NORTHERN ARIZONA UNIVERSITY

Developing and Testing a Software Defined Radio and UAV System for Wildlife Tracking

Introduction to UAV-RT System

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The Wildlife Society Conference
Albuquerque, NM

DASL dynamic and active systems lab

Outline

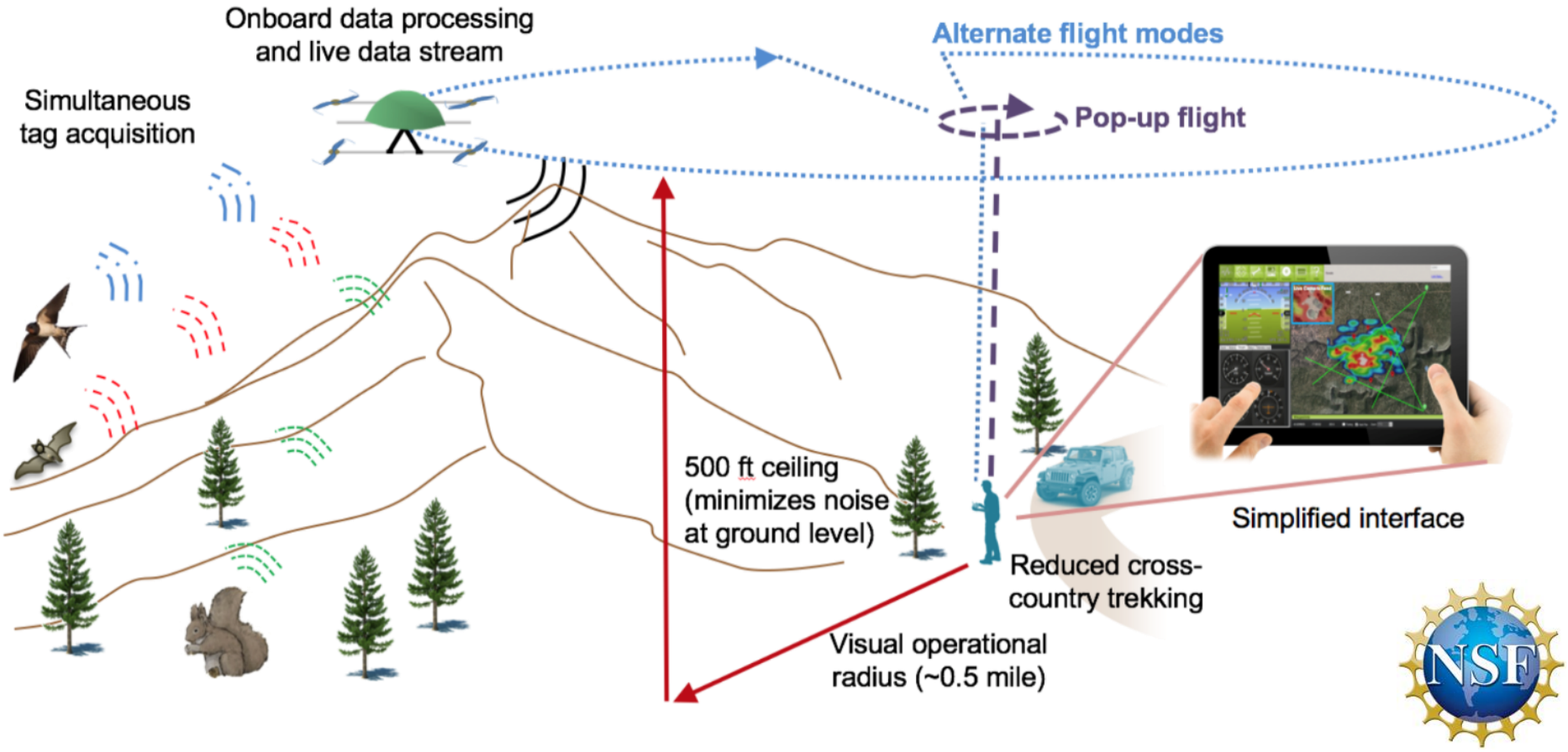
- Discuss current issues with wildlife telemetry tracking
- Overview of project objectives
- Vehicle design and basic building parameters
- Flight control and radio telemetry integration

Current Issues

- Wildlife telemetry for small species continues to present a major challenge
- Current search methods are inefficient, especially for remote locations
- GPS tags present additional cost and weight
- Current tracking requires dangerous and costly manned aircraft searches in conjunction with cross-country hiking

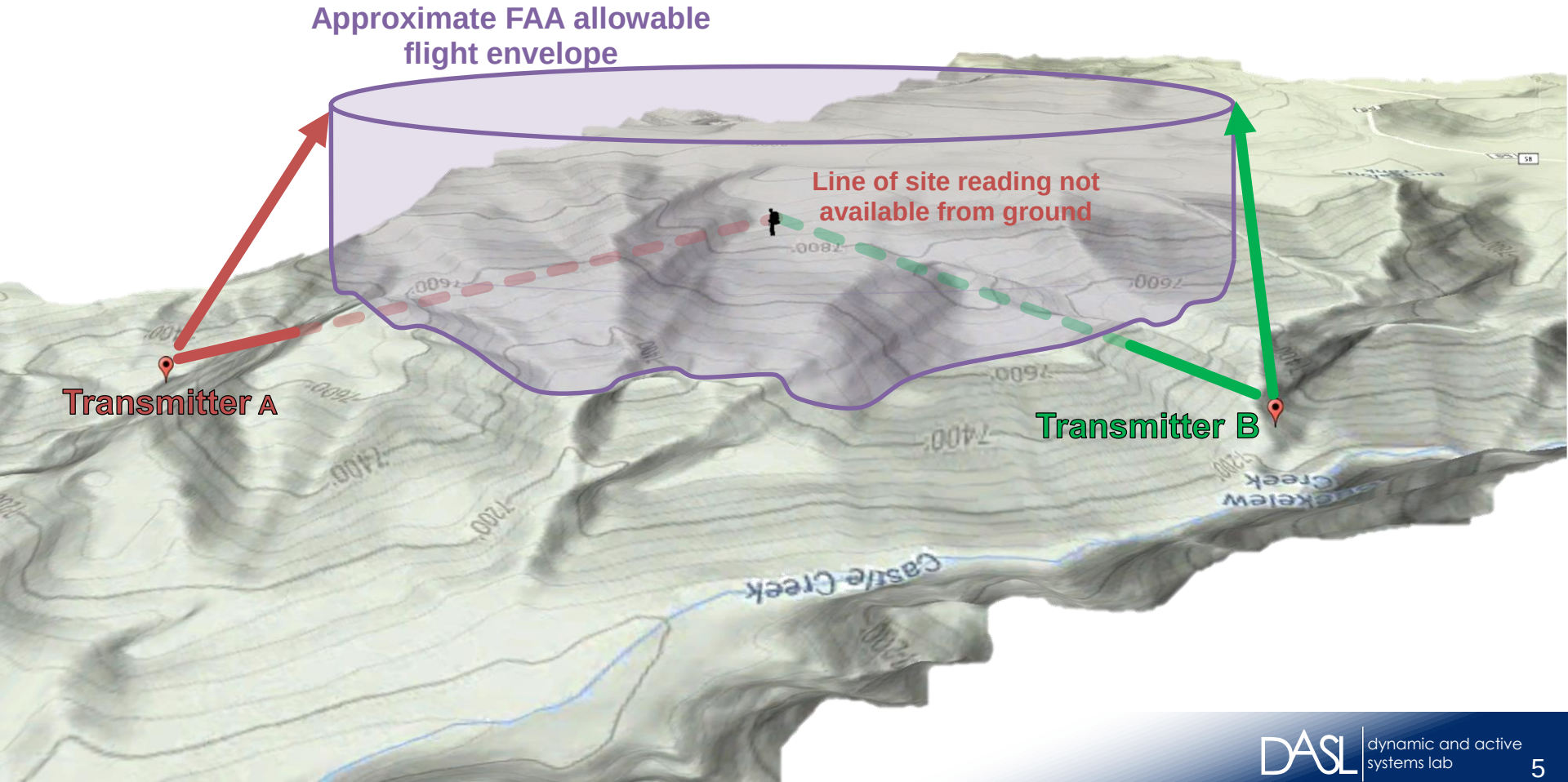
UAV-RadioTelemetry Research Program

- NSF Funded IDBR research program
- Collaboration: biologists, electrical & mechanical engineers
- Final system will integrate autonomous flight capability with onboard data processing



Major advantages

- Improved vantage points: 400 ft ceiling per FAA
- Improved mobility: ~0.5 miles (within visual range)
- 3D flight capability



