



Department of Mechanical and Aerospace Engineering

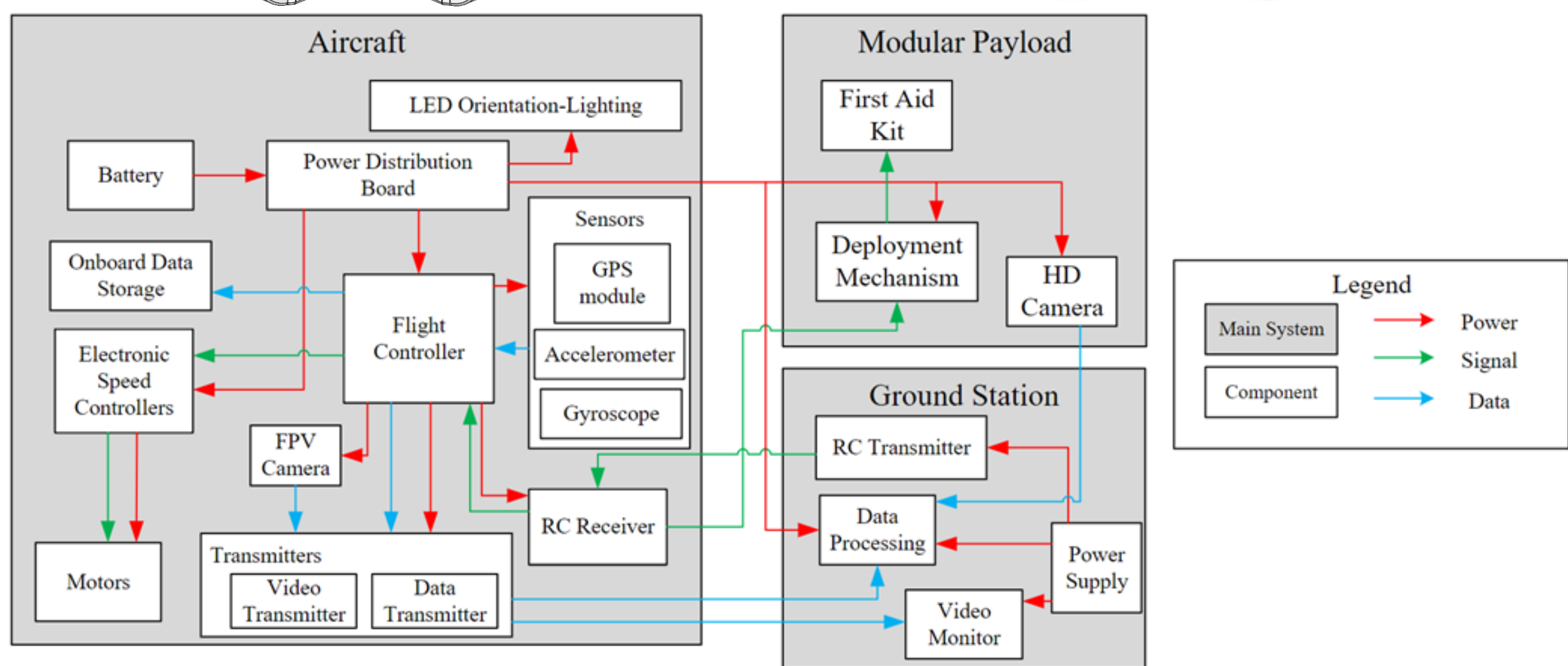
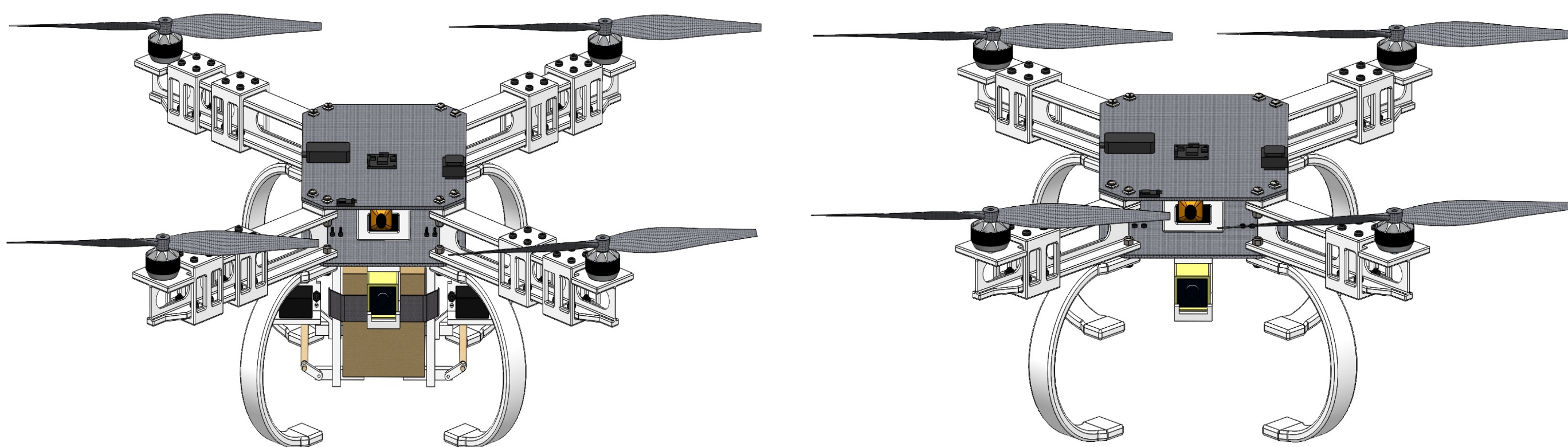
Aerospace Engineering Capstone Senior Design 2021-2022

