Sai Satya Charan Malladi

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Education

University of Michigan Ann Arbor — **Ann Arbor, MI**
MSE Aerospace | Focus: Autonomous Systems and Controls [CGPA: 3.9/4] — Aug 2021–Apr 2023
Graduate Student Instructor: Physics 151 Lab | Grader: Data-Driven and Reduced Order Modeling
Courses: Inference, Estimation & Learning | Machine Learning | Model Predictive Control | Reinforcement Learning | Avionics, Navigation & Guidance | Experimental Unmanned Aerial Vehicles | Cubesat Laboratory

Indian Institute of Technology (IIT) Madras — **Chennai, India**
B.Tech Aerospace Engineering | Minor in Control Systems [CGPA: 8.76/10] — Aug 2016–July 2020
Courses: Process Optimization | Aerospace System Estimation and Control | Modern Control Theory | Non-Linear Control Systems | Numerical Methods and Scientific Computing | Introduction to Robotics

Experience

Computational AeroSciences Laboratory | Ford Motors — **Ann Arbor, Michigan**
Research Associate under Prof. Karthik Duraisamy — Sept 2022–Present

- Worked on Multi-Fidelity Modeling and Experimental Design to build cost effective surrogate models.
- Utilised auto regressive Gaussian process framework for modeling and developed an active learning algorithm leveraging uncertainty to recommend next best design simulations.
- Used active subspace and reversible neural network to deal with the curse of dimensionality.
- Collaborated with Ford Motors to integrate code into their work flow and reduce development time by 60 %.

Odys Aviation — **Long Beach, California**
Flight Controls Intern under Alex Jedinger — May 2022–Aug 2022, Jan 2023–Aug 2023

- Worked with the GNC team for state estimation and control algorithm development.
- Performed extensive trim manifold exploration to understand the behaviour of the developed aerodynamics model.
- Developed a system identification tool set to estimate aerodynamic parameters from flight test data.
- Assisted and participated in flight test campaigns for the sub-scale prototype at Mojave.
- Developed familiarity with FAA Part 23 certification guidelines and means of compliance for VTOL aircrafts.
- Researched and designed experimental mass properties estimation methods for the sub-scale aircraft.
- Supported data analysis, Simulink flight dynamics model development and model in the loop simulations.
- Authored MATLAB and Python scripts to automate data processing.

Intelligent Robotics and Autonomy Lab — **Ann Arbor, Michigan**
Directed Study with Prof. Vasileios Tzoumas — Jan 2022–Apr 2022

- Explored map predictive motion planning, PAC Bayes framework, and probabilistic program induction.
- Learned several concepts and worked on projects pertinent to visual navigation including SLAM.

Autonomous Vehicles Laboratory, Indian Institute of Science — **Bangalore, India**
Project Assistant under Prof. Ashwini Ratnoo — Oct 2020–Aug 2021

- Worked on range and reachability analysis for hypersonic re-entry type vehicles.
- Developed a MATLAB trajectory optimization solver using pseudospectral collocation methods.
- Studied the effect of discretization nodes and allied inputs on iterations, accuracy, and convergence to the solution.

Rotorcraft and Advanced Flight Technologies Laboratory, IIT Madras — **Chennai, India**
Undergraduate Project Student under Prof. Ranjith Mohan — Dec 2018–Jun 2020

- Explored Optimal Control using the two satellite rendezvous dynamics with thrust minimization objective.
- Tested Floquet theory, Linear Quadratic Regulator (LQR), Linear Quadratic Gaussian (LQG), and Model Predictive Control (MPC) techniques for close-range maneuvers.
- Compared direct collocation and differential flatness-based trajectory optimization techniques for sizeable initial separation of satellites.

Skills

Languages: Python, MATLAB, C/C++
Software & Tools: Linux, Git, PyTorch, ROS, Simulink, Octave, LaTeX, XFLR5

Projects

Autonomous Quadcopter

- Built an autonomous quadcopter that could traverse way points using state information from motion capture.
- Tested and deployed LQR attitude control in place of existing PID inner loop on Beaglebone Blue.
- Deployed Semi-Direct Visual Odometry (SVO) algorithm on the companion flight computer - Rasberry Pi and compared the results to motion capture trajectory.
- Integrated time of flight lidar sensor to remove the initial scale ambiguity while running SVO.

Bayesian Inference & Estimation

- Developed scripts on variance reduction methods like Multi-Level Monte-Carlo (MLMC) and Control Variates.
- Coded and compared state estimation algorithms - Extended Kalman Filter (EKF), Unscented Kalman Filter (UKF) and Ensemble Kalman Filter (EnKF), and Particle Filter.
- Implemented sampling algorithms - Metropolis Hastings, Adaptive Metropolis, Delayed Rejection Adaptive Metropolis for system identification.

Gaussian Process Dimension Reduction Methods for Human Motion

- Replicated and validated key findings from the paper, Gaussian Process Dynamic Models (GPDM), using the CMU Human Motion Capture data set.
- Compared the performance of GPDM to Gaussian process latent variable method.
- Generated new motion sequences using mean prediction in latent space.

Reinforcement Learning

- Reproduced the results from the paper, FORK: A Forward-Looking Actor For Model-Free Reinforcement Learning, using OpenAI Gym's BipedalWalkerHardcore continuous control task.
- Implemented the AlphaZero algorithm to play the Othello board game.
- Used the DQN algorithm to play the Atari-Breakout game.

Convergent Block Coordinate Descent for DNNs

- Reproduced the results from the paper, Convergent Block Coordinate Descent (BCD) for Training Tikhonov Regularized Deep Neural Networks, that addresses the vanishing gradient problem.
- Compared the performance to Proximal BCD and SGD with dropout using MNIST and MNIST Fashion data sets.

CubeSat

- Developed a Multiplicative Extended Kalman Filter (MEKF) to fuse sensor data for attitude estimation.
- Conceptualised the design for gravity vector pointing camera with 2-axis control which is the primary payload.

Optimal Control

- Generated a fuel-optimal rocket landing trajectory similar to SpaceX's Starship landing maneuver using the direct transcription trajectory optimization method.
- Employed Nonlinear Model Predictive Control (NMPC) to ensure stability and off-set free trajectory tracking.

Navigation & Guidance

- Employed Kalman filter for position fixing using noisy bearing measurements.
- Implemented and compared direct pursuit, constant bearing pursuit, and proportional navigation guidance for different pursuer-evader engagement scenarios.

Design of Hybrid VTOL UAV

- Worked on airfoil selection, coefficients estimation, weight calculation and component selection for the preliminary design of a Hybrid VTOL Flying Wing UAV for a given mission profile.
- Performed 6 DOF flight simulation in XFLR5 to obtain derivatives to check for stability of different modes.

RC glider

- Designed and built a remote-controlled glider using balsa wood, carbon fiber, and coroplast material.
- Did essential aerodynamic, weight & mechanics calculations and conducted tests to ensure well-controlled flight.

Academic Achievements

- Branch Rank 4 of graduating batch of 2020 in the Aerospace Department at IIT Madras.
- All India Rank 54 (out of 4000) in the Graduate Aptitude Test in Engineering (Aerospace) 2020.
- All India Rank 3238 (out of 150,000) in the Joint Entrance Examination (Advanced) 2016