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 chain generation (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

- Over 8 years of research and industry experience in developing Control design, System Identification and Estimation based solutions for systems spanning across automotive, aerospace, and industrial applications.

- Core of my PhD research involves developing and implementing novel Set-membership and Adaptive robust control based methods for control, estimation and fault diagnostics of nonlinear systems under uncertainties. Specifically diesel engine after-treatment systems and multirotor actuators.

- 2 years of experience training undergraduate and graduate students in design and implementation of control and estimation algorithms on embedded systems (STM32 and NI-MyRio) for electromechanical systems, including refrigeration, heat transfer, and nonlinear rigid body systems.

Work Experience

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

- Worked on a USDA funded project for computer vision based fat estimation in meat. Formulated an auto-regressive estimation model and, state and parameter estimation algorithms using vision data.

- Developed OpenCV based computer vision software in C++, for real-time implementation and benchmarking of estimation algorithms on large video datasets.

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

- Designed and demonstrated supervisory control for minimizing the force mismatch across the bogie which improved the EM engine efficiency based on the requirements worked out during the cross team meetings.

- Refined the control architecture for single EM engine control and demonstrated the limitation of the linear design on the non-linear system in MATLAB using the full Simulink model developed in house.

- Created a MIMO model for the guidance bogie engine assembly for robust control and worked out the stability of off-diagonal elements 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 $July, 2016 - July, 2019$

- Responsible for thermal instrumentation and control for thermal-vacuum and thermal-balance tests of 15 satellite systems over the course of 3 years including *Chandrayan-2* (the lunar lander project of ISRO) mission's orbiter, lander and rover.

- Developed a python software interfacing with the existing *SCADA* systems for simultaneous testing of multiple satellites, doubling the productivity of test systems and enabling simultaneous testing in Chandrayan-2 mission.

- Implemented an optimal heater design software with a web based front-end in python that streamlined PI gain tuning, in-situ heater sensor mapping that completely avoided heater burnout and faults due heater saturation.

R&D and Academic Experience

Diesel Engine Aftertreatment System Diagnostics $August, 2023-$ Ongoing

- Created a Discrete nonlinear hybrid model for NO_x process dynamics in diesel engine SCR-ASC system that captures the time-evolution of the measurement signals and catalyst saturation for aging detection through parameter changes. Validated the model using real-world test-cell and truck data.

- Developed a framework for aging diagnostics using set-membership filtering and parameter change detection.

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

- Developed an RPM measurement system using the back-emf commutation signals (MECC'22), formulated and identified nonlinear model that accommodates the input uncertainties due to unknown high-frequency filters inside the ESC (ACC'24) and demonstrated the effectiveness of Adaptive Robust Control for uncertainty rejection and RPM tracking under parameter fluctuations and faults (MECC'24).

- Developed a framework for fault-diagnostics and reconfiguration using Set-membership filtering and adaptive robust control.

Instructor/TA for Control Lab Courses $August, 2020 - May, 2023$

- Assisted students in writing C, Assembly and LabView programs, and their debugging for developing closed loop control for mechanical systems such as inverted pendulum, DC motor and, heating and cooling systems using STM32 or NI-MyRio.

- ***Course Development:*** Demonstrated parameter estimation and robust control implementation procedures for refrigeration system with variable speed compressor and flow control valve (non-minimum phase system) using STM32 Discovery board as possible guided final project for the future course offerings of ME 586.

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 and Vehicle Dynamics.

Technical Skills

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

Programming Languages: Python, MATLAB & Simulink, C, C++, LabView

Embedded Systems Programming: NI-RIO systems (LabView (FPGA) and C++), STM-32 (C and C++)

OS & Software Tools: Linux, Git, Jira, LaTeX