Team Members: Greyson Brown, Timothy Gillikin, Peter Laird, Ryan Slezak, and Tyler Waliezer

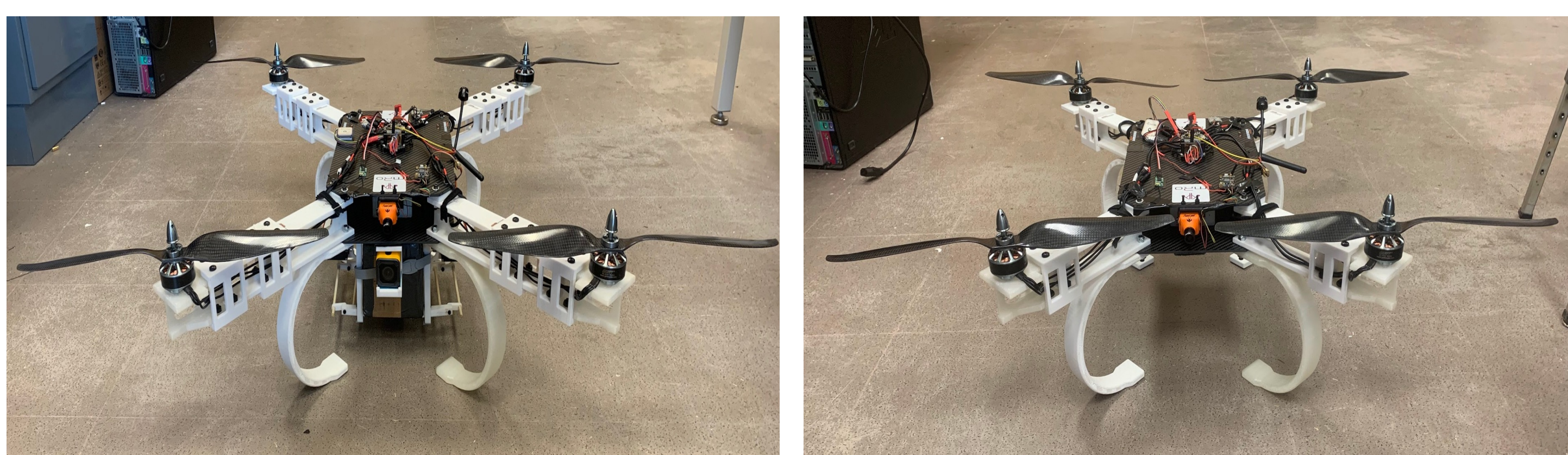
Course Instructor: Dr. Felix Ewre | TAs: Evan Youngberg and Auston Gray | Sponsor: North Carolina Forest Service | Customers: Michael Hughes & Kevin Gitushi

