Hermes Environment Risk Mitigation Executive System (HERMES)

Applications for safe autonomous aircraft operations

2026 NASA Core Flight Systems (cFS) Symposium

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HERMES Technology Focus

Safety functions to facilitate urban drone operations for commercial and first responder use cases.

- Monitoring vehicle states such as battery usage, navigation status, link status, autopilot status.
- Monitor flight path for terrestrial obstructions hazards, traffic, and staying in operating area.
- Risk based assessment and contingency decision making.
- Integrates with ground systems for data exchange and test tools interaction.

Historical Context

- **~2009-2014:** Integrate diagnostic and prognostic with multi-layer supervisory control.
- **~2012-2016:** Integrating prognostics with spacing and sequencing algorithms, during airport approach pattern. Testing with Robot Operating System(ROS), Internet Computing Engine(ICE). Migrate to cFS for flexibility to expand on-board capability.
- **~2016-present:** Safety functions to facilitate urban drone operations. Building on cFS application suite.

HERMES System and Operations Context

Extra 260 (40%, 10' span)

Tarot T-18

Flight Vehicle

PixHawk Cube

Air Space Constraint Monitor

Sensors & DAS

HERMES

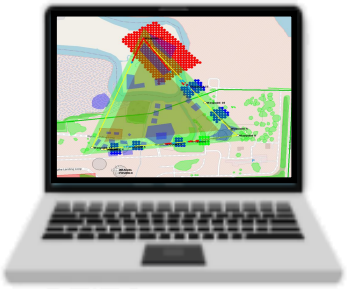
Intel NUC

Autopilot (Open source)

