Sesha N. Charla

PhD Candidate · Estimation and Control Systems · Purdue University
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Education

PhD in Mechanical Engineering
Purdue University - West Lafayette, Indiana *August*, 2021 – *December*, 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 *August*, 2019 – *May*, 2021
Major: Autonomy and Controls, Minor: Machine Learning (Reinforcement Learning and Computational Statistics)
Research: Simplex chains as control barrier functions for control under linear temporal logic constraints.

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

Control Systems Design Experience Summary

- 8+ years of research and industry experience in control design, system identification, and estimation across automotive, aerospace, and industrial applications.
- PhD research focuses on Set-membership and Adaptive Robust Control for estimation, fault diagnostics, and control of nonlinear systems under uncertainties (diesel engine after-treatment systems, multirotor actuators).
- 2+ years experience training undergraduate and graduate students in control and estimation algorithms on embedded systems (STM32, NI-MyRio) for electromechanical systems.

Work Experience

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++.

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.

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.

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.

Technical Skills

Control and Estimation: Robust, Adaptive, Optimal & Nonlinear Control Design | Convex Optimization | Mathematical Modelling | Estimation & Detection (Kalman and Set-membership filtering)| System Identification | Signal Processing | Reinforcement Learning (MDPs and Dynamic Programming)

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

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

OS & Tools: Linux | Git | Jira | LaTeX

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***]