## Design Solution

| Key Component                 | Design Solution Selection                                      |
|-------------------------------|--|
| Battery                       | Zeee 9000mAh 14.8V 4S LiPo Battery                             |
| Cameras                       | RunCam Swift Mini FPV Camera<br>Caddx Orca 4K Camera           |
| Landing Gear                  | 3D-Printed Curved, Flexible Legs                               |
| Airframe Material             | 3D-Printed ABS Plastic, Carbon Fiber                           |
| Airframe Modularity Concept   | Multi-Section I-Beam Interlocking Arms                         |
| Payload Mounting/Deployment   | Camera Bracket/Bottom-Mounted Servo-Based Deployment Mechanism |
| Flight Software               | ArduPilot  |
| Transmitter/Receiver Protocol | FrSky  |
| Propeller Specifications      | 15 x 5.5 inch Carbon Fiber                                     |
| Motor Specifications          | GARTT ML3508 700 kV Brushless                                  |

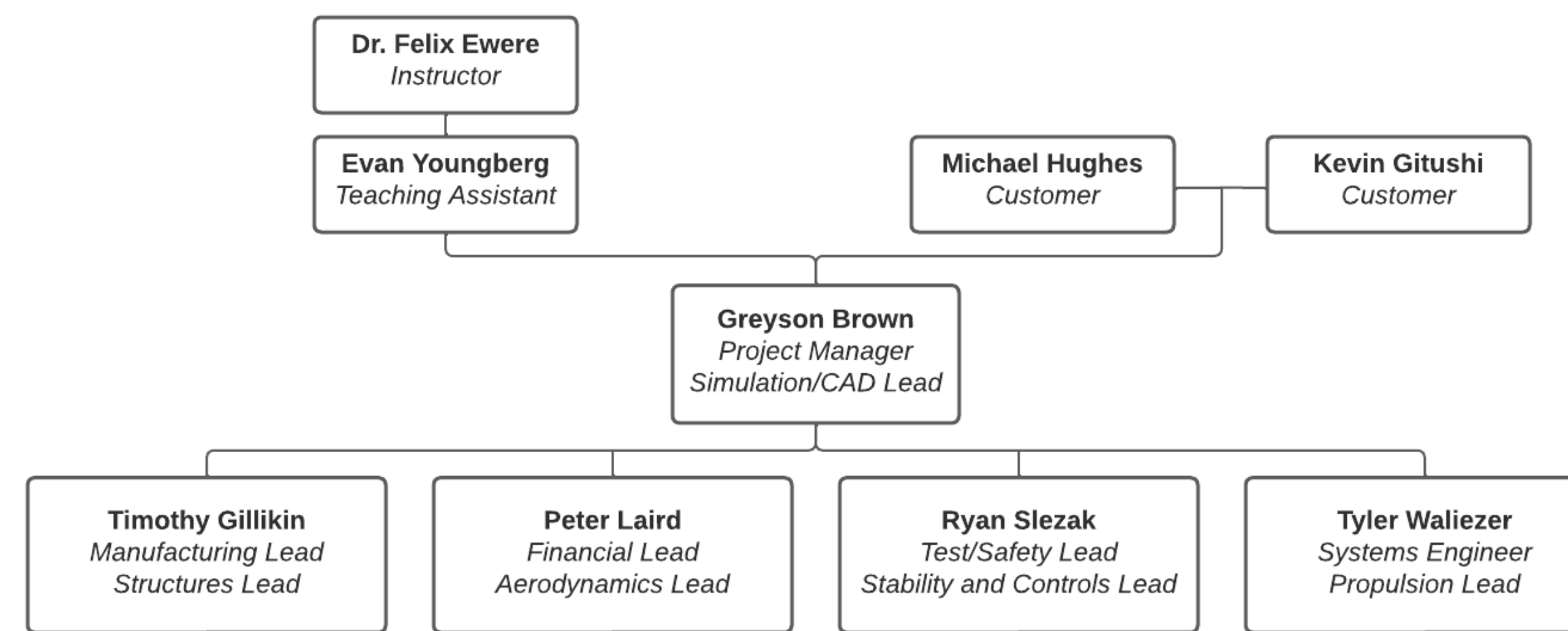


## Functional Prototype



| Features                              | Long-Arm Configuration | Short-Arm Configuration |
|---------------------------------------|------------------------|-------------------------|
| Endurance (minutes)                   | 12                     | 15                      |
| Weight (lbs.)                         | 8.89                   | 7.24                    |
| Thrust to Weight Ratio                | 1.7                    | 2.1                     |
| Overall Dimensions L x W x H (inches) | 28.03 x 24.1 x 11      | 23.79 x 19.85 x 11      |