Comm. Hardware

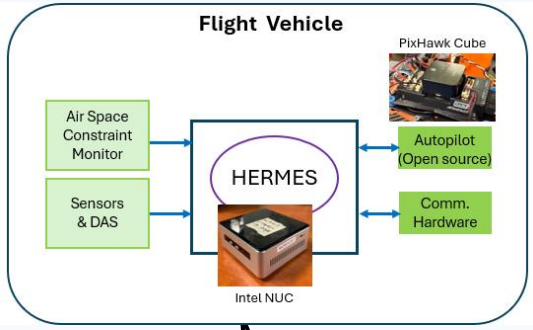
Autopilot Ground Station

Networked Data Services



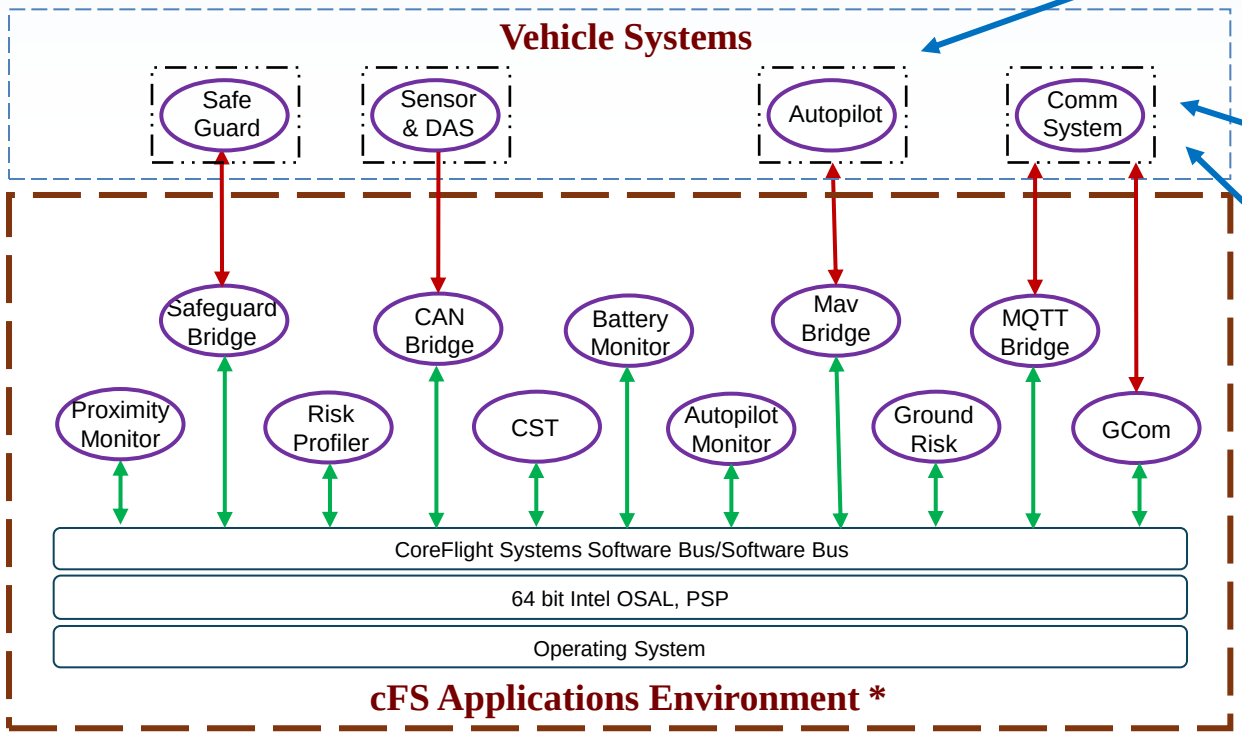
Research Ground Station

HERMES Applications



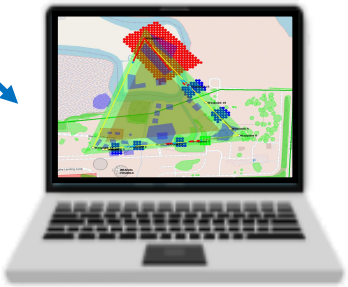
Serial Link

Autopilot Ground Station



TCP /IP Link

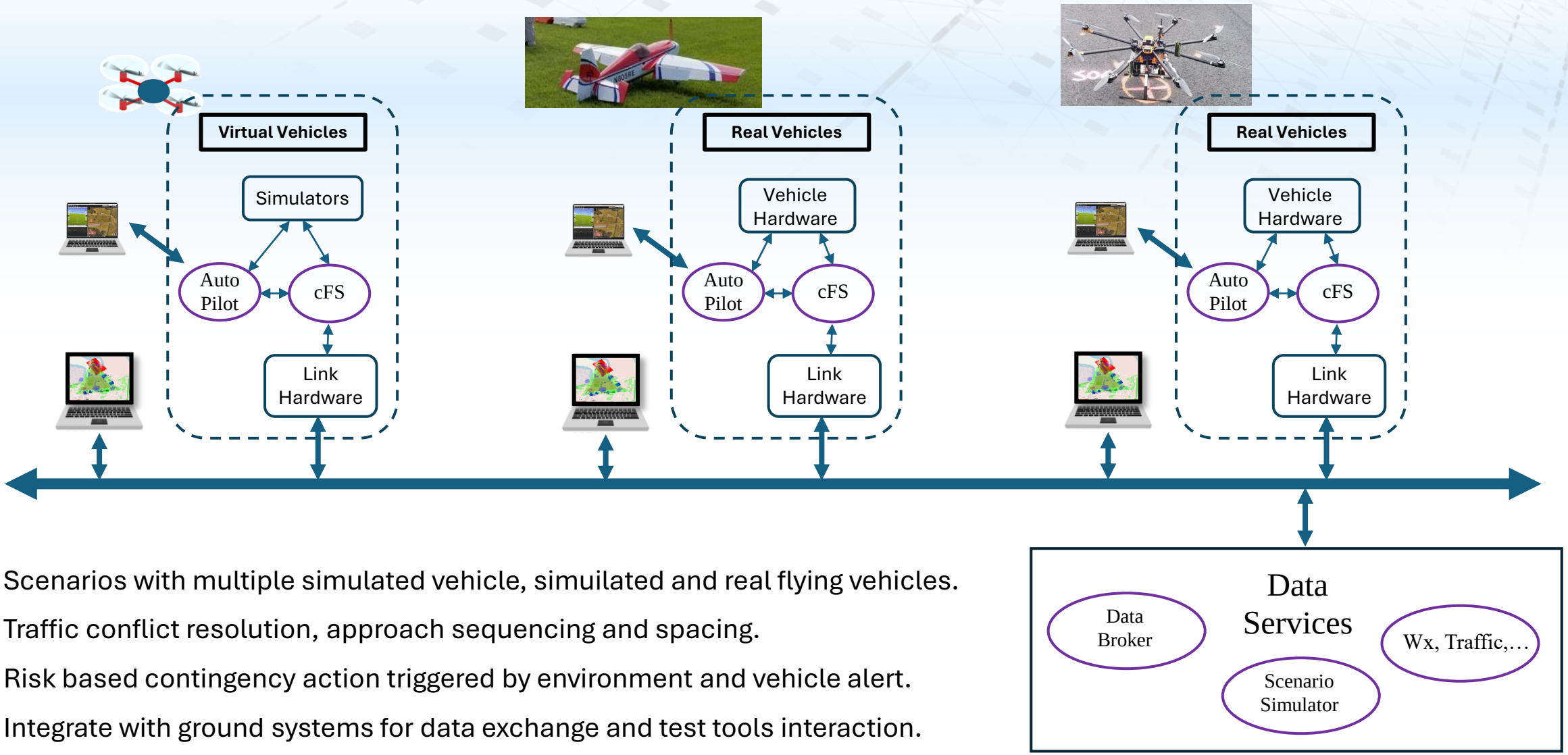
Networked Data Services



Research Ground Station

** Recent cFS applications testing. Past collaborative work (Sequencing and spacing, PLEXIL integration, …) not shown.