Autonomous Unmanned System Laboratory (AUSL)

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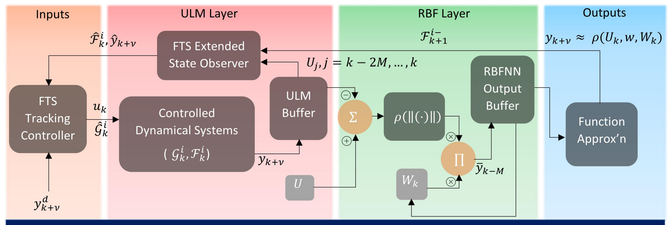
Center for Advanced Systems and Engineering (CASE)

Mission

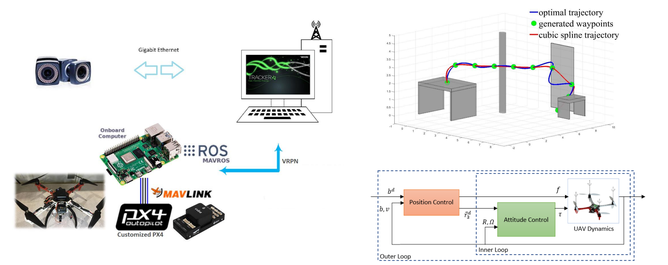
- **Research and Development:** The AUSL conducts research on control technologies for unmanned aerial and ground vehicles and exploring new techniques and methods to enhance the capabilities of autonomous unmanned vehicles for various applications. Design and development of novel guidance, navigation, and control (GN&C) schemes for autonomous unmanned vehicles is the main focus.
- **Testing and Validation:** This lab also focuses on verification and validation tests for autonomous unmanned aerial and ground vehicles (UAVs and UGVs) by providing complete testing facilities for guidance, navigation, and control in an indoor environment. This includes conducting field tests and simulations to evaluate the performance of UAVs and UGVs under different conditions.
- **Training and Education:** The AUSL also plays a role in training and educating professionals on the design, development, and use of unmanned vehicles by providing hands-on training and education to impart the necessary skills and knowledge for students who will join industries where unmanned vehicles are used. This includes applications such as security, infrastructure inspection, agriculture, wildland management, package delivery, remote sensing, and space and underwater exploration.

Scope

AUSL's research ranges from dynamics modeling, design of path planning, nonlinear control and estimation, to design and development of hardware and software systems for autonomous unmanned systems. Major ongoing research areas include:



Real-time Estimation, Control and Identification Framework



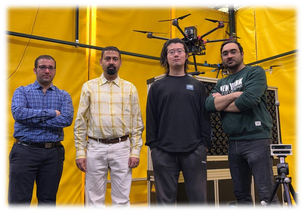
Autonomous Flight Framework for autonomous path planning and trajectory tracking control tests in GPS-denied environments

Implementation of Variational Pose Estimation using T265 Intel Camera feedback

GN&C of UAVs for wildland fire management with Ohio State University

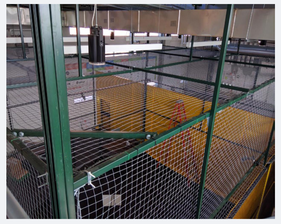
Team Members

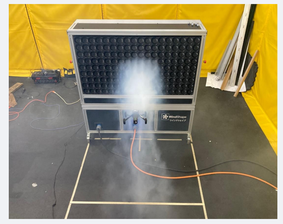
Dr. Amit K. Sanyal, Associate Professor, Director
Dr. Reza Hamrah, Postdoctoral Researcher
Mr. Ningshan Wang, Ph.D. candidate
Mr. Abhijit U. Dongare, Ph.D. candidate



Capabilities

- A 20 ft × 20 ft × 18.5 ft indoor caged-in volume that is available for safe indoor testing of UAVs.
- Lightweight quadrotor UAVs; a DJI Phantom 4 quadrotor UAV; four custom-built quadrotor UAVs and one hexacopter UAV.
- Multiple LiDAR, depth camera (Intel RealSense) and inertial sensors, Pixhawk autopilots, Raspberry Pi, Nvidia TX and NX onboard computers, BLDC motors with control units; and customized autopilot with a sensor suite and onboard processor for autonomous navigation and control.
- A sophisticated motion capture tracking system and decentralized wireless ad hoc network (WANET) for real-time telemetry.
- Facilities to develop autonomous navigation and control of UAVs using onboard inertial, vision and lidar sensors and actuators without external navigation aids like GPS or known beacons.
- A wind/turbulence generator from the Swiss company, WindShape, that creates various wind profiles with varying amounts of turbulence to test the robustness of developed control algorithms.



Services

- Design, building and manufacturing UAV platforms from scratch.
- Design, implementation, test, and debugging control algorithms for aerial autonomous systems.
- Implementation of developed algorithms in software and system level.
- Verification and validation tests (SIL and HIL) of different autonomous vehicle platforms.
- Integration of software with sensors, actuators, and all hardware components using ROS (Robot Operating System).
- Developing appropriate user interfaces, test procedures, requirements documentation and verification.
- Development of multi-channel lidar-based SLAM & A-LOAM, sensor fusion, visual feature segmentation, classification, pose estimation, path planning, and feedback control.

Projects

- Integration of Autonomous UAS in Wildland Fire Management, Amit Sanyal, Mrinal Kumar and Roger Williams from Ohio State University, Sponsored by NRI-National Science Foundation (NSF).
- A Universal Flight Management Unit for Unmanned Aircraft Systems, Amit Sanyal and Sasi Prabhakaran, Sponsored by SBIR Phase I-NSF.
- Enabling Multimodal Sensing, Real-time Onboard Detection and Adaptive Control for Fully Autonomous Unmanned Aerial Systems, Amit Sanyal, Qinru Qiu, Senem Velipasalar, Jian Tang, and Yanzhi Wang, Sponsored by Cyber Physical Systems (CPS)-NSF.
- Reliable Perception and Control for UAV Navigation in 3D Space, Amit Sanyal, Qinru Qiu, and Senem Velipasalar, Sponsored by Semiconductor Research Corporation.
- Developing a UAV Testing Lab and Collaborative Research Projects, Amit Sanyal and et al, Sponsored by New York State Department of Economic Development, Gryphon Sensors LLC.

Outcomes

- Robust And Stable Autonomous Vision-Inertial Navigation System For Unmanned Vehicles
- High Control Authority Variable Speed Control Moment Gyroscopes
- Integrated Guidance And Feedback Control For Autonomous Vehicle
- Selected Publications and Conference Papers (See https://www.researchgate.net/profile/Sanyal-Amit)

Sponsors

- Division of Computer and Network Systems: Cyber-Physical Systems (CPS)
- National Robotics Initiative (NRI)
- Division of Civil, Mechanical and Manufacturing Innovation Dynamics, Control and Systems Diagnostics (DCSD)
- Division of Electrical, Communications and Cyber Systems: Energy, Power, Control, and Networks (EPCN)

AUSLab. Autonomous Unmanned System Laboratory

Syracuse University
Center of Excellence in Environmental & Energy Systems