



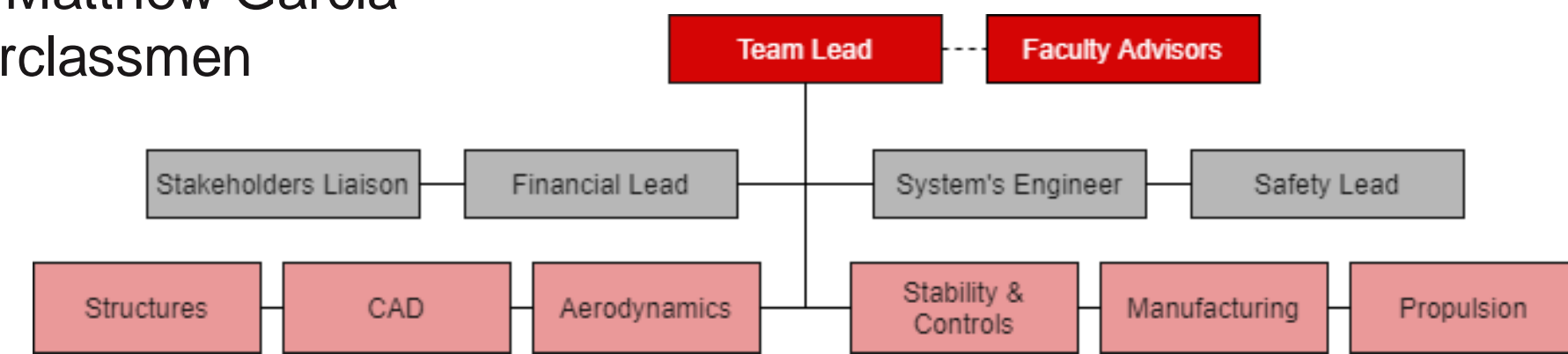
# AIAA Design/Build/Fly Competition

Aerospace Engineering Capstone Senior Design 2020 – 2021  
Department of Mechanical and Aerospace Engineering



## Team Organization

**Team members:** Christian Coggins, Grant Stevenson, Connor Knox, Hannah Oliver, Spencer Freeman, Carissa Hardy, Matthew Garcia  
7 sub-team leads, 9 underclassmen



