

## EDUCATION

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### The Ohio State University

Columbus, OH

*Ph.D. Aerospace Engineering (Expected graduation SP2025)*

*Jan 2021 – Present*

- **Advisors:** Mrinal Kumar, Debdipta Goswami
- **Concentrations:** Data-driven modeling and machine learning applications on complex systems, space domain awareness, Koopman operator theory and applications

### University of Southern California

Los Angeles, CA

*Master of Science in Aerospace/Astronautical Engineering*

*July 2017 - May 2019*

- **Advisors:** David Barnhart, Mike Gruntman
- **Concentrations:** Space systems engineering, satellite avionics, and optimal control

### Anna University

Chennai, India

*Bachelor of Engineering in Aeronautical/Aerospace Engineering*

*July 2013 - April 2017*

## PUBLICATIONS

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12. **S. Narayanan**, M. N. Gul Mohamed, I. Nayak, S. Chakravorty, and M. Kumar, “Time-delayed dynamic mode decomposition for families of periodic trajectories in cislunar space,” in *AAS/AIAA Astrodynamics Specialist Conference 2024*, 293-2024
11. **S. Narayanan**, M. N. Gul Mohamed, I. Nayak, S. Chakravorty, and M. Kumar, “On dynamic mode decomposition for nonlinear periodic systems with a focus on orbital mechanics,” in *AAS/AIAA Astrodynamics Specialist Conference 2024*, 121-2024
10. M. Wolf, R. Balo, **S. Narayanan**, and M. Kuamar, “On solar radiation pressure: Influence of area-to-mass ratio uncertainty and various shadow models,” in *AAS/AIAA Astrodynamics Specialist Conference 2024*, 134-2024
9. D. Maity, D. Goswami, and **Narayanan, Sriram**, “On the effect of quantization on dynamic mode decomposition,” *IEEE Conference on Decision and Control*, 2024
8. A. Cortez, B. Ford, I. Nayak, **S. Narayanan**, and M. Kumar, “Hybrid A\* path search with resource constraints and dynamic obstacles,” *Frontiers in Aerospace Engineering*, vol. 1, p. 1076271, 2023
7. A. C. Cortez, B. T. Ford, I. Nayak, **S. Narayanan**, and M. Kumar, “Path planning for a dubins agent with resource constraints and dynamic obstacles,” in *AIAA SCITECH 2023 Forum*, p. 1054, 2023
6. **S. Narayanan**, I. Nayak, and M. Kumar, “An iterative scheme to learn system dynamics of space objects from partial state information,” in *AIAA SCITECH 2023 Forum*, p. 0124, 2023
5. **S. Narayanan**, I. Nayak, and M. Kumar, “On the application of time delay embedding for the data driven discovery of nonlinear systems from partial state information,” in *AIAA SCITECH 2022 Forum*, p. 2440, 2022
4. G. Minster, A. Chang, J. B. Inouye, **S. Narayanan**, A. Carter, J. Tong, and D. A. Barnhart, “Hyperion: Artificial gravity reusable crewed deep space transport,” *Journal of Space Safety Engineering*, vol. 7, no. 1, pp. 3–10, 2020
3. **S. Narayanan**, D. Barnhart, R. Rogers, D. Ruffatto, E. Schaler, N. Van Crey, G. Dean, A. Bhanji, S. Bernstein, A. Singh, *et al.*, “REACCH-reactive electro-adhesive capture cloth mechanism to enable safe grapple of cooperative/non-cooperative space debris,” in *AIAA Scitech 2020 Forum*, p. 2134, 2020

2. R. Rughani, R. Rogers, J. Allam, **S. Narayanan**, P. Patil, K. Clarke, M. Lariviere, J. Plessis, L. Na, D. Healy, *et al.*, “Improved cubesat mission reliability using a rigorous top-down systems-level approach,” in *70th International Astronautical Congress*, 2019
1. **S. Narayanan**, R. Rughani, R. Rogers, K. Clarke, and J. Allam, “Mission Dodona: Electronic power system design, analysis and integration,” in *Small Satellite Conference*, 2019

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#### UNDER REVIEW

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1. **S. Narayanan**, M. N. G. Mohamed, I. Nayak, S. Chakravorty, and M. Kumar, “On the predictive capability of dynamic mode decomposition for nonlinear periodic systems with focus on orbital mechanics,” *The Journal of the Astronautical Sciences*, 2024