Project objectives

- Open-source, purpose designed UAV
  - Packable (protected when stored)
  - Field repairable
  - Simple fabrication/assembly
- Radio payload development
  - Initial objective: Radio relay (400 ft pole for antenna)
  - Secondary objectives:
    - environment mapping
    - automated bearing estimates
    - automated search methods
- Technology dissemination
  - Conference talks
  - Website development
    - System design (plans, tutorials)
    - **Legal information for FAA compliance**
    - Open source software and firmware

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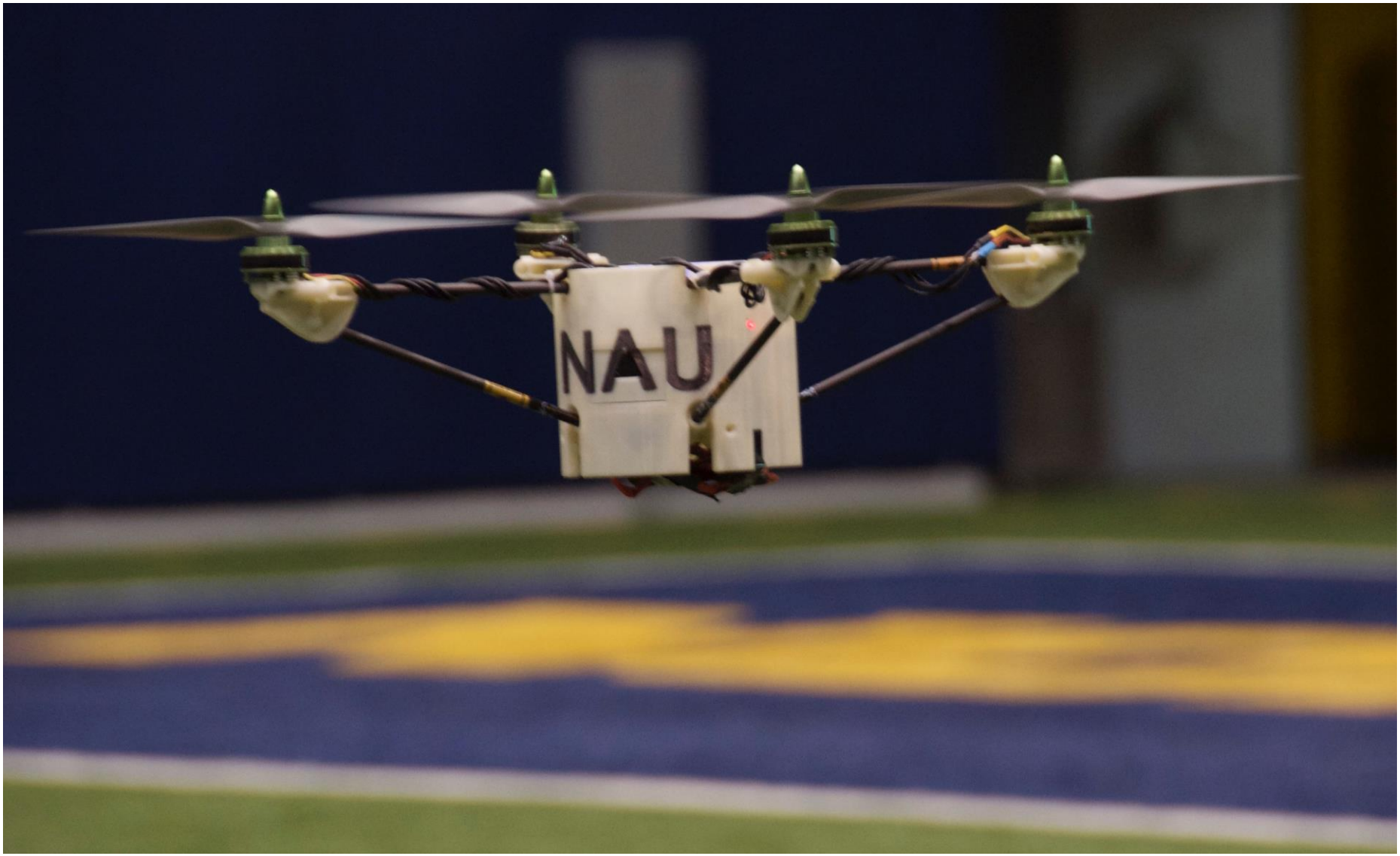
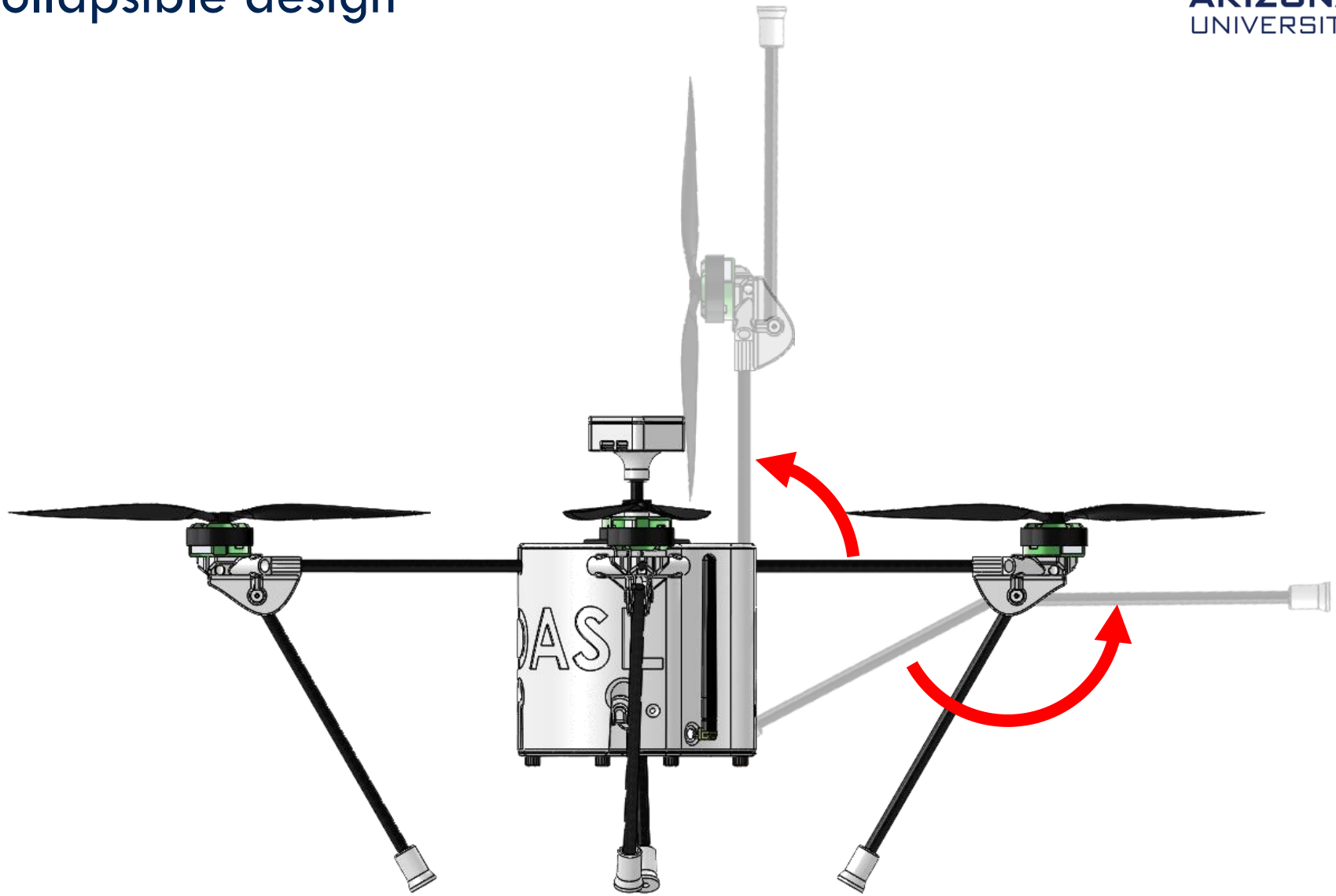
Previous design



