthapuram*
- Analysed finite-burn maneuver parameters like starting position, burn time and steering techniques to optimize the achieved orbit under minimum fuel consumption

Awards and Fellowships

- Fall 2024 **Dean's Fellowship** *Aerospace Engineering, University of Maryland for 2024-25 Academic Year*
- Spring 2024 **Future Faculty Fellow** *A. James Clark School of Engineering, University of Maryland*
- 2020 **Institute Technical Citation** *Technical Council of IIT Bombay*
- 2019 **2nd place at CubeSat Design Challenge** *International Conference on Small Satellites (ICSS)*
- 2019 **Institute Technical Color** *Technical Council of IIT Bombay*
- 2015 **Kishore Vaigyanik Protsahan Yojna (KVPY) Fellowship** *Department of Science & Technology, India*
- 2013 **National Talent Search Examination (NTSE) Fellowship** *NCERT, India*
- 2011 **2nd place at University of Toronto Space Design Contest (UTSDC)** *Held in Toronto, Canada*

Journal Articles

- 2026 **A.Sikka**, C.M.Hartzell. *Investigating the Role of Magnetic Cohesion in Avalanching on 16-Psyche: A Discrete Element Modeling Approach.*, submitted to Planetary Science Journal
- 2026 **A.Sikka**, C.M.Hartzell. *An Experimentally Validated Magnetic Force Model for Discrete Element Modeling of Paramagnetic Granular Media.*, Granular Matter, 28, 53 (2026). DOI: [10.1007/s10035-026-01643-x](https://doi.org/10.1007/s10035-026-01643-x)
- 2023 **A.Sikka**, I.DesJardin, T.Leps, and C.Hartzell, *Development of an Empirical Model of the Force between Paramagnetic Particles in Uniform Magnetic Field on M-type Asteroids*, en, The Planetary Science Journal, vol. 4, no. 7, p. 129, Jul. 2023, Publisher: IOP Publishing, DOI: [110.3847/PSJ/ace323](https://doi.org/10.3847/PSJ/ace323).

White Papers

- 2024 M.Hirabayashi et al. (incl. **A.Sikka**) *Near-Earth Objects Workshops to Assess Reconnaissance for Planetary Defense: Working Groups Final Report*. LINK: ntrs.nasa.gov/citations/20250005751

Conference Proceedings

Oral Presentations

- 2024 **A.Sikka** and C.Hartzell. *DEM Simulations of avalanching of metallic regolith under the influence of magnetic forces*. At 56th Annual Meeting of the Division for Planetary Sciences (DPS), Oct. 2024
- 2024 **A.Sikka** and C.Hartzell. *Extending LIGGGHTS to Perform Discrete Element Method Simulations of Mass Wasting Events in Uniform Magnetic Field on Psyche (16)-Like Metallic Bodies*. At 54nd LPSC, Mar. 2024
- 2022 **A.Sikka**, I.DesJardin and C.Hartzell. *Characterizing Magnetic Force Between Paramagnetic Particles of Magnetic Asteroids*. At 52nd Lunar Planetary Science Conference (LPSC), Mar. 2022

Poster Presentations

- 2024 **A.Sikka** and C.Hartzell. *Magnetic Force Model to simulate Avalanching on Metallic Asteroids like 16-Psyche*. At Granular Matter Gordon Research Seminar (GRS) and Conference (GRC), Jun. 2024
- 2023 **A.Sikka** and C.Hartzell. *Empirical model of the force between paramagnetic particles in uniform magnetic field on m-type asteroids*. At Asteroids, Comets and Meteors (ACM) Conference, Jun. 2023

Second Author (*equal contribution)

- 2021 A.R.Ranade*, **A.Sikka*** et al. *Survey and Analysis of Payloads for Missions on PSLV's Orbital Platform*. In Scitech Forum, American Institute of Aeronautics and Astronautics (AIAA), 2021
- 2020 Y.Sanghvi*, **A.Sikka*** and A.R. Ranade. *Quality Assurance Practices for Student Satellite Teams*. In Advances in Small Satellite Technologies, Springer, Singapore, 2020, pp. 439–450.