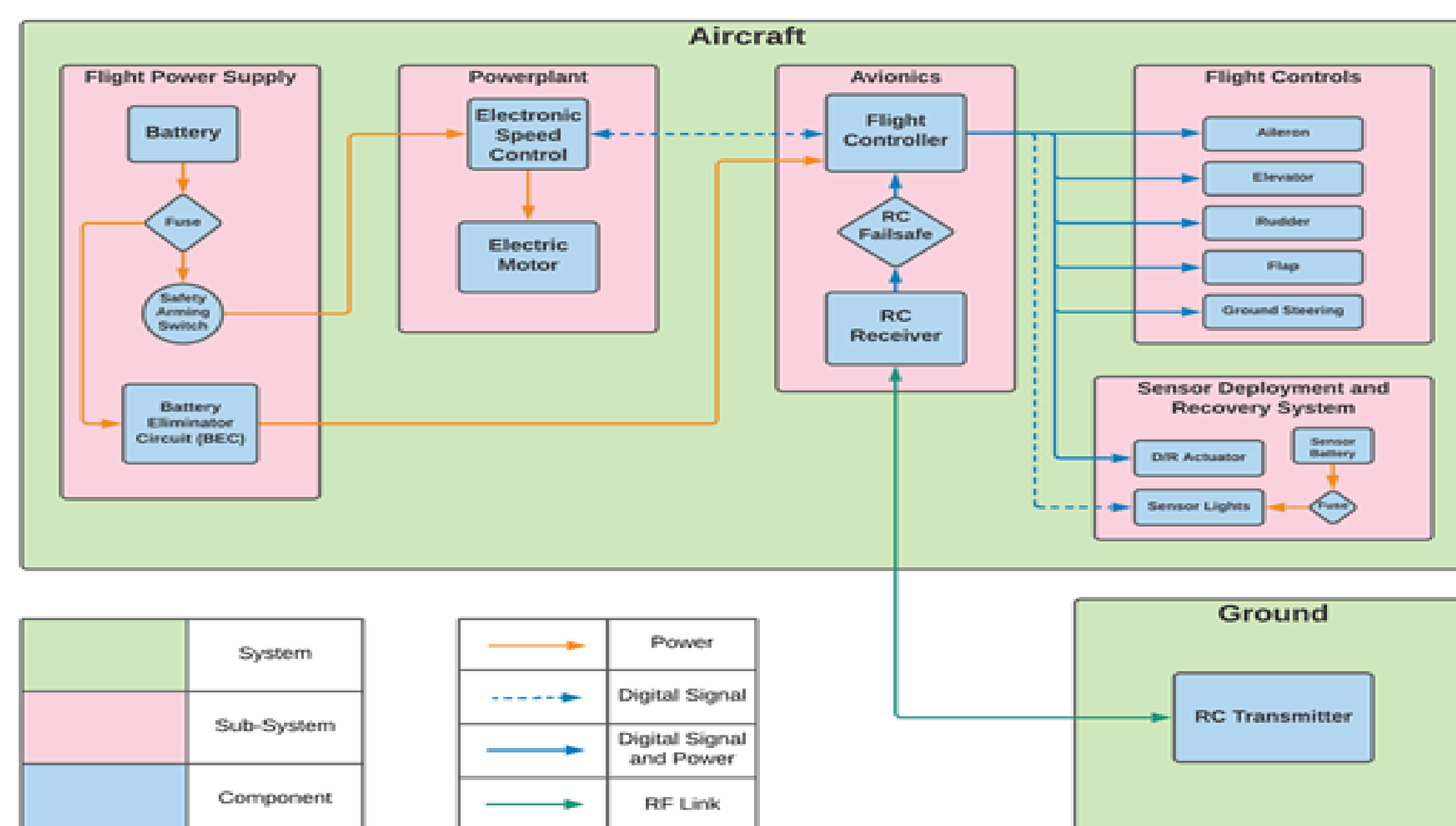
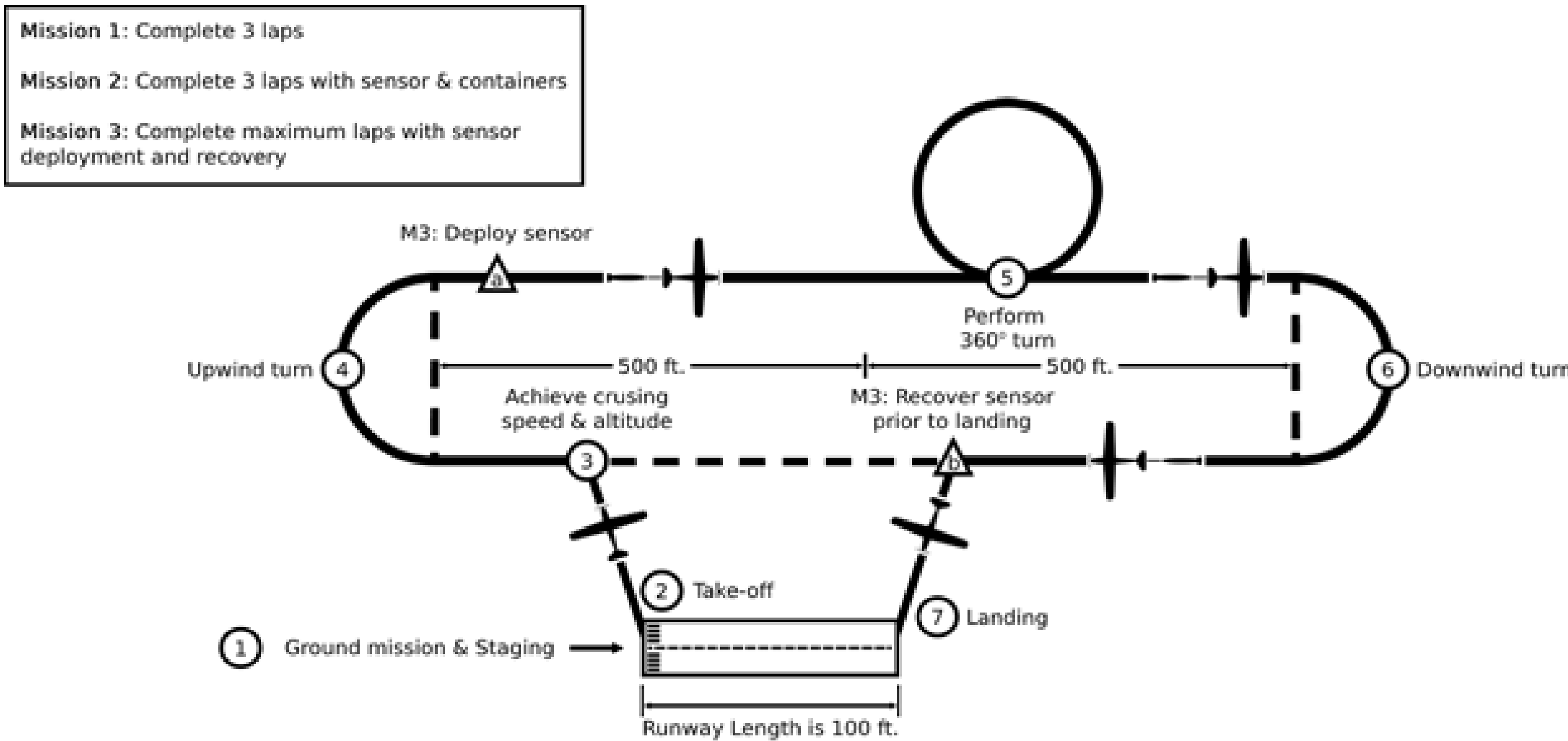
## Project Overview

**Mission Statement:** C.O.V.I.D. will design, build, and fly a fixed wing aircraft with the ability to carry shipping containers as well as deploy and recover a towed sensor in flight. The aircraft, named AirWolf, will have an optimal flight speed and number of shipping containers to score as high as possible in the 2021 AIAA Design/Build/Fly Competition.