*

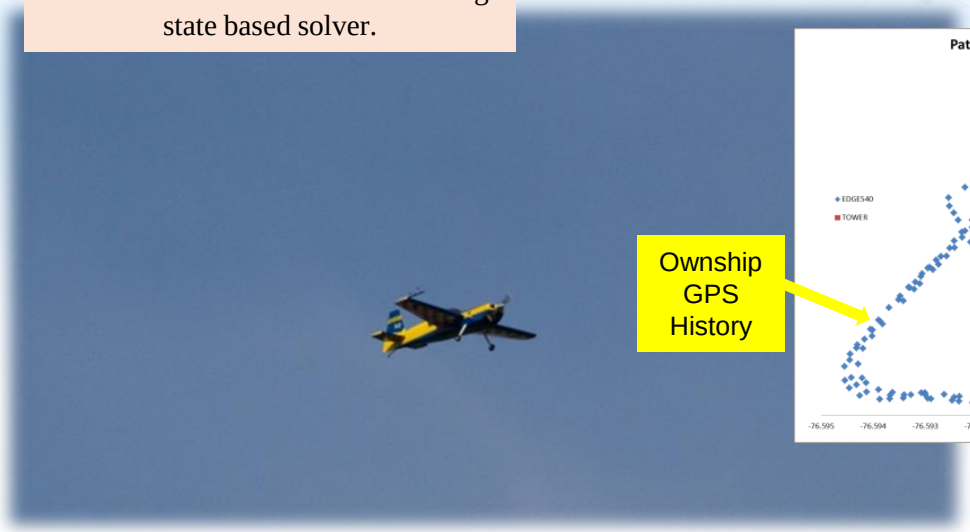
Augmented Reality Test Environment for cFS Applications

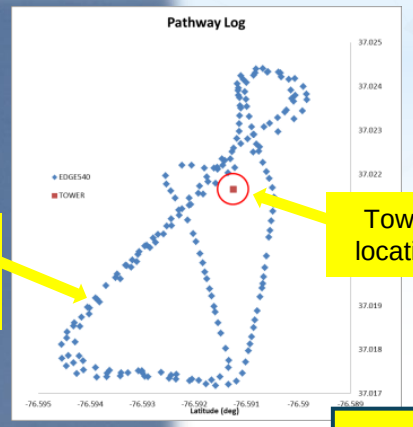


- Scenarios with multiple simulated vehicle, simuilated and real flying vehicles.
- Traffic conflict resolution, approach sequencing and spacing.
- Risk based contingency action triggered by environment and vehicle alert.
- Integrate with ground systems for data exchange and test tools interaction.