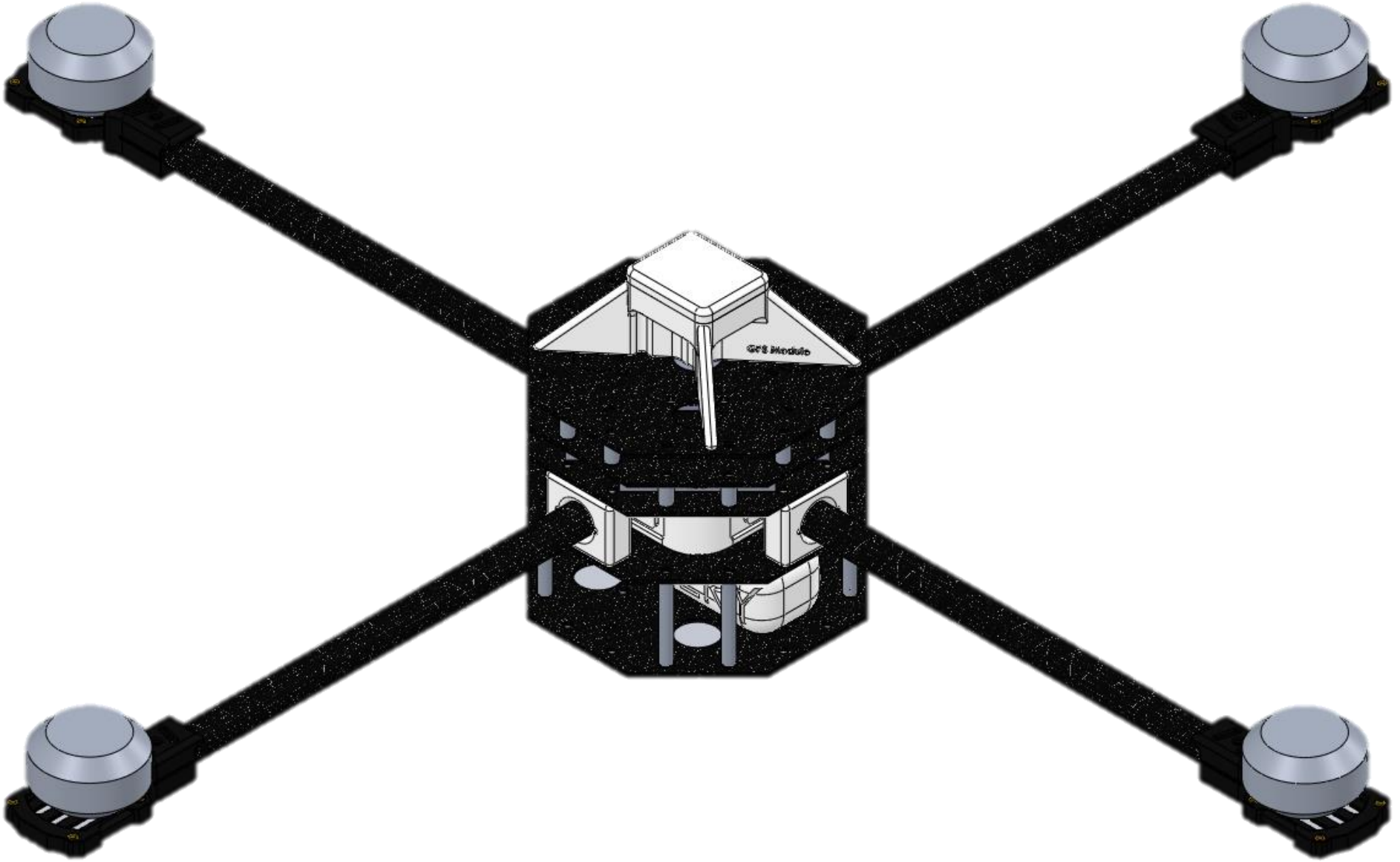
Collapsible design



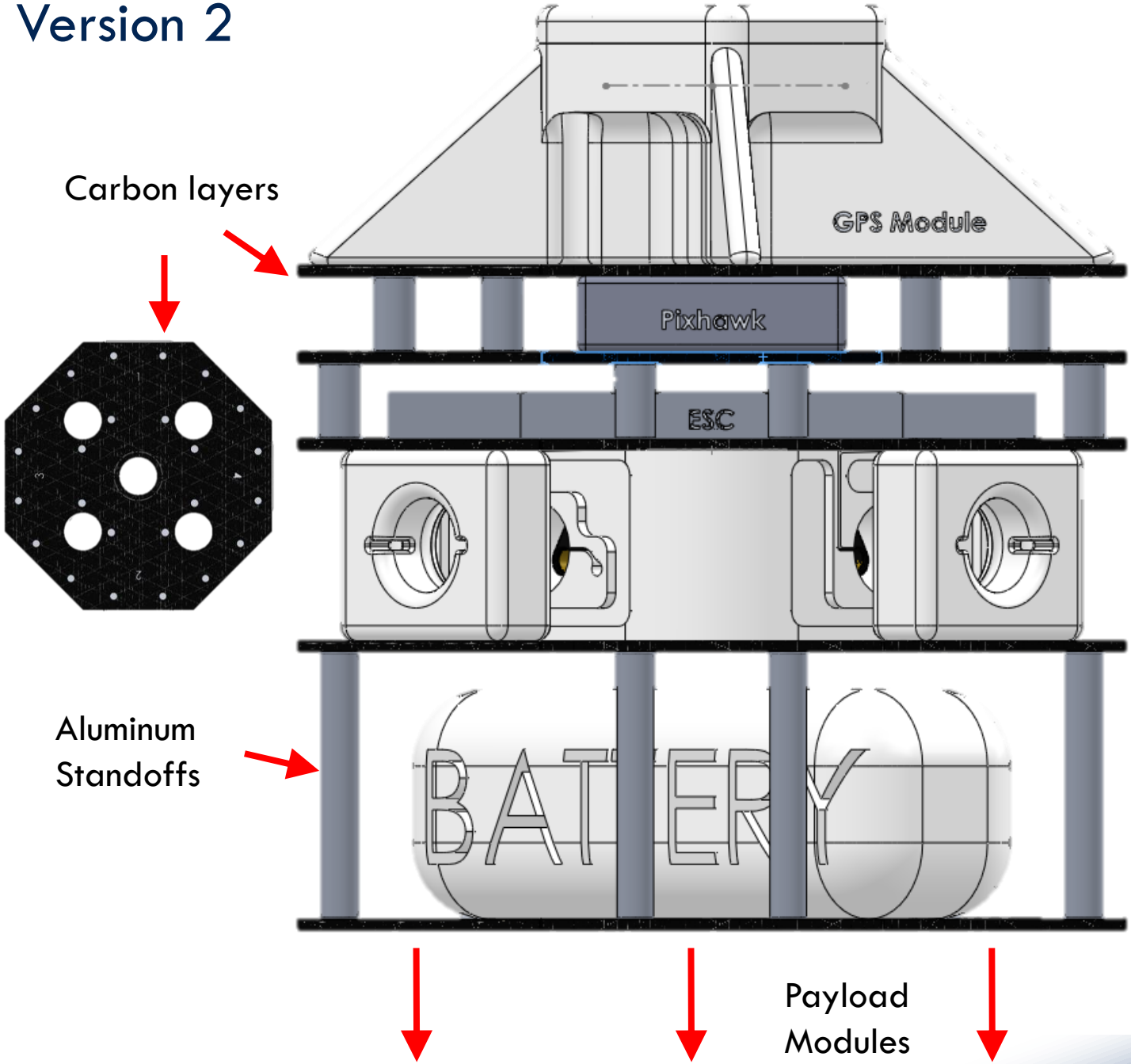
Findings from revision 1

- 3D printed material isn't ideal for direct load path
  - Compressive loads okay
- Design need for resilience to "off-nominal" landings
  - Hinges are inherently weak
  - Design should protect features hard to replace
- All-in-one fuselage not ideal
  - Fractures requires entire rebuild
- Carbon fiber used on many drones for a reason
- Modularity makes repairs easier
  - Repairable = Replaceable