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#### UNDER PREPARATION

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1. **S. Narayanan**, M. N. Gul Mohamed, S. Chakravorty, and M. Kumar, “Data-driven partial state filtering for forecasting resident space object dynamics,” in *IEEE Transactions on Aerospace and Electronic Systems*, Q1 2025

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#### RESEARCH INTERESTS

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I am interested in estimating dynamic systems and control using data-driven system identification and machine-learning methods. Some areas of interest that I have been working on or wish to explore include, but are not limited to:

- **Estimation and control of partially observable dynamical systems:** Learning dynamical systems with missing/partial or low-fidelity measurements or unknown parameters, data-driven modeling and control of complex physical systems, machine learning methods for estimating such dynamical systems and control, causal inference methods, developing a unifying theory in this domain.
- **Robotics and Control:** Developing machine learning methods for robot autonomy, focusing on control in partially observable environments. Applying reinforcement learning and data-driven control strategies to enhance robot navigation and decision-making under uncertainty.
- **Off-Line vs. On-Line Computations:** Trade-offs between offline (design-time) and online (run-time) computations, particularly in Model Predictive Control (MPC) and reinforcement learning.
- **Stochastic Modeling and Control:** Developing methods for controlling systems with inherent randomness, using probabilistic techniques and stochastic optimization to handle uncertainty in dynamics and measurements.
- **Parametric vs. Non-Parametric Methods:** Exploring the trade-offs in control systems applications: Using parametric models for verification, fault diagnosis, and policy transfer between systems.
- **Space domain awareness:** Predictive modeling for space debris tracking, anomaly detection in space systems, optimizing satellite operations with machine learning, data fusion for comprehensive space situational awareness, uncertainty propagation, tracking, and data correlation.
- **Cislunar Applications:** Timeseries predictive modeling, augmented physics models for enhanced forecasting.

## PROFESSIONAL EXPERIENCE

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### **The Ohio State University**

*Graduate Research/Teaching Associate - Ph.D. Candidate*

Columbus, OH

*Dec 2020 - Present*

- Improving machine learning tools to track objects in space better, using advanced state prediction methods even with limited data, and applying these techniques in robotics and beyond.
- Implementing data-driven state estimators and filters for Space Domain Awareness (SDA) applications, leveraging control theory principles for robust estimation under uncertainty.
- Mentoring students on research activities, emphasizing control theory, state estimation, and aerospace applications.
- Teaching mechanical and aerospace engineering courses, including control theory, state estimation, and dynamic system modeling, focusing on robotics applications and autonomous systems.

### **PointPro USA**

*Research Engineering Intern*

Columbus, OH

*May 2024 - Aug 2024*

- Supported Pointpro's backend software operations at the Space Systems Command's (SSC), SDA Tools Applications and Processing (TAP) Lab.
- Improved an adaptive Monte Carlo detection and threat estimation framework to generate more confident results in a highly uncertain environment.
- Developed and tested an optimal measurement update algorithm to generate new uncertainty point clouds for threat assessment.
- Built visualization tools and data packages for downstream delivery and integration with other cohort members in the Apollo Accelerator program.

### **Panasonic Avionics Corporation**

*Systems Engineer*

Lake Forest, CA

*Feb 2020 - Nov 2020*

- Built and integrated flight infotainment systems and tested engineering kits for delivery purposes.
- Tested, troubleshoot, and triaged issues to validate and certify products before delivery.
- Maintained laboratory test racks that house all systems for several aircraft and customers.
- Created, planned, and managed system requirements, drafted compliance, and test procedures per FAA regulatory standards.

### **Information Sciences Institute**

*Graduate Research Assistant/Research Engineer*

Marina Del Rey, CA

*May 2018 - May 2019/June 2019 - Jan 2020*

- Led power sub-system development for Dodona (La Jument 2) satellite → Created test plans, built test equipment, installed DAQ systems using programmable laboratory instruments, and created procedures to maintain compliance.
- Performed comprehensive evaluation of electronics such as solar panels and battery systems through standalone tests, in-circuit tests, and depth of discharge analysis.
- Worked in collaboration with NASA-Jet Propulsion Laboratory to develop a gecko-adhesion-based robot for on-orbit servicing missions → Created a control/physics simulation to characterize sensor behavior and system performance, simulation tools used: MATLAB Simulink, Project Chrono, and Gazebo.
- Supported USC undergraduate students in the development of MAGNETO satellite.

