

Shreeram Murali

Curriculum Vitae

Last Updated: Oct 10, 2022

RESEARCH INTERESTS

Combinations of 3 or more of the following: mobile robotics, motion planning, vision-based control, nonlinear dynamics, data-driven dynamics and control.

CONTACT INFORMATION

- **Email:** shreeram.m@gmail.com
- **Website:** shreeram-murali.github.io

EDUCATION

Bachelor of Engineering (B.Eng.) Mechanical Engineering

Ramaiah Institute of Technology

Bangalore, India

Aug 2017 – Jul 2021

- Graduated: First Class (1st) with Distinction
- GPA: 9.37/10

RESEARCH EXPERIENCE

Indian Institute of Science

Aug 2021 – present

Data Augmented Control of Autonomous Systems (DACAS) Lab

Junior Research Fellow

Advisor: Prof. Jishnu Keshavan

My research at DACAS is mainly focused on control strategies that utilize visual cues to confer mobile robots with autonomy.

1. Vision-based adaptive leader-follower formation control of ground vehicles
 - Implemented a Zeroing Neural Network (ZNN) based adaptive control law to accomplish formation control and obstacle avoidance
 - Implemented and evaluated the performance of adaptive first-order sliding-mode control algorithms with output constraints for formation control
 - Implemented a prescribed-time, prescribed-bound first-order sliding-mode control for formation control
 - Wrote ROS subscriber-publishers for navigation using sensor-data extraction using Python and C++ and publishing control inputs
 - Implemented a real-time object tracking using OpenCV based on fiducial markers such as AprilTags and ArUco markers to enable tracking at high FPS throughput
 - Defined an experimental process with robust methodology and safety cutoffs to test, gather datasets, and validate the control strategy
2. Autonomous landing of a quad-rotor using optic flow
 - Implemented a sliding-mode control algorithm for constant flow-divergence based autonomous landing
 - Integrated motion capture positioning data into the UAV's navigational control loop
 - Implemented controllers from existing literature to evaluate and compare performance against proposed control strategies
3. Nonlinear control
 - Gathered over 100 datasets of control inputs and outputs for a nano quad-rotor to learn the lifted dynamics when experiencing nonlinear ground effects during trajectory-tracking

Department of Mechanical Engineering

Ramaiah Institute of Technology

Advisor: Prof. Lokesh K.

Jun 2019 – Apr 2020

- Evaluated common UAV trajectory-tracking algorithms using software-in-the-loop simulations and studied their effect on path following and flight characteristics
- Developed a geometric path planning method for static obstacle avoidance based on Bezier-spline curves and assessed their impact on flight navigation

Department of Mathematics

Ramaiah Institute of Technology

Advisor: Prof. Ramprasad S

Jun 2018 – Dec 2018

- Solved fluid-flow and heat-transfer problems numerically using MATLAB
- Conducted literature survey of recent papers and reproduced their numerical results

MANUSCRIPTS

In review:

- [J1]: S. Belgaonkar, J. Keshavan, and **S. Murali**, “Leader-Follower Formation Control of Mobile Robots with Visibility Constraints Using a Zeroing Neural Network,” *IEEE/ASME Transactions on Mechatronics*, 2022.
- [J2]: J. Keshavan, S. Belgaonkar, and **S. Murali**, “Adaptive first order sliding mode control with output constraint,” *IEEE Transactions on Industrial Electronics*, 2022.

Accepted for presentation:

- [C1]: S. Singhal, J. Keshavan, and **S. Murali**, “Constant Optical Flow Divergence based Robust Adaptive Control System for Autonomous Vertical Landing of Quadrotors,” *AIAA SciTech*, 2023.

WORK EXPERIENCE

Tata Consumer Products

Software Engineer Intern (IoT)

Bangalore, India

Feb 2021 - Jul 2021

Development of IoT devices to monitor and dashboard internet user experience through performance parameters of cafés’ WiFi

- Developed Python scripts to run automatically on Raspberry Pi based IoT devices to read café parameters and push to a time-series database hosted on the cloud
- Deployed an InfluxDB time-series database on AWS cloud and created data dashboards for multiple user-cases using Grafana
- Configured multiple IoT devices to be deployed to cafés for remote monitoring
- Produced detailed technical documentation to aid IoT configuration for remote operation and debugging

PROJECTS

Crazypaths ([GitHub](#))

Dec 2021 – Jan 2022

- Package for polynomial path planning and trajectory-tracking for flying a quad-rotor with a motion capture system in the control loop.
- Package is capable of path planning, generating polynomial waypoints, pre-flight visualisation, and enables path-following aided by optic flow sensors and/or motion capture

- Defined an autopilot and flight navigation system weighing less than 250g incorporating multiple redundancies using the Pixhawk embedded system
- Improved flight navigational accuracy by tuning the aerial vehicle's on-board PID control systems and improved stability by diminishing oscillations
- Tested, gathered data, and validated system performance in over 100 hours of SITL simulations and 20 hours of flight time

Two-axis Antenna Tracker ([GitHub](#))

Feb 2020

- Developed a two-axis antenna tracker which continuously points a unidirectional antenna towards a moving transmitter at a refresh rate of 5Hz
- Computed the tracker's pan and tilt angles in real-time (5Hz) by obtaining flight GPS and telemetry using
- Resulted in uninterrupted data transfer at the rate of approximately 10 images in 3 seconds

ACTIVITIES*Team Lead, Edhitha Unmanned Aerial Systems*

- Defined the electrical and mechanical architecture of an unmanned aerial vehicle of 6kg all-up weight
- Secured funding of over INR 200,000 in university grants and corporate sponsorships
- Took critical decisions regarding the selection of an airframe platform within a data-driven framework of technical, operational, and environmental constraints

Core-Team Volunteer, Numera

- Travelled to multiple schools in Bangalore to attract talented kids of diverse backgrounds to conduct a mathematics competition

Volunteer, Tata Volunteering Week

- Volunteered at a local hospital to conduct free health check-ups for people in underprivileged areas

CERTIFICATIONS

- **Basics of Robot Perception, AI & Robotics Technology Park, Indian Institute of Science:** Coordinate transforms, camera models, camera calibration, homographies, convolution and filtering, edge detection, feature descriptors (SIFT, HoG, SURF, ORB, R2D2), object tracking, optical flow, Hough transforms, RANSAC, feature-based pose estimation.
- **Numerical Methods for Engineers, The Hong Kong University of Science and Technology (Coursera):** Scientific Computing, Root Finding, Matrix Algebra, Quadrature and Interpolation, ODEs, PDEs using MATLAB
- **Probability and Statistics, University of London (Coursera):** Uncertainty Quantification, Hypothesis Testing, Inference, Monte Carlo methods

SKILLS**Software:** Python, ROS, C, C++, MATLAB, SQL, InfluxDB, AWS, REST APIs**Engineering:** SOCs (Pi, Arduino, Jetson), ArduPilot, Fusion360**Fabrication:** Additive Manufacturing, Computer Numerical Control (CNC)**Languages:** English (bilingual native, professionally fluent) — TOEFL score: 112/120 (R29, L27, S28, W28)