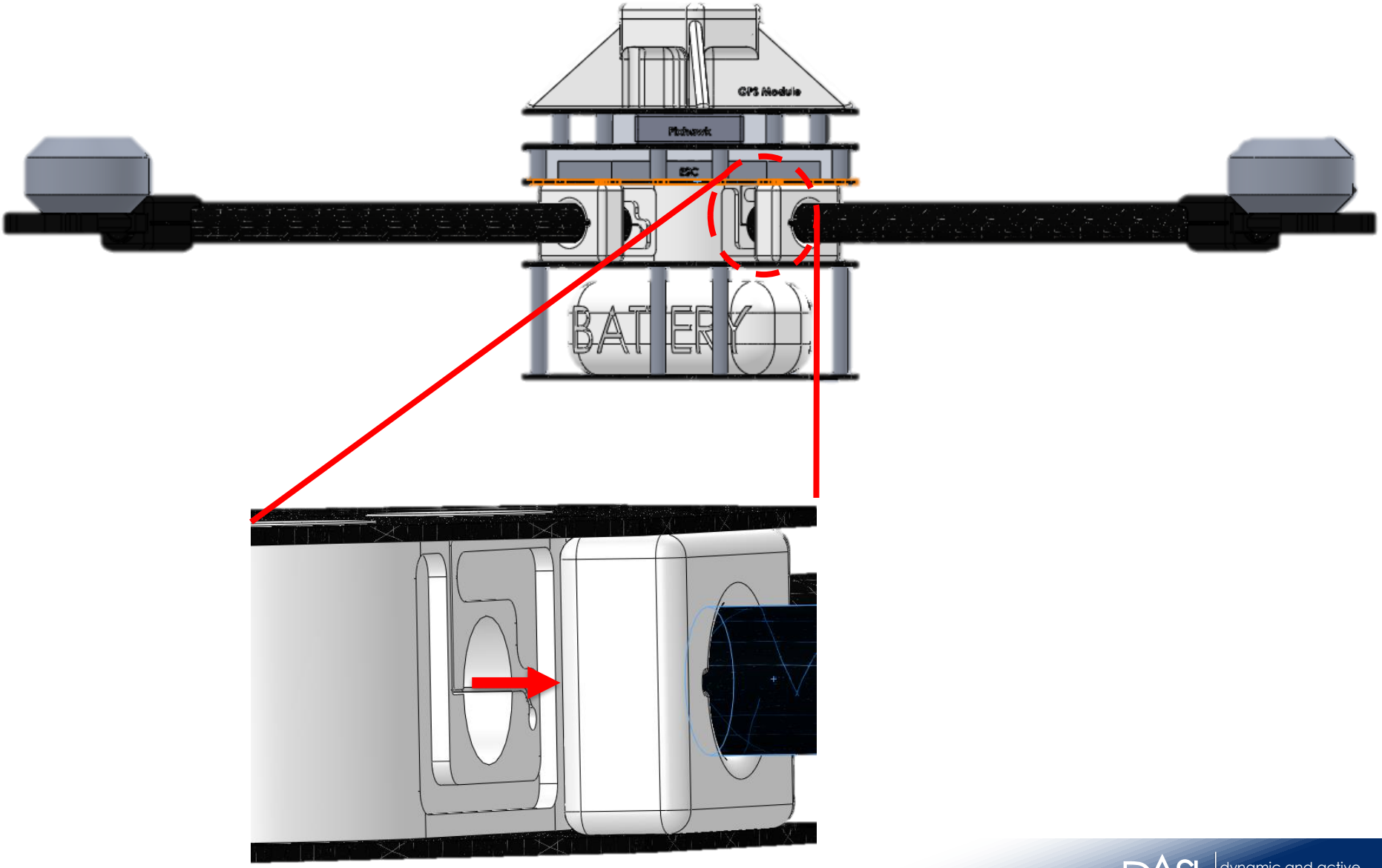
Version 2



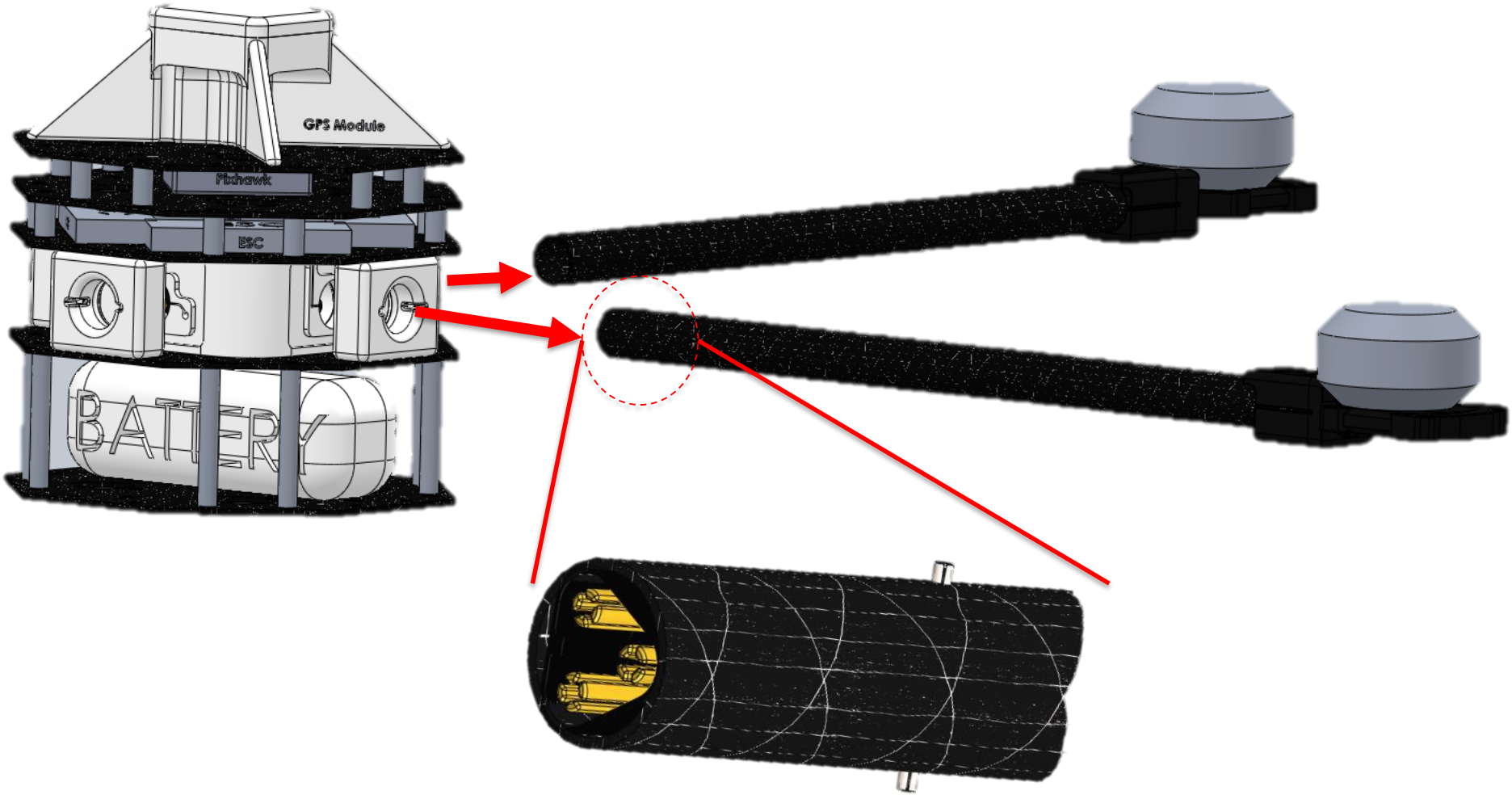
Version 2


Carbon layers
Aluminum Standoffs
GPS Module
Pixhawk
ESC
BATTERY
Payload Modules
Antenna Layer
Flight Computer
Structural Core
Battery Layer