### **University Of Southern California**

*Graduate Research Assistant*

Los Angeles, CA

*December 2017 - May 2018*

- Worked in trajectory optimization for spacecraft - applied optimal control theory to optimize a low thrust rendezvous trajectory.
- Developed an optimizing routine for a two-body rendezvous scenario.

### **Flight Laboratory, Indian Institute of Technology**

*Trainee*

Kanpur, India

*December 2016 - January 2017*

- Performed weight and flight performance estimation studies on Cessna 206H station-air and NAL Hansa-3 aircraft.
- Carried out calibration of control surfaces for NAL Hansa-3 aircraft.

## TEACHING EXPERIENCE

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- **AE4510/11: Experimental Projects:** Graduate Teaching Associate (SP2023, SP2024, AU2024)
- **AE3581: Numerical Methods in Aerospace Engineering:** Graduate Teaching Associate (AU2023)
- **AE3542: Flight Vehicle Structures I:** Graduate Teaching Associate (AU2024)
- **AE3520: Flight Vehicle Dynamics:** Graduate Teaching Associate (SP2023, SP2024)
- **AE2200: Introduction to Aerospace Engineering I:** Graduate Teaching Associate (AU2023)

## MENTORSHIP

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- **Santhosh Rajkumar:** P.h.D. Student, Mechanical Engineering, OSU
- **Rondale Balo:** P.h.D. Student, Aerospace Engineering, OSU
- **Mark Wolf:** M.S. Student, Aerospace Engineering, OSU (2025)
- **Joey Caley:** Undergraduate Student, Aerospace Engineering, OSU (2023)
- **Ian Binder:** Undergraduate Student, Aerospace Engineering, OSU (2023)

## INVITED TALKS AND POSTERS

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- **American Control Conference (ACC) Workshop: Recent Developments in Data-Driven Methods for Dynamical Systems and Control:** Iterative Learning of Dynamics of Physical Systems from Partial State Information (May 2023)
- **Edward F. Hayes Advanced Research Forum (2023):** Poster session: Data-driven identification and forecasting of space object dynamics from partial measurements (February 2023)

## SERVICE

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- **Session Chair at AIAA SciTech:** Learning, Reasoning, and Data-Driven Systems (Jan 2023)
- **Reviewer:** AIAA - Journal of Aerospace Information System  
Elsevier - Aerospace Science and Technology  
Elsevier - Acta Astronautica  
Springer - Journal of Astronautical Sciences  
Modeling, Estimation and Control Conference (MECC) - 2024 (x2)

## MEMBERSHIPS

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- **AIAA:** Student Member
- **IEEE:** Student Member

## KEY SKILLS

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### Software:

- MATLAB (including Simulink), Python, Julia, C++, C – Proficient in scientific software development.
- Unix – Knowledge of scripting, system administration and experience developing on embedded platforms.
- LaTeX, Microsoft Office, JIRA/Confluence, Git – Proficient.
- Blender, ROS, Project Chrono, and Gazebo – Working knowledge.
- AGI Satellite Toolkit – Level 1 Certification.
- SOLIDWORKS, ANSYS, AutoCAD – Designing and simulation (working knowledge).

### Hardware:

- Experience with general machine shop equipment and tools, including soldering, 3D printing, and reflow processes.
- Low-speed wind tunnel experience.
- Familiar with workshop environments and tool usage.

## REFERENCES

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- **Mrinal Kumar (kumar.672@osu.edu)**: Professor, Mechanical and Aerospace Engineering, OSU
- **Debdipta Goswami (goswami.78@osu.edu)**: Assistant Professor, Mechanical and Aerospace Engineering, Electrical and Computer Engineering, OSU
- **Suman Chakravorty (schakrav@tamu.edu)**: Professor, Aerospace Engineering, TAMU
- **Brian Ritchie (ritchie.11@osu.edu)**: Clinical Assistant Professor, Mechanical and Aerospace Engineering, OSU
- **David A. Barnhart (barnhart@isi.edu)**: Research Professor, Astronautical Engineering, USC
- **Stephanie Truong (stephanietruong@panasonic.aero)**: Staff Engineer/Manager(Systems Engineering), Panasonic Avionics Corporation