

Work Experience

Robotics Research Engineer, University of Arizona, AZ

Jan 2023 – Dec 2024

Quadruped Navigation and Control

- Designed a fluid flow-based motion model for quadruped robots, improving trajectory accuracy and reducing deviations by 30%.
- Integrated ROS2 middleware with Vicon Motion Capture for real-time localization, reducing positional error by 25%.
- Conducted 170+ trials to optimize trajectory planning and response latency, achieving a 20% reduction in motion lag.
- Applied finite element analysis (FEA) to assess structural integrity across terrains, optimizing load distribution and minimizing deformation.
- Developed model predictive control (MPC)-based strategies for quadruped motion, improving stability during dynamic maneuvers.
- Documented system architecture, sensor calibration, and deployment procedures to standardize robotic operation.
- Led risk analysis for robotic deployment, ensuring mechanical compatibility and reducing system failures.
- Investigated multi-robot coordination for agricultural applications, integrating UAVs and quadrupeds for crop monitoring.

Quadcopter Team Coordination

- Developed a 2D affine transformation model for UAV-quadruped coordination, enhancing formation control and reducing collision risk.
- Designed Jacobian-based real-time motion planning, improving quadcopter path accuracy by 20% in constrained environments.
- Implemented sensor fusion techniques with LIDAR, IMU, and Vicon localization, reducing tracking errors in UAV navigation.
- Conducted hardware-in-the-loop (HIL) simulations to refine UAV state estimation, improving real-time feedback for trajectory corrections.
- Improved mission efficiency by 30% through PLC-driven automation and adaptive multi-agent decision-making.
- Performed risk assessments to ensure compliance with safety standards, mitigating operational vulnerabilities in autonomous systems.

Projects

Generative Design & Additive Manufacturing Project

- Designed and manufactured lightweight structural components using generative design, optimizing weight efficiency, durability.
- Evaluated stress-strain distribution in additive-manufactured components across various loading conditions, ensuring structural reliability.
- Simulated 3D printing processes and tested multiple materials, identifying the most effective composition for enhanced structural efficiency.
- Performed FEA-based optimization and CFD simulations to refine load distribution, minimizing deformation under operational stress.
- Analyzed material properties of Titanium, Cobalt Chrome, and Aluminum to balance strength and weight for industrial applications.
- Compiled technical documentation and integrated bill of materials (BOM), applying design-for-manufacturing principles to streamline production workflows.
- Maintained document control using SAP, ensuring compliance with manufacturing regulations and optimizing production planning.

Bicopter System Control & Stability

- Implemented PID and LQR controllers, enhancing flight stability through validation testing, system tuning, and vibration analysis.
- Conducted system identification and motor speed optimization, increasing efficiency, stability, and energy conservation.
- Integrated Simulink models with Arduino, enabling real-time data acquisition, signal processing, and precise control.
- Analyzed vibration characteristics and dynamic response, refining control loops to improve flight maneuverability.

Centrifugal Pump Performance Optimization

- Conducted CFD simulations, modal analysis, and FEA to optimize impeller material selection and improve flow dynamics.
- Evaluated performance curves and pressure distribution under different operating conditions, enhancing system efficiency.
- Proposed design modifications for reducing cavitation and vibration-induced failures.

Research Publications

- M. Ghufuran, S. Tetakayala, H. Rastgoftar, “Motion Planning for Quadruped Teams: An Experimental Evaluation Using a Dynamic Fluid Flow Model,” IEEE, DOI: 10.1109/ICARCV63323.2024.10821616.
- M. Ghufuran, S. Tetakayala, J. Hughes, A. Wilson, H. Rastgoftar, “Quadcopter Team Configurable Motion Guided by a Quadruped,” IEEE, DOI: 10.1109/ICARCV63323.2024.10821600.

Technical Skills

Languages:	Python, C++, MATLAB, Arduino, Simulink
Tools:	ROS2, Gazebo, SolidWorks, FEA, CFD, SAP
Technologies:	Vicon, LIDAR, IMU, MPC, PID, LQR

Education

M.E. Robotics and Automation	Jan 2023 – Dec 2024
University of Arizona, AZ	
Relevant Coursework:	Control Systems, System Identification, Embedded Systems, CAD Design, Machine Learning, Computational Robotics, Autonomous Systems, Sensor Fusion, Deep Learning, Digital Twin Technologies
B.Tech Mechanical Engineering	Jun 2018 – Apr 2022
Hindustan Institute of Technology and Science, India	
Relevant Coursework:	Finite Element Analysis, Computational Fluid Dynamics, Manufacturing Systems, Structural Analysis, Control Theory