Version 2



Removable arms



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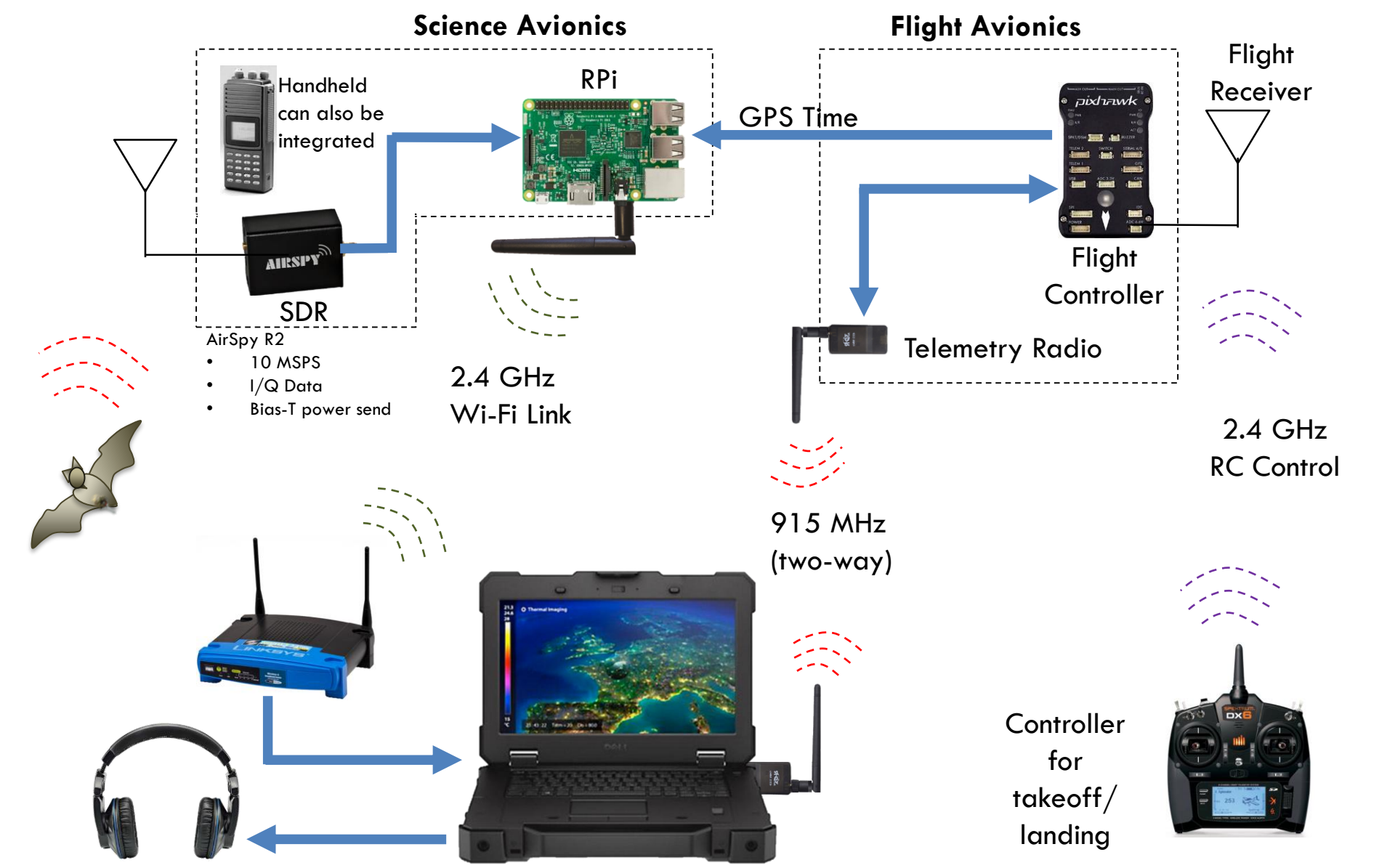
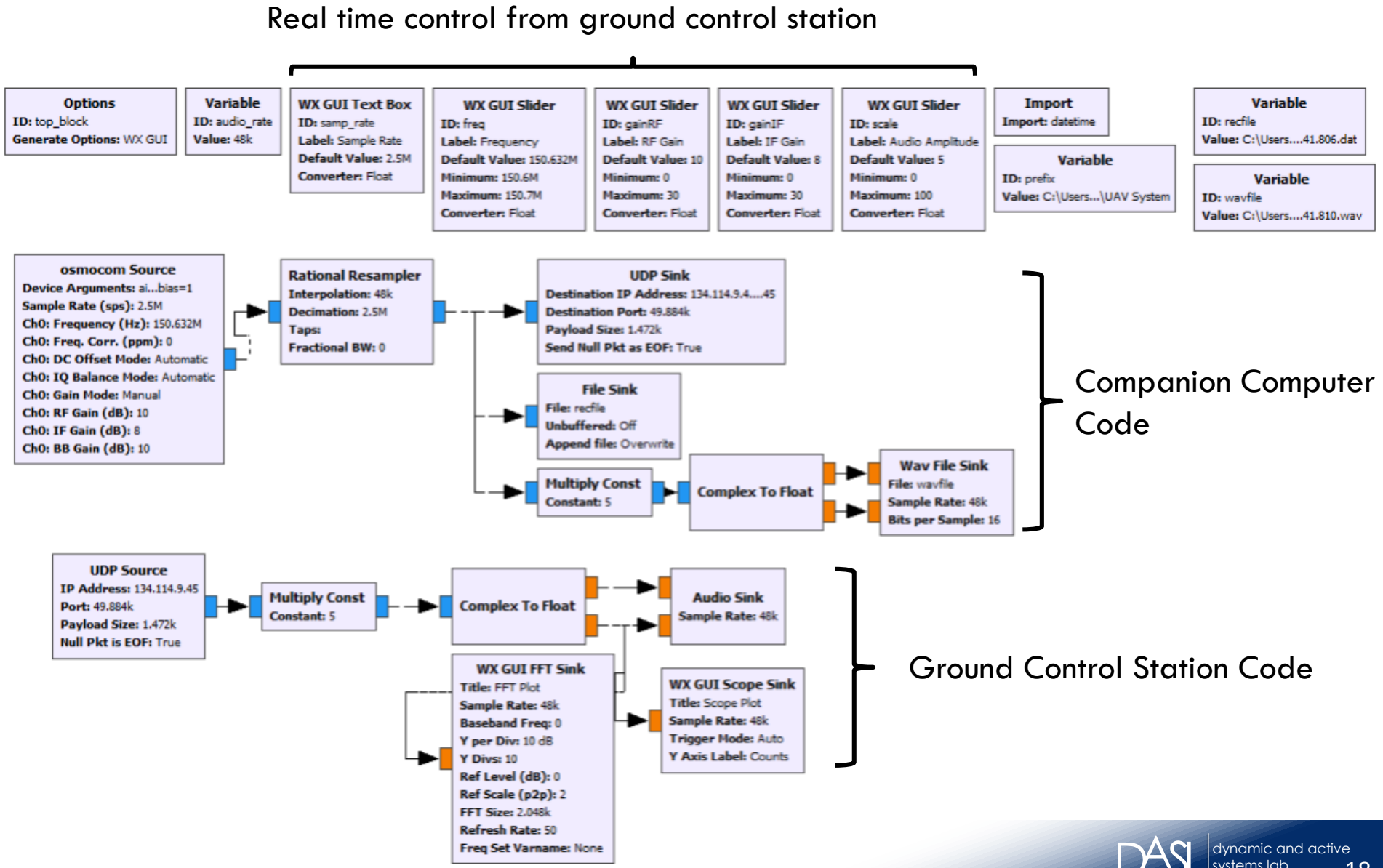
Current system setup