Other Author

- 2024 I.Mishra et al. (incl. **A.Sikka**) *A Concept for a New Frontiers Class Ceres Lander*. At the annual American Geophysical Union (AGU) meeting, Dec. 2024
- 2023 M.Buys et al. (incl. **A.Sikka**) *SIZLE: Smallsat to Image Zodiacal Light Above Ecliptic*. in ASCEND, American Institute of Aeronautics and Astronautics (AIAA), Oct. 2023
- 2020 K.Jagdale et al. (incl. **A.Sikka**) *Sanket - Technology Demonstration of Antenna Deployment System on PSLV Stage 4 Orbital Platform*. At Small Satellite Technology & Applications National Conference, 2020
- 2019 A.R.Ranade, et al. (incl. **A.Sikka**) *Learnings from Pratham, First Student Satellite of IIT Bombay*. At International Conference on Small Satellites (ICSS), Feb. 2019

Relevant Expertise

Programming Languages Python, C++, LaTeX, HTML/CSS

Programming Experience Numerical Methods, HPC, Parallel Computing, SSH, Git

Teaching Topics Engineering mechanics, dynamics, design under constraints, systems engineering

Operating Systems Linux, Windows, MacOS

CAD & Simulation SOLIDWORKS, ANSYS, Discrete Element Modeling (DEM), LIGGGHTS

Hands-on Engineering Vibration testing, thermal-vacuum test plan, prototype integration & validation

Engineering Experience

- Summer 2024 **CORA: Ceres Ocean Reconnaissance and Analysis** *JPL's Planetary Science Summer School (PSSS)*
- Collaborated with a 17-person team on CORA, a New Frontiers class lander/hopper mission to study Ceres' Occator crater
 - Estimated and maintained costs for each NASA Work Breakdown Structure (WBS) within allocated budgets using JPL Institutional Cost Models (ICM) as the cost lead
 - Worked alongside JPL's Team X for the point design study onsite at JPL in the culminating week
- Feb. 2023 **Lucy Occultations Campaign** *Southwest Research Institute (SWRI)*
- Trained to set up & operate a CPC1100 telescope at remote locations (Deployed in KS for the campaign)
 - Confirmed detection of Asteroid Polymele, Lucy mission's target, by analyzing light curves in Python
- Summer 2022 **SIZLE: Smallsat to Image Zodiacal Light Above Ecliptic** *Cornell SmallSat Summer Design School*
- Collaborated with a 20-person team on a SMEX mission concept as the systems engineer
 - Acted as the bridge between the science and engineering teams to convert the science traceability matrix requirements to engineering requirements
- 2020 - 2021 **Low-thrust Trajectory Design to Outer-Planets**
- Implemented a c++ framework based on indirect method and genetic algorithm to design optimal low-thrust trajectories to outer planets using gravity assist

IIT Bombay Student Satellite Project - An interdisciplinary team of 40+ members across four subsystems

A student-run initiative to convert IIT Bombay to a Center of Excellence in Satellite and Space Technology

- 2018 - 2020 **Systems Engineer & Project Manager**
- Took over leadership during a critical time to ensure continuity post-launch of the first satellite along with the changes in the student satellite policies by the Indian Space Research Organisation (ISRO)
 - Secured and maintained transparency of 1.5M INR funding every year in competitive grant applications
 - Finalised the mission statement and payload from 30+ proposed payload ideas for Advitiy, a CubeSat concept to broadcast SSTV images to Indian villages, increasing space awareness
 - Ensured implementation of Quality Assurance Practices; verified by ISRO scientists
- 2016 - 2017 **Mechanical Engineer** *Pratham, First Student Satellite of IIT Bombay, launched on 26th Sep.'16*
- Qualified satellite interface design through vibration testing at U. R. Rao Satellite Centre (URSC), Bengaluru, leveraging Solidworks and ANSYS Workbench to validate performance under PSLV launch specifications
 - Developed testing plan of all onboard subsystems in vacuum undergoing temperatures of -60°C to 100°C for the environment testing of the flight model