## Team Organization



## Project Overview

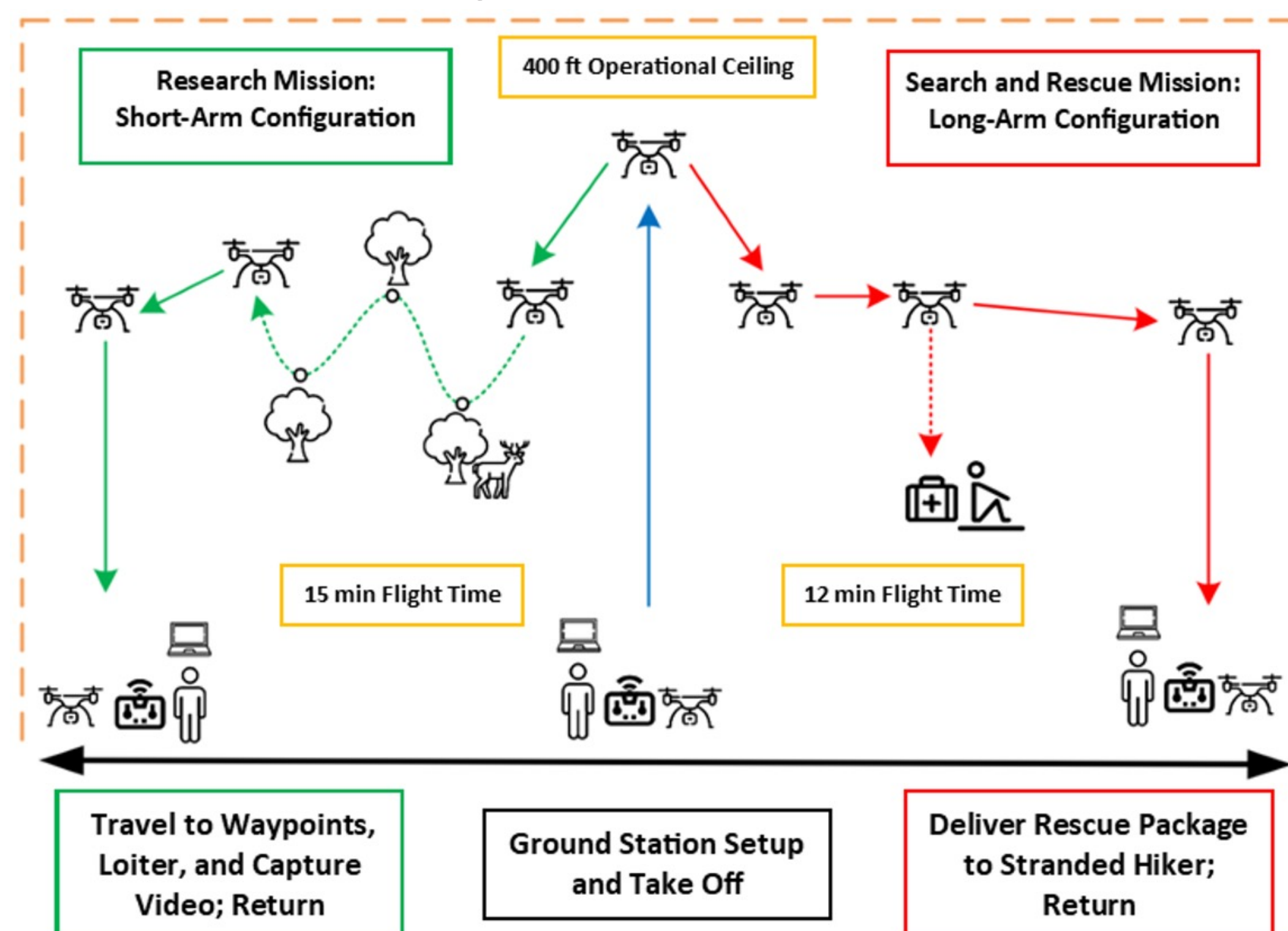
**Need Statement:** The North Carolina Forest Service (NCFS) is in need of a versatile system that can assist with ecological research, while also providing a means for safer recreation on public lands through improved search and rescue (SAR) efforts.

**Mission Statement:** The LUVTREES Team will construct a **lightweight, battery operated quadrotor UAS** that will be **used by operators to provide emergency assistance** to individuals in need of search and rescue as well as **track large animal populations**.

