CCRI: ENS: Enhanced Open Networked Airborne Computing Platform

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Introduction

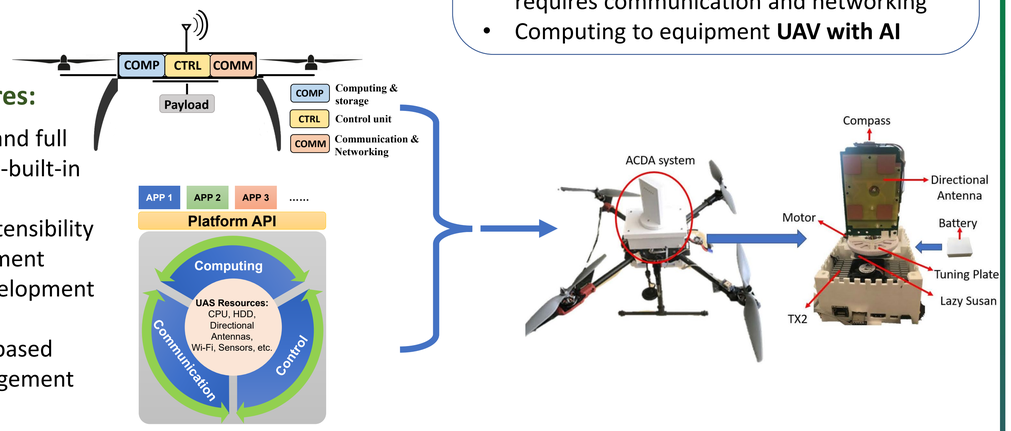
This project aims to develop an enhanced **open** networked airborne computing platform to facilitate the design, implementation, and testing of an **airborne computing platform** that seamlessly integrates **control, computing, communication, and networking**.

Challenges for Current UAV Research:

- UAV is a **multidisciplinary** system
- Current commercial UAV is a **closed system**
- From **single UAV to UAV networks**, which requires communication and networking
- Computing to equipment **UAV with AI**

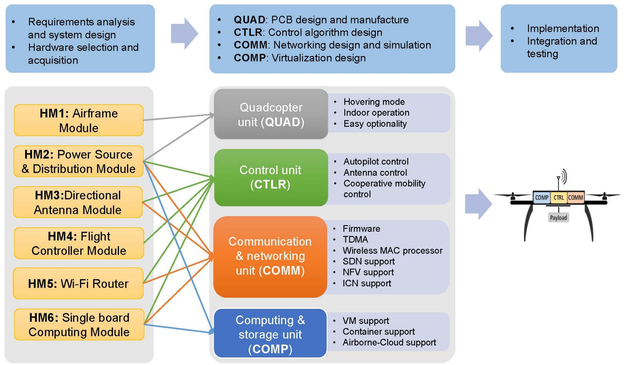
Innovative Features:

- Modular design and full functionality: Pre-built-in and ready to use
- Flexibility and extensibility for new development
- Friendly APP development capability
- Flywheel model based community engagement



System Overview

Current System



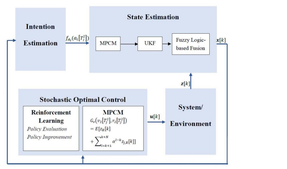
Enhanced System:

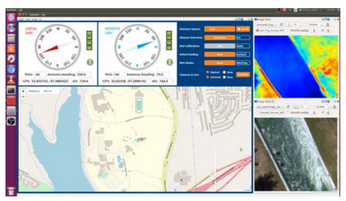
- Hardware and Control
  1. Supporting ROS2
  2. Updating processor
  3. Improving control for directional antenna
- Communications and Networking
  1. Adding software-defined radio
  2. Supporting cellular network
  3. Adding phased array antenna
  4. Enhancing software-defined networking
- Airborne Computing Service
  1. Target recognition and tracking service
  2. Mobile edge computing service
  3. LiDAR data processing service
- Security
  1. Providing security package
  2. Federated learning platform

Enabled Research

1. Platform development
   - Power system
   - Propeller design (noise)
2. UAV Control
   - Flight control
   - Path planning
   - Mobility modeling
   - Multi-UAV coordination
   - Intelligent flight control
3. Communications and networking
   - Directional antenna control
   - LTE base station
   - Integrated sensing and comm.
   - Phased-array control
   - Channel modeling
4. Airborne computing
   - Datasets
   - Virtualization
   - Coded distributed computing
   - Coded federated learning
   - Intelligent UAV
   - Federated learning

Green : Enabled by enhanced system



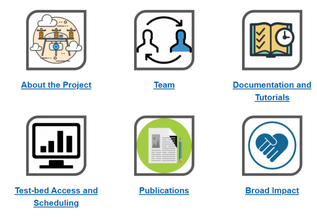


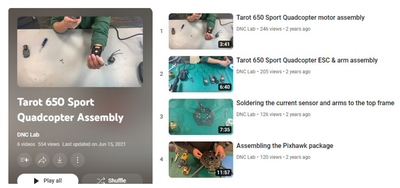
Selected Publications

- J. Chang, S. Li, M. Liu, Y. Wan, S. Fu, J. Xie, and K. Lu, "On-Demand Emergency Aerial Communication using Directional Antennas: A CPS Co-design Approach," Book Chapter, Smarter Cyber Physical Systems: Enabling Methodologies and Applications, CRC Press, 2023.
- B. Wang, et al. "Learning and Batch-Processing Based Coded Computation with Mobility Awareness for Networked Airborne Computing", IEEE Transactions on Vehicular Technology, Vol. 72, No. 5, pp. 6503 - 6517, 2022.
- B. Wang, et al., "On Batch-Processing Based Coded Computing for Heterogeneous Distributed Computing Systems," IEEE Transactions on network of science, 2021
- M. Liu, et al., "Adaptive Optimal Control for Stochastic Multi-Agent Differential Games using On-Policy and Off-Policy Reinforcement Learning," IEEE Transactions Neural Networks and Learning Systems, 2020.
- K. Lu, et al., "Toward UAV-based Airborne Computing," IEEE Communication Magazine, vol. 26, no. 6, pp. 172-179, December 2019.

Community Engagement

Project Website: https://utari.uta.edu/research/airborne/





UNT Advanced Air Mobility (UAAM) Test Center

- 300' x 120' x 80'
- Net covered
- WiFi coverage
- 5G System to be available

Dissemination

Tutorials at VTC, ICUAS, ICCSI, LATINCOM

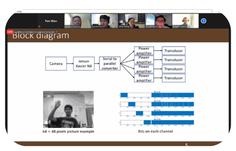
Demonstration Globecom, VTC, US Ignite, GCTC

Outreach

Austin Fire Dept.

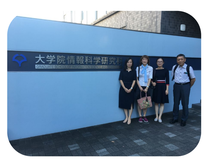
Minimaker in Denton

Denton Emergency Dept.



Student competition In CPS IoT Week

Workshop UTA, 2023



Visit Osaka Univ.

Robotics Summer Camp at SDSU, 2022-2023

Students and Awards

CCRI: 2235157, 2235158, 2235159, 2235160