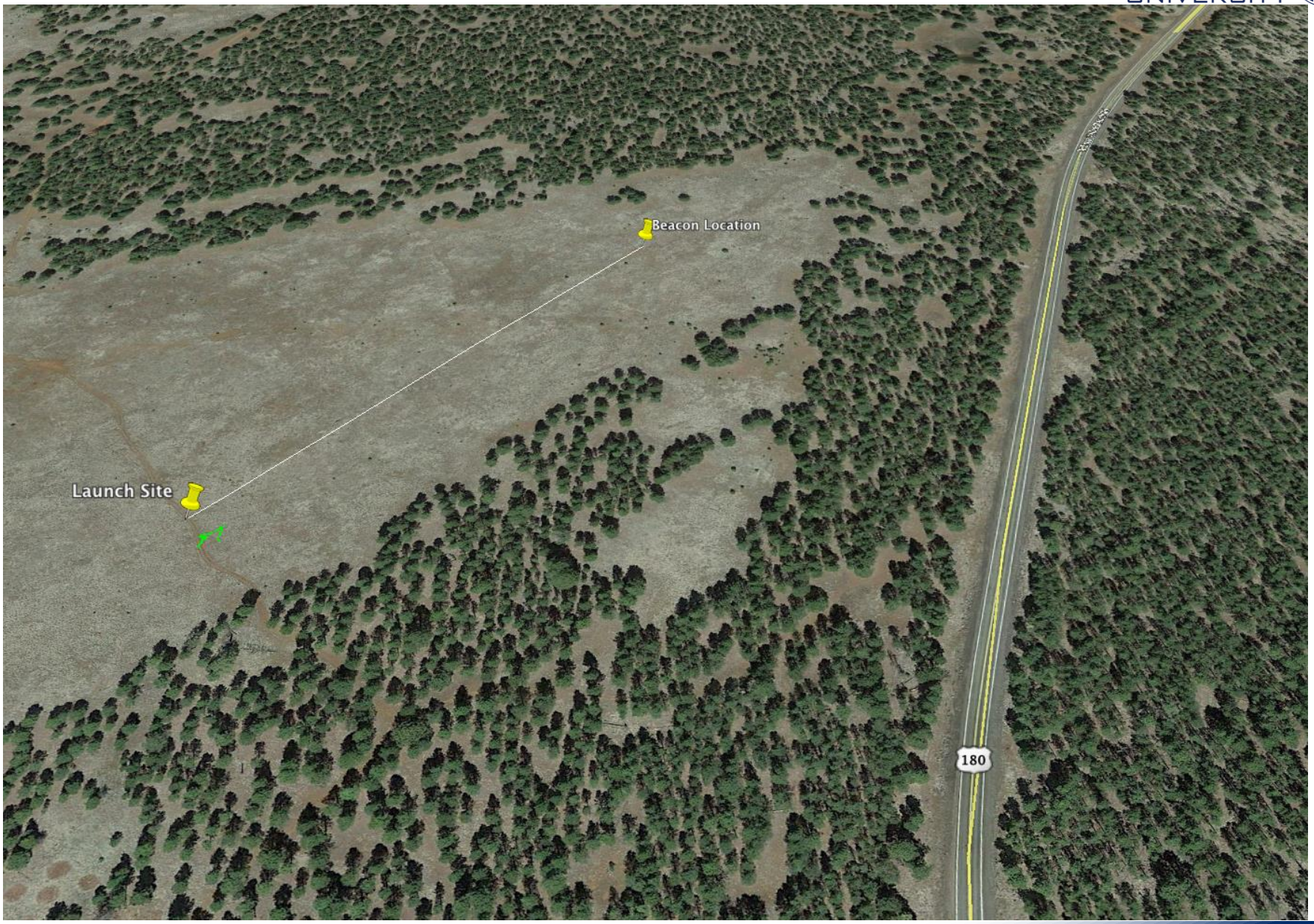


Ground control station

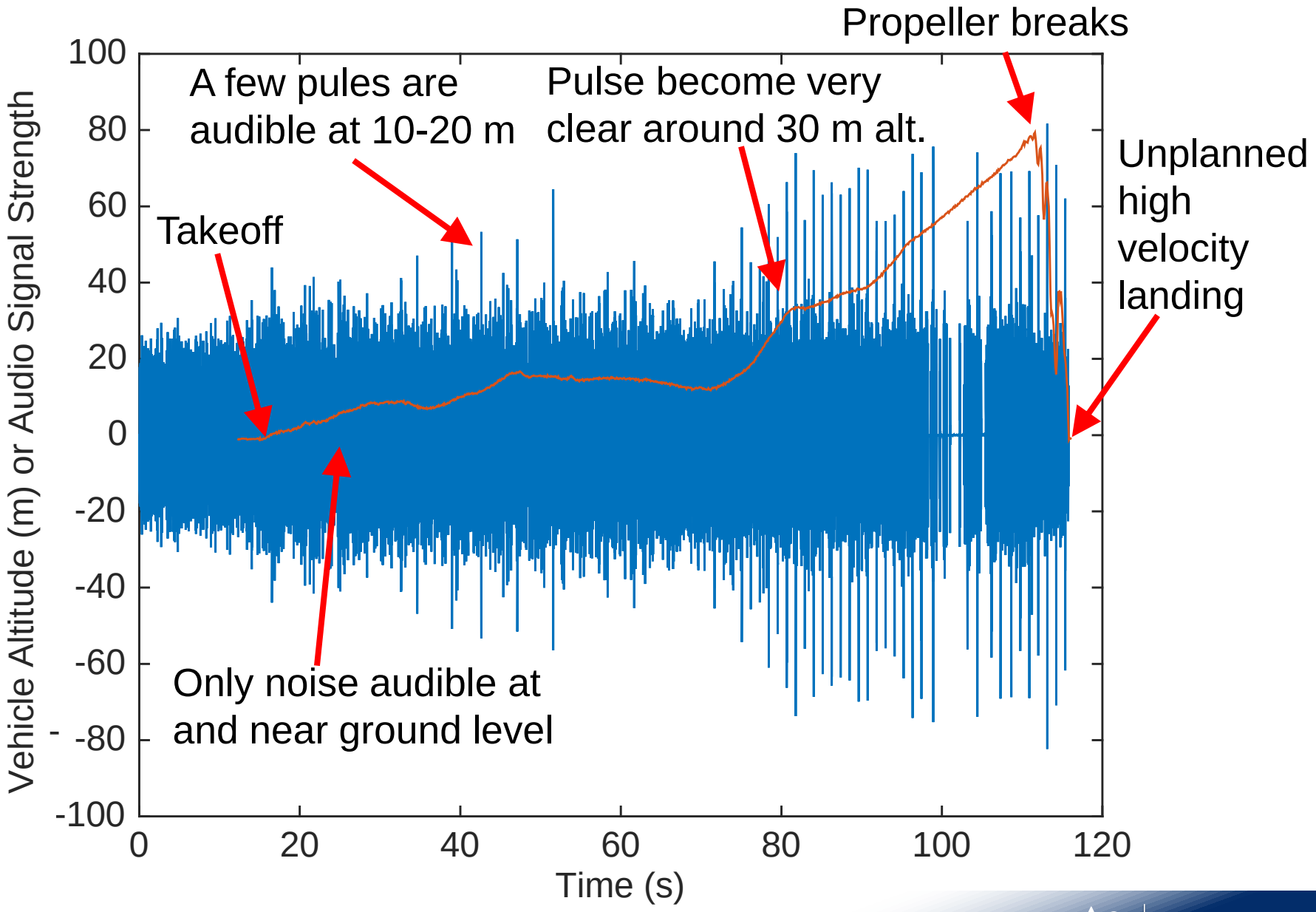
GNU Radio Code



Proof of concept testing: Overview



Proof of concept testing: Initial results