Professional Service and Affiliations

AAS Student Member

AIAA Student Member

- 2025 **Judge - Space Technology Payload Challenge** *NASA TechLeap 2025*
- 2024 - 2026 **Executive Secretary** *NASA ROSES Review Panels*
- Oct 2024 **Co-chair at AAS DPS Meeting** *Lab Studies, Meteorites, and Instrument/Mission Development – Part 2*
- 2024 **Working Group Member** *Near-Earth Objects Workshops to Assess Reconnaissance for Planetary Defense*

Teaching & Mentoring Experience

Graduate Teaching Assistant

University of Maryland, College Park

- Spring 2025 Space Flight Dynamics - ENAE 404
- Fall 2024 Spacecraft Navigation and Guidance - ENAE 441
- Designed and delivered active-learning recitations and formative assessments to improve conceptual understanding and problem-solving confidence
 - Developed programming-based assignments in Python and MATLAB to connect dynamics and guidance theory with practical engineering workflows

2024 **Future Faculty Fellow** *A. James Clark School of Engineering, University of Maryland*

- Selected for UMD's [Future Faculty Program](#), which prepares doctoral fellows for faculty careers through training in pedagogy, course design, active learning, assessment, and research mentoring

Graduate Teaching Assistant *IIT Bombay*

Spring 2020 Spaceflight Mechanics & Dynamics - AE240 & AE713

Fall 2019 Aerodynamics of Aerospace Vehicles - AE707

- Supported students in applying analytical foundations to aerospace design and problem-solving
- Facilitated problem-solving sessions and one-on-one mentoring for a diverse student group

2024 **Research Mentor** *Planetary Surfaces and Spacecraft Lab*

- Mentored first-year undergraduates and a high-school student on Brazil nut effect research in simulations of paramagnetic particles
- Provided structured mentoring with regular checkpoints, emphasizing inclusive team practices and clear technical communication

2021 **Team Mentor** *Terps in Space Mission 16, University of Maryland*

- Co-mentored four sophomores to design a space experiment selected for flight to the International Space Station

2018 - 2020 **Social Goal as Project Manager** *IIT Bombay Student Satellite Team*

- Structured & contributed to [Satellite 101](#) wiki as a comprehensive resource for new satellite teams, covering project management, systems engineering, and technical design
- Organised **Ground-station Workshop** for 50+ students from 15+ colleges of India; Taught *Systems Engineering Principles and Useful Team Building Practices*

Invited Talks and Public Outreach

2026 - present **Space Rocks** - [smallbodies.substack.com](#) *Newsletter on small bodies and planetary defense*

2021 - present **Indian Space Ecosystem Blog** - [blog.aerospacenerd](#) *with 650+ subscribers*

2026 **How Magnetic Interactions Alter the Fluidity of Metallic Asteroid Regolith** *Burgers Symposium, JHU*

2026 **Lightning Talk** *At 34th Meeting of NASA's Small Bodies Assessment Group (SBAG)*

2025 **Unlocking Metallic Worlds: Granular Mechanics on Asteroid Psyche** *Aerospace Dept, IIT Bombay*

2024 **Lightning Talk** *At 31st Meeting of NASA's Small Bodies Assessment Group (SBAG)*

2023 **Path to Graduate School** *Alumni Core Talks for Aerospace Undergraduates at IIT Bombay*

2020 **How to start a student satellite team?** *Somaiya Space Conclave*

2018 **Student Satellite Project Exhibition to the Prime Minister, India** *Silver Jubilee of the IIT Bombay*

2017 **Pratham: IITB Student Satellite** *Technology Forum on Student Micro/nano-satellites (Harbin, China)*