Shreeram Murali

Curriculum Vitae
Last Updated: October 2023

Research Interests

Combinations of: data-driven control, nonlinear control, mobile robot navigation, motion planning, vision-based control.

Contact Information

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Education

Master of Science (M.Sc.) Electrical Engineering — Espoo, Finland
Aalto University — *Aug 2023 – present*

- **Major**: Control, Robotics, and Autonomous Systems
- **Minor**: Computer Science
- Received the Aalto University Category A Scholarship Award (100%)

Bachelor of Engineering (B.Eng.) Mechanical Engineering — Bangalore, India
Ramaiah Institute of Technology — *Aug 2017 – Jul 2021*

- Graduated: First Class (1st) with Distinction
- GPA: 9.37/10
- Best Achiever Award (outgoing class of 2021)

Research Experience

Indian Institute of Science — Aug 2021 – July 2023
Data Augmented Control of Autonomous Systems (DACAS) Lab
Junior Research Fellow
Advisor: Prof. Jishnu Keshavan

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

1. Vision-based adaptive leader-follower formation control of ground vehicles
   - Implemented and evaluated the performance of adaptive first-order sliding-mode control algorithms with and without prescribed-time convergence, prescribed error bounds, input constraints and state constraints for formation control in numerical simulation and experiments
   - Integrated and experimentally implemented an potential field method based obstacle avoidance scheme with the formation control strategy
   - 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
2. Autonomous landing of a quad-rotor using optic flow
   - Integrated motion capture data into the UAV's navigational control loop
   - Implemented controllers from existing literature to evaluate and compare performance against proposed control strategies

Department of Mechanical Engineering Jun 2019 – Apr 2020
Ramaiah Institute of Technology
Advisor: Prof. Lokesha K.

- 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

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

Publications

Publications:

- **[C1]**: S. Singhal, J. Keshavan, and **S. Murali**. "Constant Optical Flow Divergence based Robust Adaptive Control Strategy for Autonomous Vertical Landing of Quadrotors," AIAA 2023-1150. *AIAA SciTech Forum*. January 2023. doi:10.2514/6.2023-1150
- **[J1]**: J. Keshavan, S. Belgaonkar and **S. Murali**, "Adaptive control of a constrained first order sliding mode for visual formation convergence applications," in *IEEE Access*, doi: 10.1109/ACCESS.2023.3323896

Manuscripts in review:

- **[J2]**: Saurabh Belgaonkar, Jishnu Keshavan, and **Shreeram Murali**, "A novel adaptive super-twisting control strategy for leader-follower formation tracking under visibility constraints," *Elsevier Mechatronics*, 2023.

Work Experience

Tata Consumer Products Bangalore, India
Software Engineer Intern (IoT) *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

QTM Wrapper (GitHub)

- This package enables the asynchronous event-based streaming (>300 Hz) of real-time positioning data from a motion capture system.
- Contains a `Pose` class with easy conversions from rotation matrices to Euler angles and quaternions.
- It's a handy robotics toolkit to enable the easy integration of control algorithms with positioning data from motion capture.

Edhitha Unmanned Aerial Systems (Website) *Jun 2018 – Apr 2020*
Mechanical and Navigation Engineer (university student team)

- 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

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
- **Basic Life Support**

Awards

- **Best Achiever Award** (outgoing class of 2021) for distinguished performance in Academics, Co-curricular, Extra-curricular Activities and Service to Community during 2017-2021 *by* Department of Mechanical Engineering

Skills

Software: Python, ROS, C, C++, MATLAB, Scala, SQL, InfluxDB, AWS, REST APIs
Engineering: EcoStructure, SOCs (Pi, Arduino, Jetson), ArduPilot, Fusion360
Fabrication: Additive Manufacturing, Computer Numerical Control (CNC)
Languages: English (bilingual native, professionally fluent)