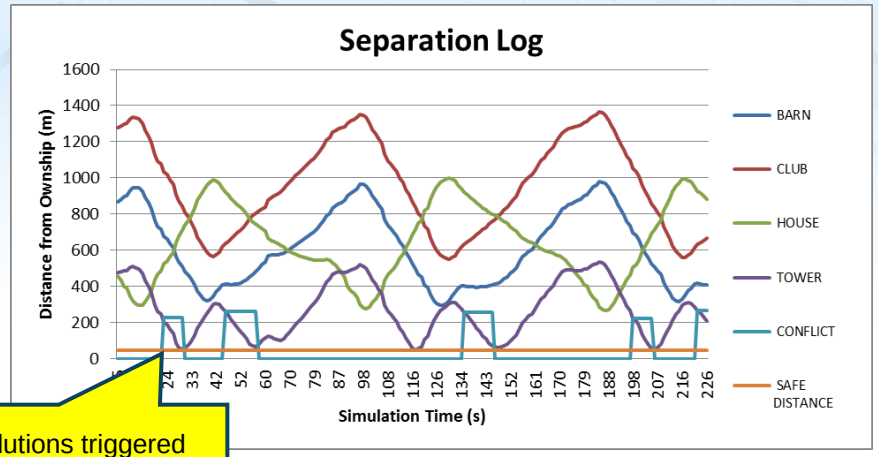
Early Augmented Reality (AR) Flights – State based separation testing

On-board software de-conflicts using state based solver.