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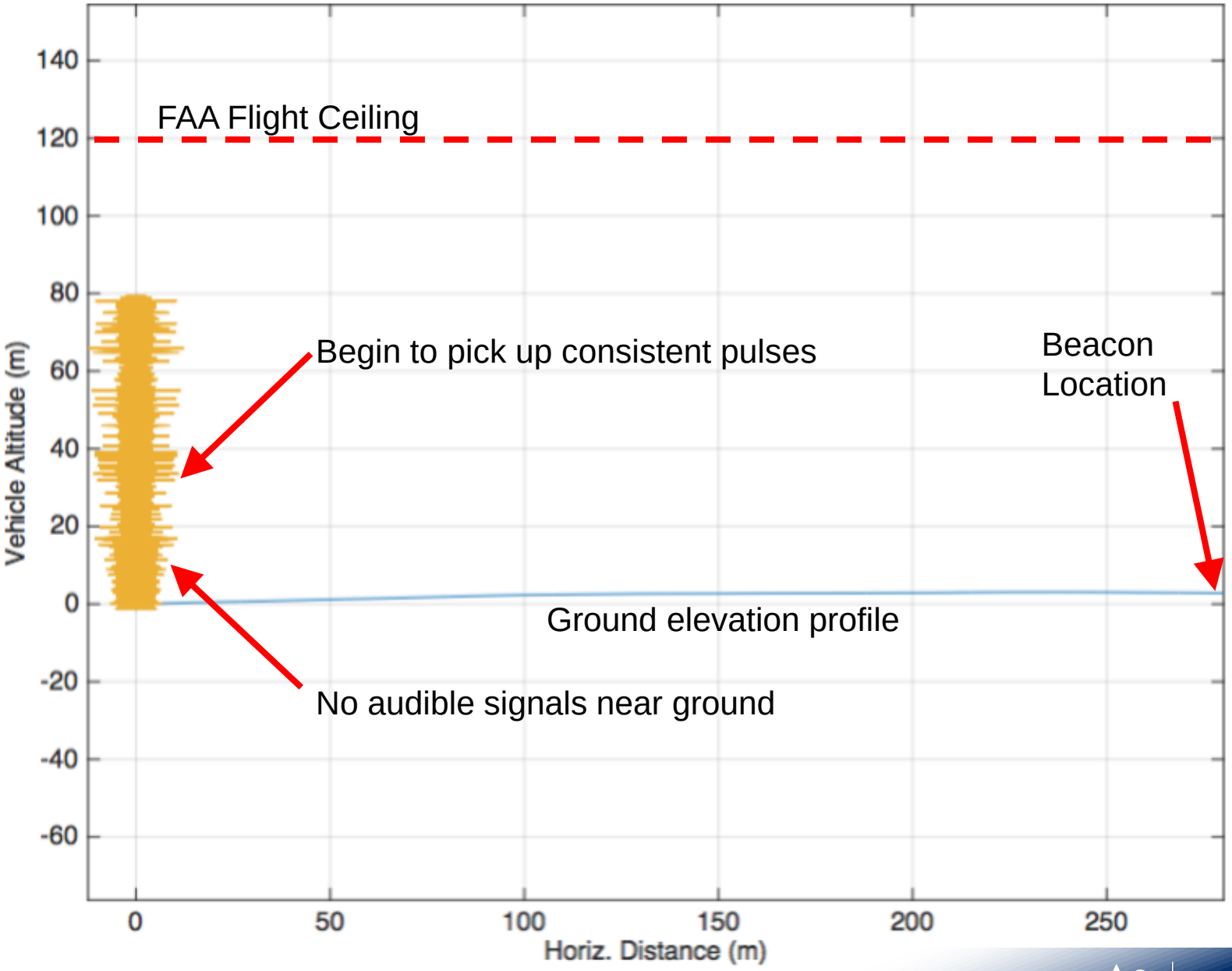
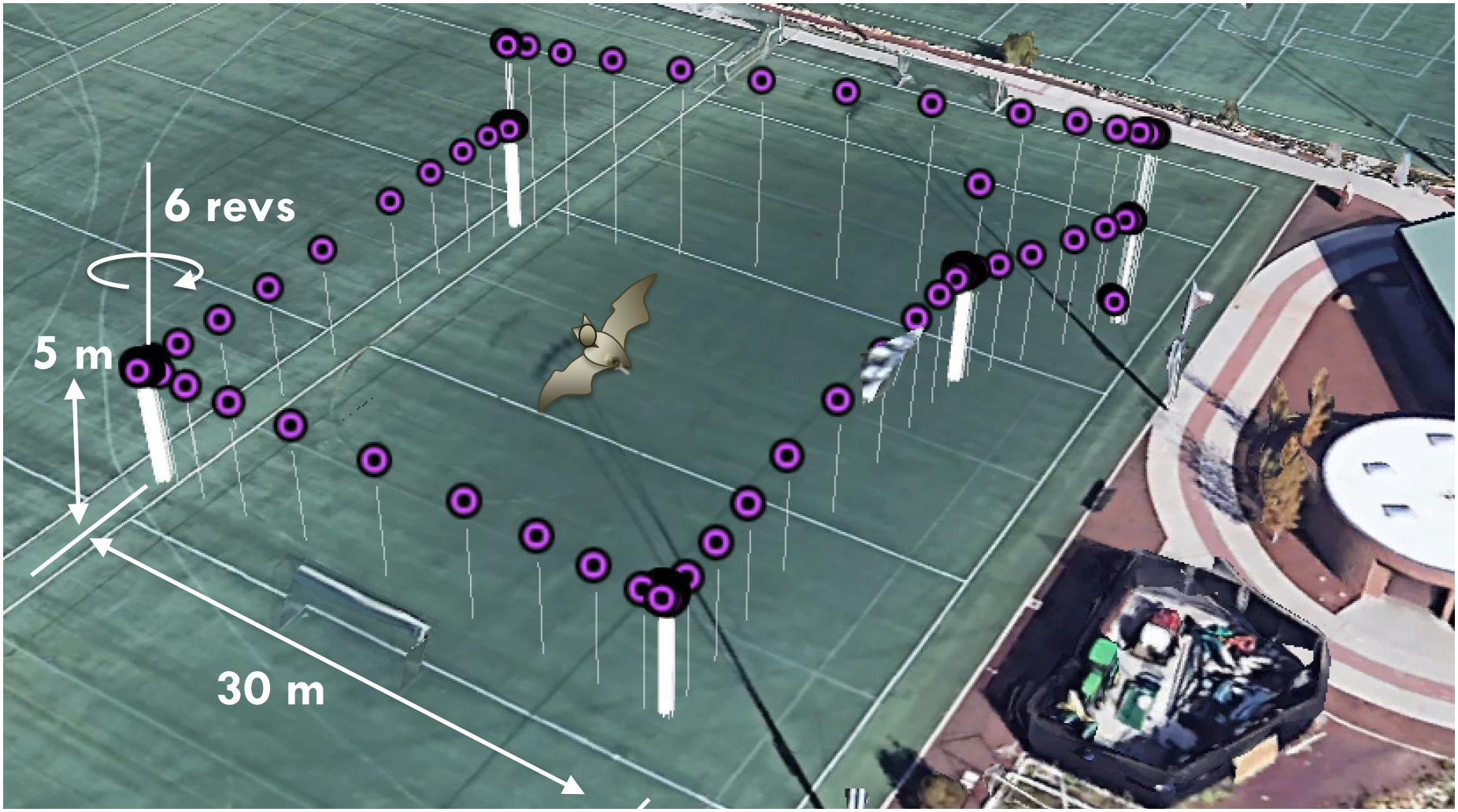
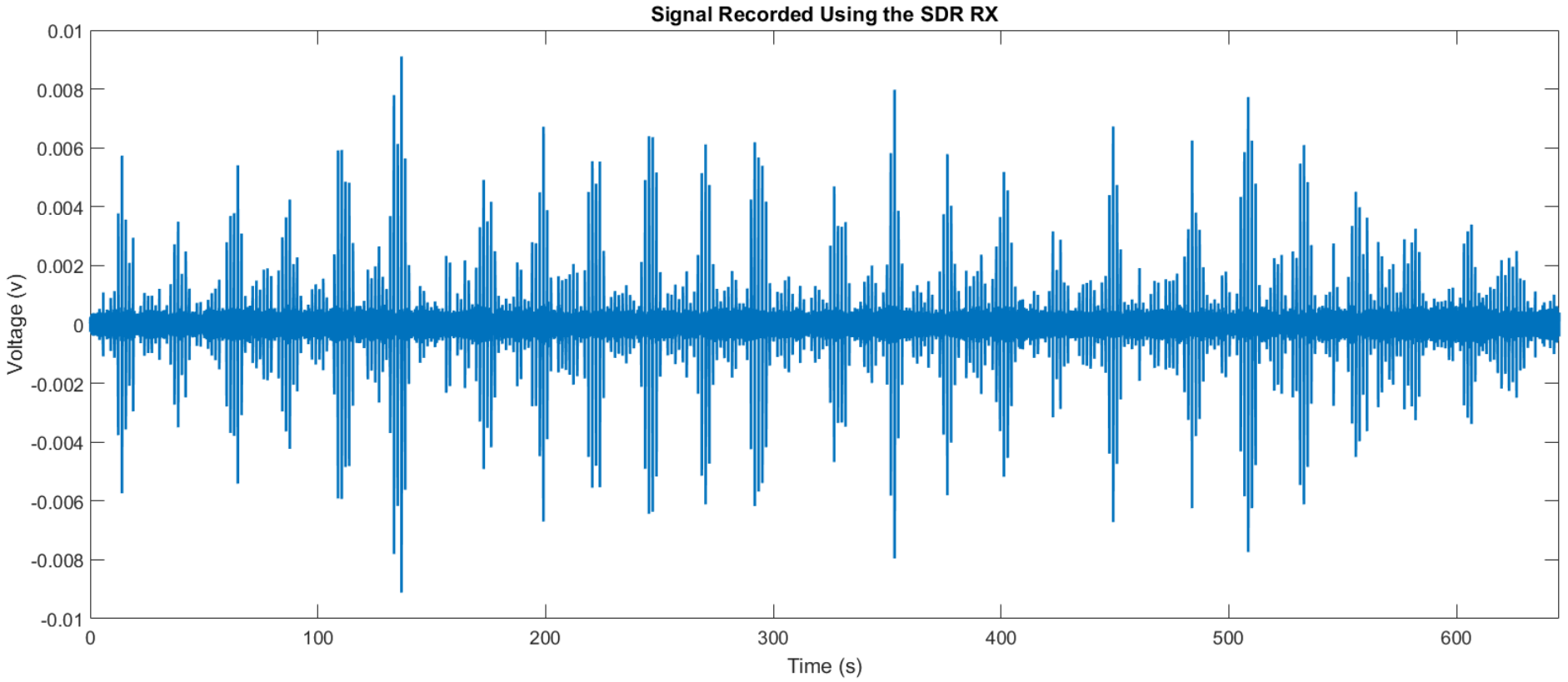