## Missions and CONOPS Overview

**Research Mission:** Observe and study populations of large wildlife using an onboard HD camera and live first-person view (FPV) footage.

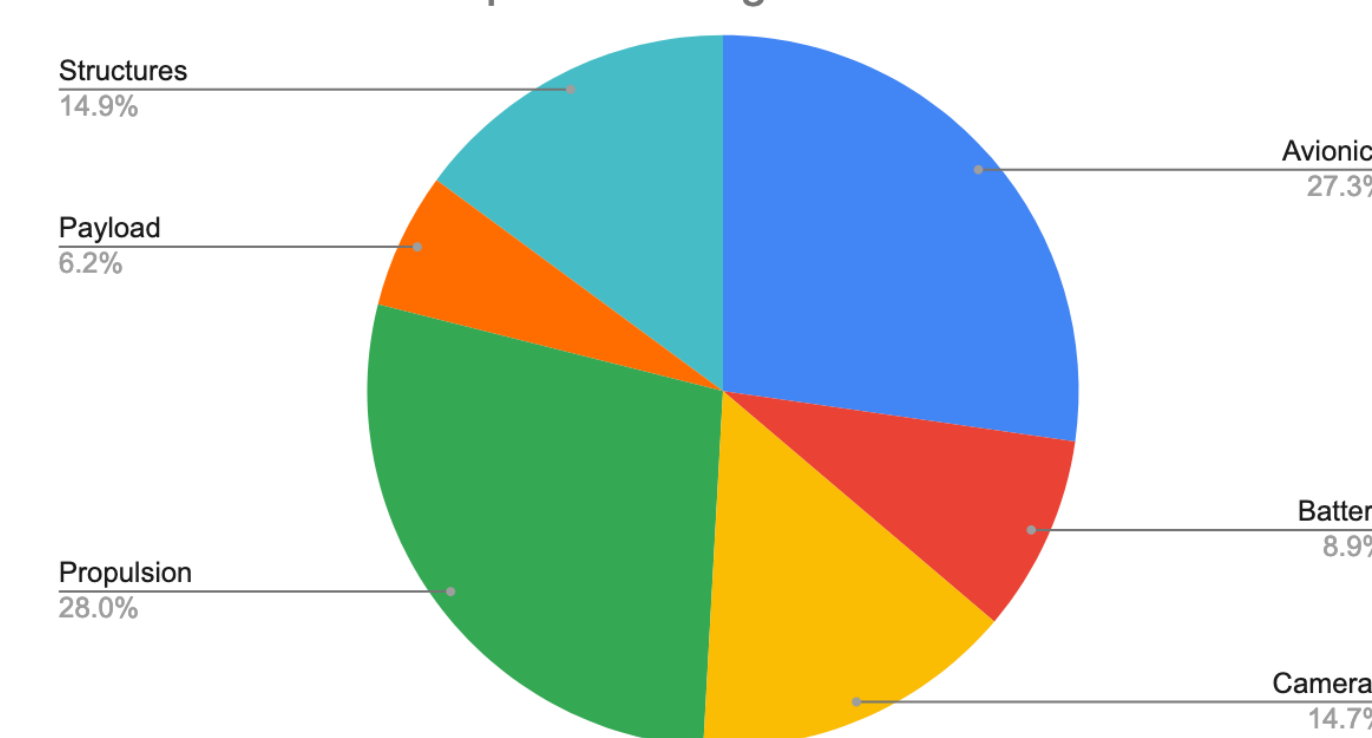
**Search and Rescue Mission:** Deliver an emergency supply kit containing first-aid and other emergency supplies to a stranded recreationalist and relay pertinent information to ground crews.



