

AMLAN SINHA

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RESEARCH STATEMENT

I am a Ph.D. candidate in Mechanical and Aerospace Engineering at Princeton University, specializing in dynamical systems, optimal control and astrodynamics. My research aims to harness knowledge from *dynamical systems* and *optimal control* to develop a theoretical and algorithmic framework to design robust trajectories for low-thrust spacecrafts under operational uncertainty such as partial or complete engine loss in complex multibody dynamical systems during the preliminary mission design phase.

Research Interests: Astrodynamics, Dynamical Systems, Optimal Control, Robust Control

EDUCATION

Princeton University 2020-Present

Doctoral Candidate in Mechanical Engineering

Certificates: Computational Science and Engineering

Princeton University May 2020

M.A. in Mechanical Engineering

GPA: 3.61/4.00

Cornell University May 2018

B.S. in Mechanical Engineering, Minor in Aerospace Engineering

GPA: 3.52/4.00 (*Cum Laude*)

RESEARCH EXPERIENCE

Beeson Lab Jan 2022 - Present
Graduate Research Assistant, Adviser: Ryne Beeson Princeton, NJ

- Quantitatively and qualitatively assess the role of dynamical structures on robust low-thrust spacecraft trajectories in complex multibody dynamical environments,
- Investigate the structure of optimal solutions for low-thrust non-robust spacecraft trajectories in complex multibody dynamical environments from a global optimization perspective

Rowley Lab Aug 2018 - Dec 2021
Graduate Research Assistant Princeton, NJ

- Developed a Bayesian algorithm to determine optimal control strategies minimizing the worst-case regret for a linear dynamical system with an unknown system parameter with additive gaussian noise.

CONFERENCE PUBLICATIONS

Sinha, A., Beeson, R. (2024) “*On Robust Low Thrust Trajectories and Invariant Manifolds (Part II)*,” AAS/AIAA Space Flight Mechanics Conference, American Astronautical Society, Broomfield, CO. (*accepted, in-preparation*)

Sinha, A., Beeson, R. (2024) “*Analysis of Robust Low Thrust Trajectories For The Power & Propulsion Element to Earth-Moon L2 Southern Near Rectilinear Halo Orbit*,” AAS/AIAA Space Flight Mechanics Conference, American Astronautical Society, Broomfield, CO. (*accepted, in-preparation*)

Li, A., Graebner, J., **Sinha, A.**, Beeson, R. (2024) “*Learning Optimal Control and Dynamical Structure of Global Trajectory Search Problems with Diffusion Models*,” AAS/AIAA Space Flight Mechanics Conference, American Astronautical Society, Broomfield, CO. (*accepted, in-preparation*)

Gi Jo, S., **Sinha, A.**, Anderson, A., Graebner, J., Schmitt, J., Palomo, M., Canales Garcia, D., Beeson, R. (2024) “*Global Analysis of Optimal Trajectories from Earth-Moon 9:2 Near Rectilinear Halo Orbit to Low-Lunar Orbits*,” AAS/AIAA Space Flight Mechanics Conference, American Astronautical Society, Broomfield, CO. (*accepted, in-preparation*)

Sinha, A., Chhabra, A., Beeson, R. (2024) “*Debris proliferation modeling and risk analysis for cislunar orbits*,” International Astronautical Congress, International Astronautical Federation, Milan, Italy. (*accepted, in-preparation*)

Sinha, A., Chhabra, A., Beeson, R. (2024) “*Incorporating orbital debris risk analysis into cislunar orbital procedures and post-mission disposal*,” International Astronautical Congress, International Astronautical Federation, Milan, Italy. (*accepted, in-preparation*)

Chhabra, A., **Sinha, A.**, Beeson, R. (2024) “*Incentivizing adoption of cislunar orbital debris mitigation policies via norms of behaviour*,” International Astronautical Congress, International Astronautical Federation, Milan, Italy. (*accepted, in-preparation*)

Olson, A., **Sinha, A.**, Chhabra, A., Fry, S., Ahner, K., Beeson, R. (2024) “*A Feasibility Study of Microsat Mission Architectures for Ring Science in the Uranian System*,” AAS/AIAA Space Flight Mechanics Conference, American Astronautical Society, Orlando, FL.