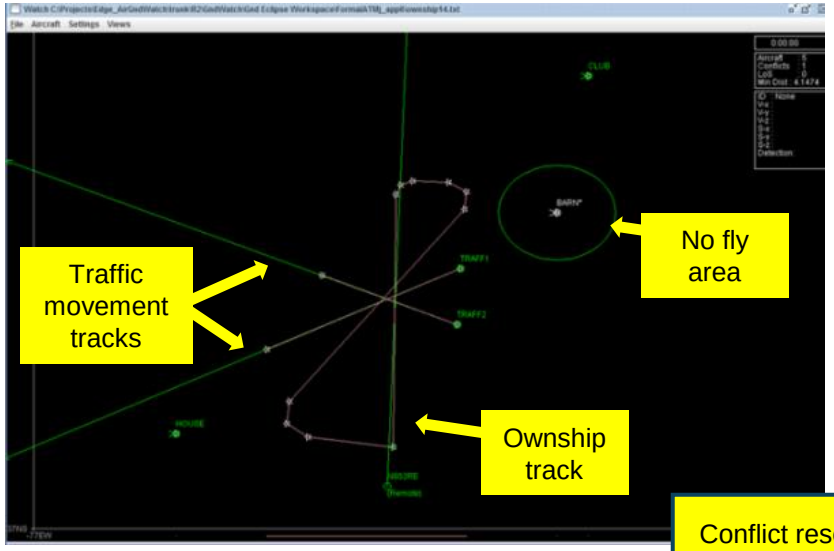


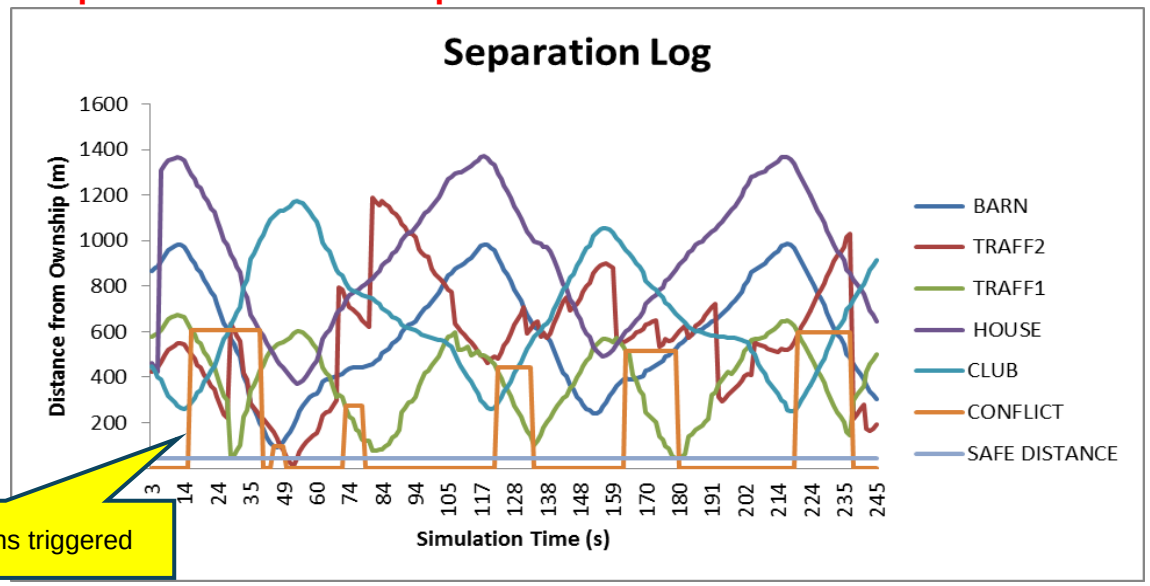


Tower Separation Scenario – Track variance



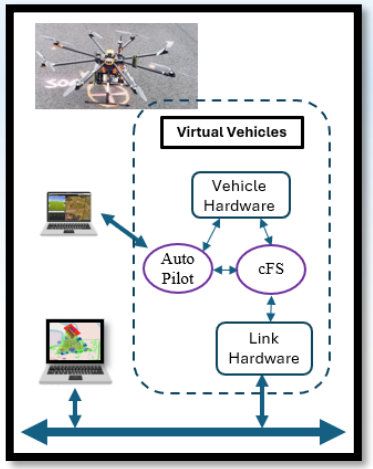
Forward and broad side separation Scenario – Speed variance