## Cost Breakdown

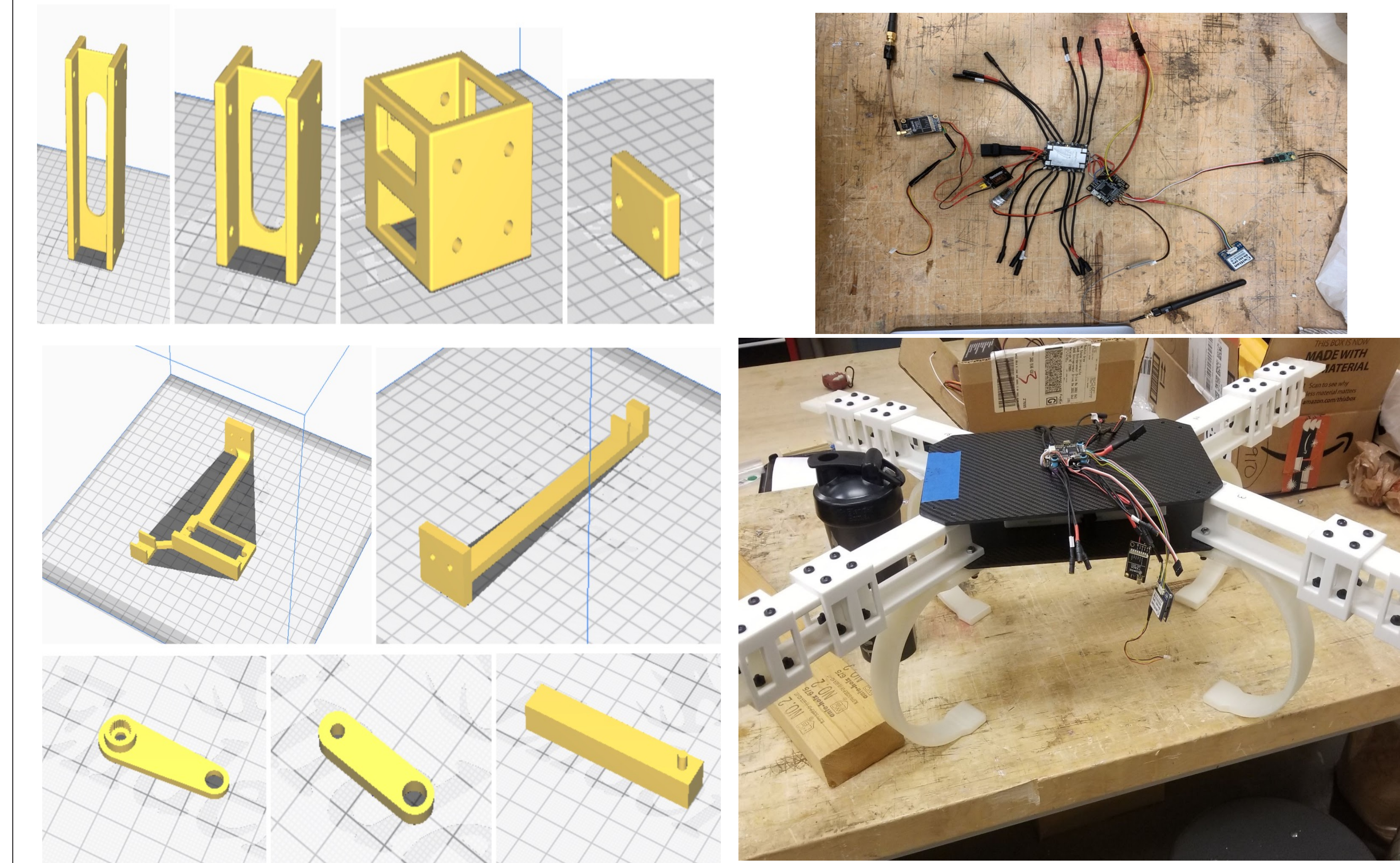
| Subsystem     | Cost            |
|---------------|-----------------|
| Propulsion    | \$248.15        |
| Avionics      | \$241.23        |
| Structures    | \$131.78        |
| Camera        | \$129.98        |
| Battery       | \$79.04         |
| Payload       | \$54.69         |
| <b>Total:</b> | <b>\$884.87</b> |

LUVTREES UAS Expended Budget Breakdown



## Manufacturing

Manufacturing and assembly of the UAS began at the start of the spring semester in January 2022. The main manufacturing tasks were printing the 3D-printed parts, cutting the carbon fiber for the main structure, and assembling and soldering the electrical components. The team concluded manufacturing in time for the Flight Readiness Review on March 11, 2022.



## Flight Testing

As of April 15, 2022, the LUVTREES UAS has conducted many successful flights. Notable flights include:

- March 22: First hover and loiter, demonstrated directional control in long arm configuration (~15 minutes of flight).
- March 24: Tested flight modes (loiter, altitude hold) and first successful payload drop from altitude in long arm configuration (~15 minutes of flight).
- March 25 (Official Flight Test @ Mid-Pines Field): Demonstrated full capabilities and mission profiles. Both short and long arm configurations were tested with course instructors as witnesses. (~25 minutes of flight).

