

EDUCATION

The Ohio State University

Ph.D. Aerospace Engineering (Expected graduation SP2025)

Columbus, OH

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

Master of Science in Aerospace/Astronautical Engineering

Los Angeles, CA

July 2017 - May 2019

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

Anna University

Bachelor of Engineering in Aeronautical/Aerospace Engineering

Chennai, India

July 2013 - April 2017

PUBLICATIONS

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

UNDER REVIEW

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

UNDER PREPARATION

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*, 2024

RESEARCH INTERESTS

I am broadly 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.
- **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: modeling uncertainty in real-time, developing efficient interfaces between modes, robust real-time methods, data collection, and performance analysis.
- **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. Developing methods to combine data-driven and first-principles models, advancing physics-informed machine learning.
- **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, partially observable scenarios.
- **Cislunar Applications:** Timeseries predictive modeling, augmented physics models for enhanced forecasting, quantifying gaps between restricted and full order models, using data to bridge these gaps, and exploring chaotic dynamics and stochastic scenarios for more realistic conditions.

PROFESSIONAL EXPERIENCE

The Ohio State University

Graduate Research/Teaching Associate - Ph.D. Candidate

Columbus, OH

Dec 2020 - Present

- Developing machine learning models and data-driven tools for applications in the space situational awareness domain, specifically to address low-fidelity partial/incomplete measurements. Regimes of interest include LEO-GEO, xGEO and Cislunar.
- Implementing data-driven state estimators and filters for SDA applications backed by theoretical analysis
- Mentoring undergraduate and graduate students on their research activities and contributions to the lab and projects.
- Serving as a teaching assistant for mechanical and aerospace engineering courses – AE2200, AE3520, AE3581, AE4510/11.

PointPro USA

Research Engineering Intern

Columbus, OH

May 2024 - Aug 2024

- Supported Pointpro's backend software operations at the Space Systems Command's (SSC), Space Domain Awareness (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, troubleshooted, 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

- **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

- **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

- **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

- **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

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

KEY SKILLS

Software:

- MATLAB (including Simulink), Python, C++, C – Proficient in software development.
- Linux – Knowledge of 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).

Numerical Libraries:

- Prior experience with - NumPy, SciPy, Pandas, Matplotlib, PyTorch, TensorFlow, JAX, Numba, CVXPY, OpenCV, Gensim, Eigen, Boost, Armadillo, GSL (GNU Scientific Library), Ceres Solver, CasADi, ACADOS, OptiToolbox, Ipopt, MATLAB Optimization Toolbox, SNOPT

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

- **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