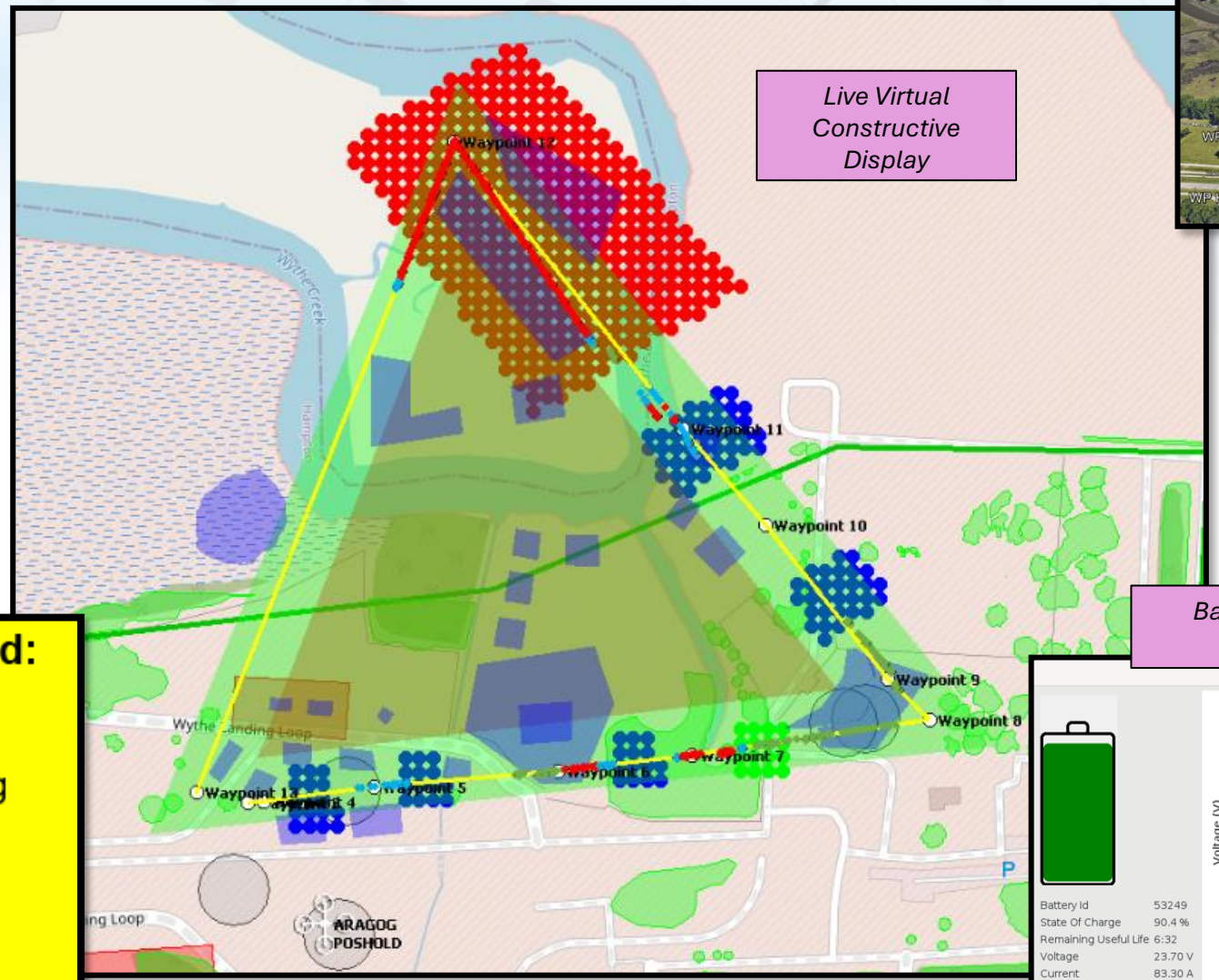


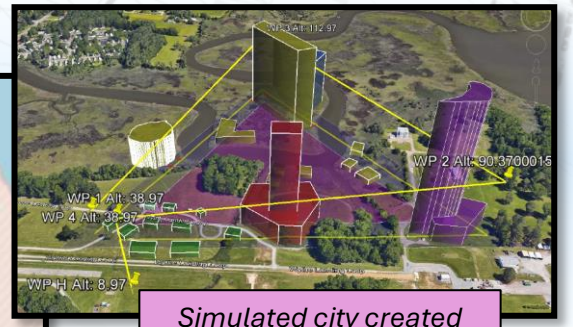
Recent AR Testing

Single agent decision testing.



Live Virtual Constructive Display



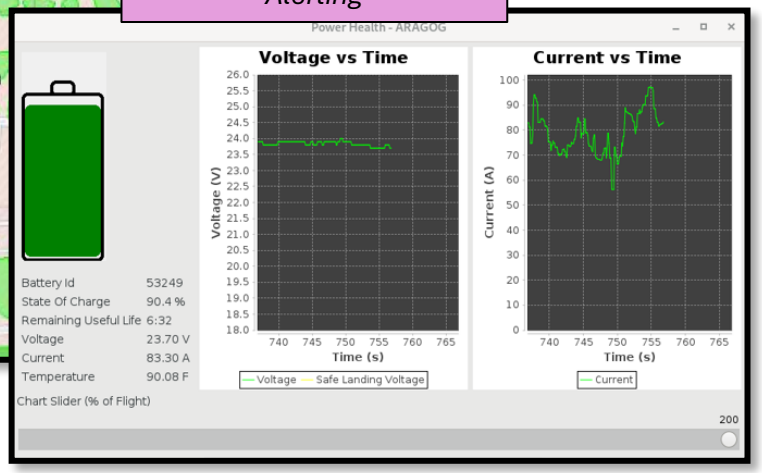


Simulated city created for risk based decision algorithm test

cFS Applications Tested:

- Proximity alerting
- Ground population alert
- Airspace constrain alerting
- Battery alerting
- Risk assessment
- Autopilot state transition monitoring
- Decision execution

Battery Monitor and Alerting



Summary and Status

- cFS is key enabler for UAS safety applications development and flight testing.
- cFS applications developed over several projects being updated for release.
- Current work focused on cFS applications for pro-active decision support with more emphasis on air traffic management use cases.

Questions?

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