Sesha N. Charla

PhD Candidate · Estimation and Control Systems · Purdue University · seshacharla.github.io

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Education

PhD in Mechanical Engineering
Purdue University - West Lafayette, Indiana $2021 - 2025$
Thesis: Model-based Fault Diagnosis using Set Membership Filtering for Nonlinear Systems under Uncertainty.
Research Focus: Estimation Theory, Adaptive Robust Control, Nonlinear Systems, Fault Diagnosis.

Masters in Aeronautics and Astronautics
Purdue University - West Lafayette, Indiana $2019 - 2021$
Major: Autonomy and Controls, Minor: Machine Learning (Reinforcement Learning and Computational Statistics)
Research: Simplex chains as control barrier functions for control under polytopic uncertainties and constraints.

Bachelor of Technology in Aerospace Engineering
Indian Institute of Space Science and Technology - Thiruvananthapuram, India $2012 - 2016$
Thesis: Finite Element Dynamic Model using Modified Lagrangian for Launch Vehicle Bending: Trajectory Simulations.

Experience Summary

- 3 years of professional experience as Instrumentation and Control Systems Engineer for Satellite Systems. Internships at Virgin Hyperloop and SC Solutions.

- More than 2 years of industry (Cummins) collaboration during PhD research.

- 2 years of experience in training students and developing control and estimation algorithms on embedded systems (STM32 (C), NI-MyRio (LabView)).

Technical Skills

Control and Estimation: Robust (H_∞, $\mu-$syn), Adaptive (MRAC, ARC, RL), Optimal (MPC, LQG) & Nonlinear (Backstepping, Sliding Mode) Control Design | Convex Optimization | Mathematical Modelling | Estimation & Detection (Kalman and Set-membership filtering)| System Identification | Signal Processing | Motion Planning and Trajectory Generation | Reinforcement Learning (MDPs and Dynamic Programming)

Programming: Python | MATLAB & Simulink | C | C++ (CMake, eigen)| LabView

Embedded Systems: NI-RIO systems (LabView [FPGA, NI Real-time module], C++) | STM-32 (C, C++)

OS & Tools: Linux | Git | Jira | LaTeX| EPICS Framework (Control Systems) | ROS

Work Experience

Motion Control Engineer (Internship)
Virgin Hyperloop - Los Angeles, California   *June*, $2022 - $ *August*, 2022

- Designed and demonstrated supervisory control to minimize force mismatch across bogies, improving EM engine efficiency.

- Refined control architecture for EM engine using MATLAB/Simulink, demonstrating linear control limitations.

- Developed a MIMO model for guidance bogie engine assembly and analyzed robust stability and control performance w.r.t suspension parameters.

Research Engineer - Estimation and Control Systems (Internship)
SC Solutions - Portland, Oregon   *May*, 2023 − *August*, 2023

- Developed auto-regressive estimation models for computer vision-based fat estimation in meat (USDA-funded project).

- Designed state and parameter estimation algorithms using vision data; implemented OpenCV-based real-time estimation software in C++.

Scientist/Engineer 'SC', Test Instrumentation and Controls, Thermal Systems Group (Full-time role)
Indian Space Research Organization (ISRO) - Bengaluru, India   *July*, 2016 − *July*, 2019

- Led thermal instrumentation and control for 15 satellite systems, including Chandrayaan-2 (orbiter, lander, rover).

- Developed a Python-based SCADA interface, doubling satellite test productivity and enabling simultaneous testing.

- Designed an optimal heater control and design tool with a web-based front-end, preventing burnout and saturation faults.

- Demonstrated the use of the EPICS framework on a test setup as a proof of concept for a unified SCADA system, as part of the proposed technology development program.

R&D and Academic Experience

Diesel Engine Aftertreatment System Diagnostics   *August*, 2023− Ongoing

- Developed a discrete nonlinear hybrid model for NO_x process dynamics in SCR-ASC systems; validated with test-cell & truck data.

- Formulated an aging diagnostics framework using set-membership filtering & parameter detection.

Actuator Fault diagnosis and robust control in Multi-rotors   *August*, 2021− Ongoing

- Designed an RPM measurement system using back-EMF commutation signals (MECC'22) and developed a nonlinear model considering the ESC dynamics (ACC'24).

- Implemented Adaptive Robust Control for uncertainty rejection & fault-tolerant RPM tracking (MECC'24).

- Created a set-membership filtering & adaptive control-based fault-diagnostics framework.

Instructor/TA for Control Lab Courses   *August*, 2020 − *May*, 2023

- Taught C, Assembly, and LabView programming for closed-loop control of mechanical systems (e.g., inverted pendulum, DC motors, thermal systems).

- ***Course Development:*** Developed coursework on parameter estimation & robust control for a refrigeration system (ME 586) using STM32 Discovery board.

Relevant Course Work: Multivariable Systems and Robust Control | Adaptive Control| Detection & Estimation Theory | System Identification | Computational Statistics (EM algorithm) | Reinforcement Learning (Bandit problems and MDPs) | Nonlinear Systems | Vehicle Dynamics.

Honors, Scholarships & Service

- Reviewer for MECC, ACC and IFAC Journal of Mechatronics

- Graduate Research Assistantship from Cummins. Aging diagnostics of diesel engine after-treatment systems. [***Aug. 2023 - present***]

- Graduate Research Assistantship from NASA-ULI. Fault-diagnostics in urban air mobility systems. [***Aug. 2020 - 2021***]

- DOS-ISRO fellowship, Department of Space, India. Scholarship for undergraduate studies. [***Aug. 2012 - May. 2016***]