Sinha, A., Beeson, R. (2023) “*On Robust Low Thrust Trajectories and Invariant Manifolds*,” AAS/AIAA Space Flight Mechanics Conference, American Astronautical Society, Big Sky, MT.

Sinha, A., Beeson, R. (2023) “*Analysis of Robust Low Thrust Trajectories For The Lunar Gateway*,” AAS/AIAA Space Flight Mechanics Conference, American Astronautical Society, Big Sky, MT.

Li, A., **Sinha, A.**, Beeson, R. (2023) “*Amortized Global Search for Efficient Preliminary Trajectory Design with Deep Generative Models*,” AAS/AIAA Space Flight Mechanics Conference, American Astronautical Society, Big Sky, MT.

Beeson, R., **Sinha, A.**, Jagannatha, B., Bunce, D., and Carroll, D. (2022) “*Dynamically Leveraged Automated Multi-body (N) Trajectory Optimization*,” AAS/AIAA Space Flight Mechanics Conference, American Astronautical Society, Charlotte, NC.

JOURNAL PUBLICATIONS

Sinha, A., Eggl, M., Fefferman, C., Rowley, C.W. (*in preparation*) “Optimal control for a scalar linear dynamical system with unknown parameter.”

FELLOWSHIPS, AWARDS AND HONORS

C.V. Starr Fellowship , <i>Merit Fellowship, Princeton University</i> (2020)	\$95,000
Graduate Teaching Fellowship , <i>Merit Fellowship, Princeton University</i> (2020)	N/A
University Administrative Fellowship , <i>Professional Development Fellowship, Princeton University</i> (2019)	\$1,000
Engineering Learning Initiative , <i>Summer Research Fellowship, Cornell University</i> (2015-17)	\$12,000
Cornell University Scholarship , <i>Full-Ride Undergraduate Scholarship, Cornell University</i> (2014-18)	\$320,000

TEACHING EXPERIENCE

Graduate Teaching Assistant <i>Princeton University</i>	2018-Present <i>Princeton, NJ</i>
<ul style="list-style-type: none">· MAE 206 (Engineering Dynamics)· MAE 342 (Space Systems Design)· MAE 433 (Automatic Control Systems)· MAE 501 (Mathematical Methods of Engineering Analysis)	
Undergraduate Teaching Assistant <i>Cornell University</i>	2014-2018 <i>Ithaca, NY</i>
<ul style="list-style-type: none">· ENGRG 1112 (Practical Computing in Engineering)· MAE 2210 (Thermodynamics)· MAE 2030 (Engineering Dynamics)· MAE 3260 (System Dynamics)	

OUTREACH AND LEADERSHIP EXPERIENCE

Instructor (Math) , <i>Garden State Youth Correctional Facility, Crosswicks, NJ</i>	Aug 2021-Present
Co-Founder , <i>Start Smart</i> (a program for low-income students from Bangladesh)	May 2020-Present
Sustainability Chair , <i>Graduate Student Committee (MAE), Princeton, NJ</i>	Jan 2020-July 2021

RELEVANT COURSEWORK

Classical Mechanics, Dynamical Systems, Optimal Control, Numerical Analysis, Linear Programming, Convex Optimization, Machine Learning

TECHNICAL STRENGTHS

Computer Languages	Python, C, C++, Matlab
Tools	Bash, Git, Latex, Mathematica, Jira
Design and Fabrication	Solidworks, ANSYS, Arduino, Raspberry Pi
Research Skills	Classical Mechanics, Dynamical Systems, Optimal Control, Optimization, High Performance Computing, Model Reduction, Time-Series Analysis