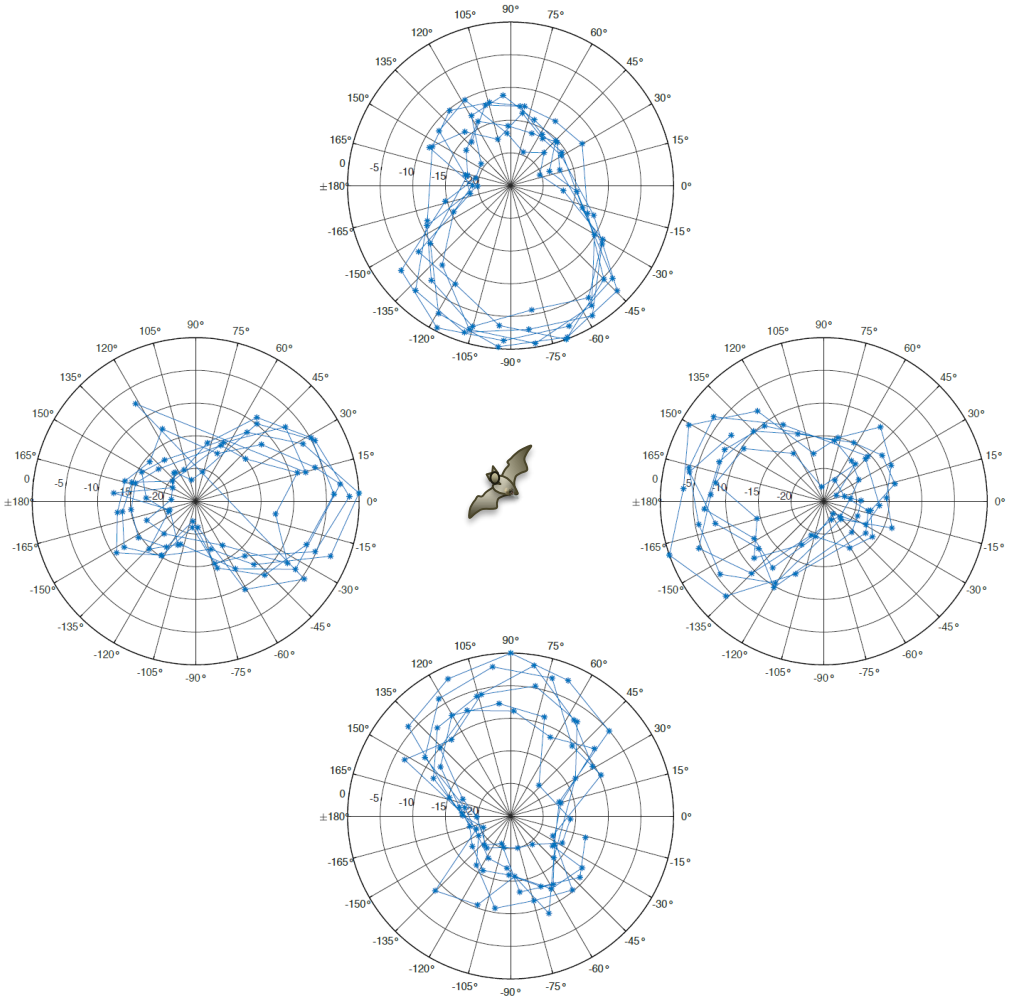
Preliminary direction of arrival test

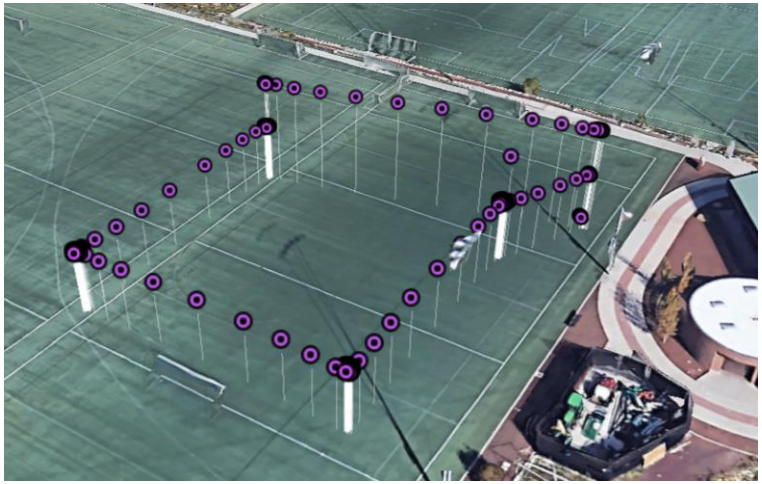


Received signal by SDR system

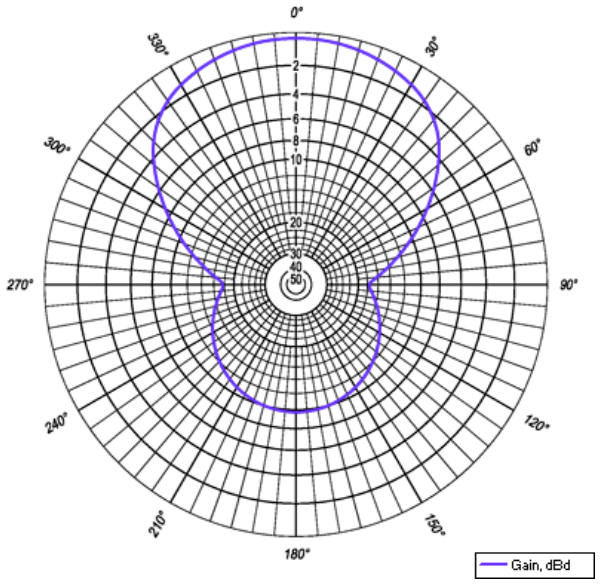


Post processing results





Telonics RA-23K Gain Pattern



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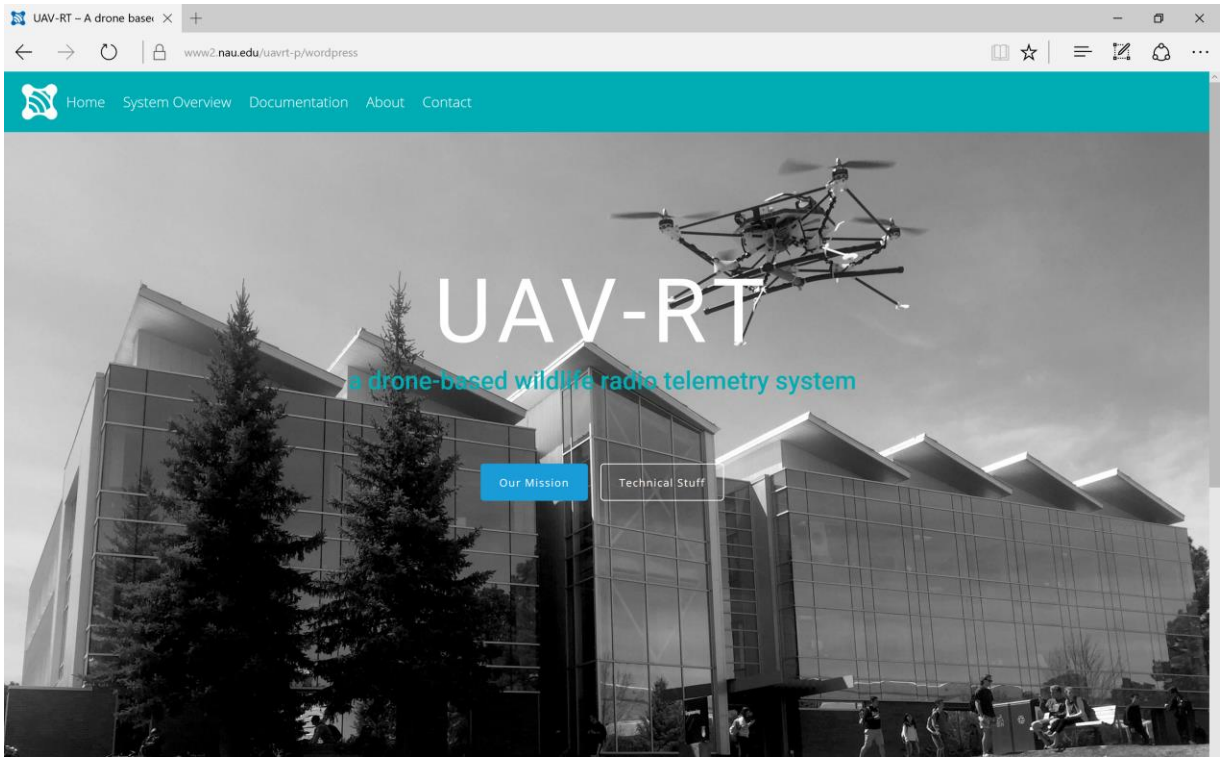
Website Overview

- Website in development provides overview of system and detailed design and software information
- Provides summary of project goals and is being optimized to create an open source environment so users can create and modify their own system



Future work

- Field testing of V2 vehicle
- Collection of radio data at longer range (reduction of system noise)
- Standardizing GNU radio processing code
- Near term objectives
  - Real-time integration of signal and vehicle telemetry on companion computer
  - Testing of omni-directional antennas
- Continued website development

Acknowledgments

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- Collaborators Paul Flikkema, Carol Chambers, Michael Shafer

- Student Researchers:
  - Kellan Rothfus
  - Gabriel Vega
  - Matthew Robertson
  - Michael Finley

- Postdoc
  - Amir Torabi

QUESTIONS?