**Objectives:** The aircraft shall be remote controlled, take off in 100 ft, carry simulated shipping containers and sensor, weigh below 55 lbs., have a wingspan at or below 5 ft, deploy and recover a towed sensor in-flight, optimize the payload to achieve maximum competition points, and successfully land on the runway with no damage

## Mission Overview

Ground Mission: Assemble the payload inside the aircraft in flight configuration while being timed, perform drop tests from a height of 10 in.  
Mission 1: Complete three laps in under 5 minutes with no sensor or shipping container  
Mission 2: Complete three laps in under 5 minutes with shipping container and sensor payload  
Mission 3: Complete the maximum number of laps in 10 minutes with sensor deployed

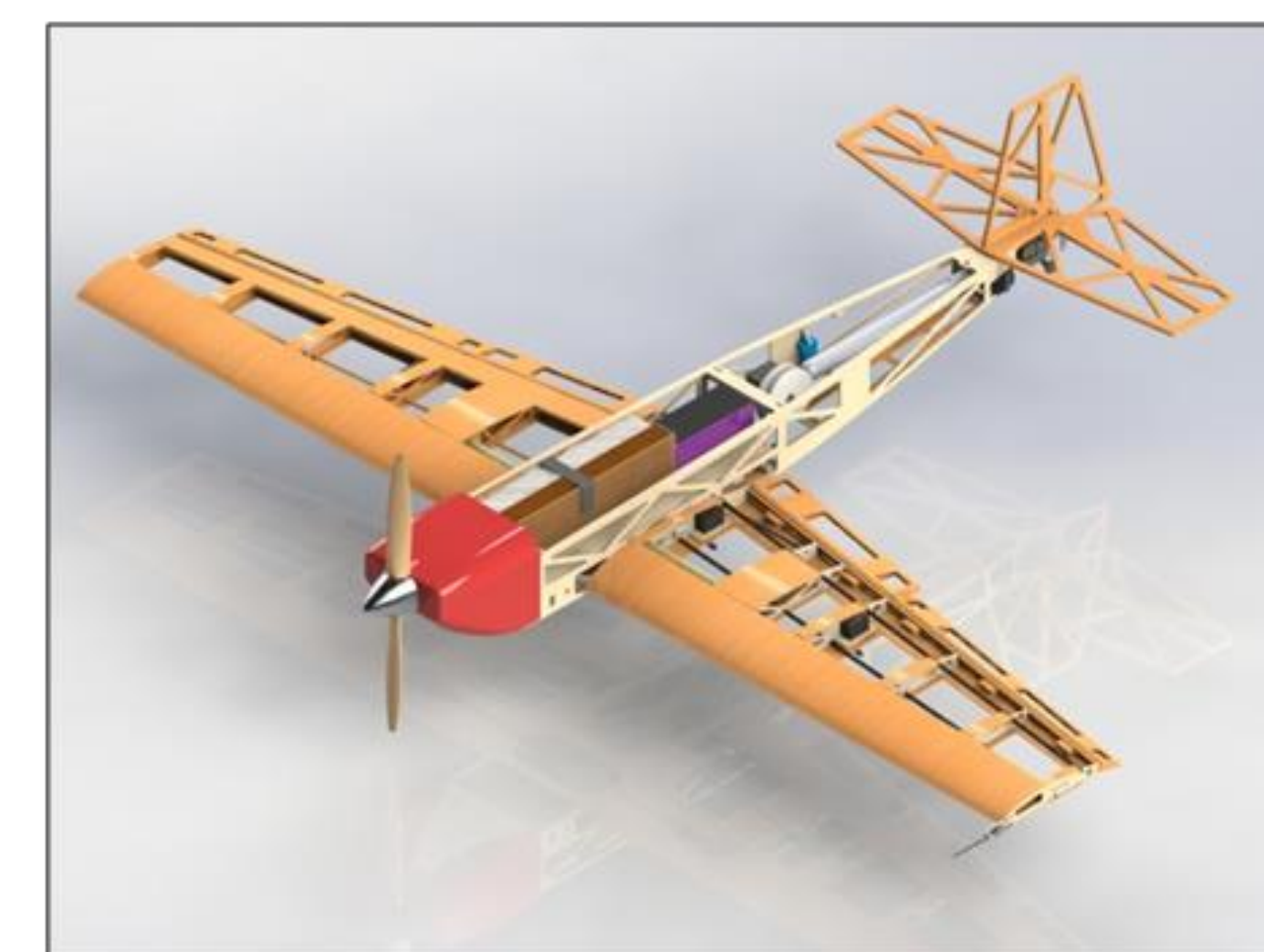
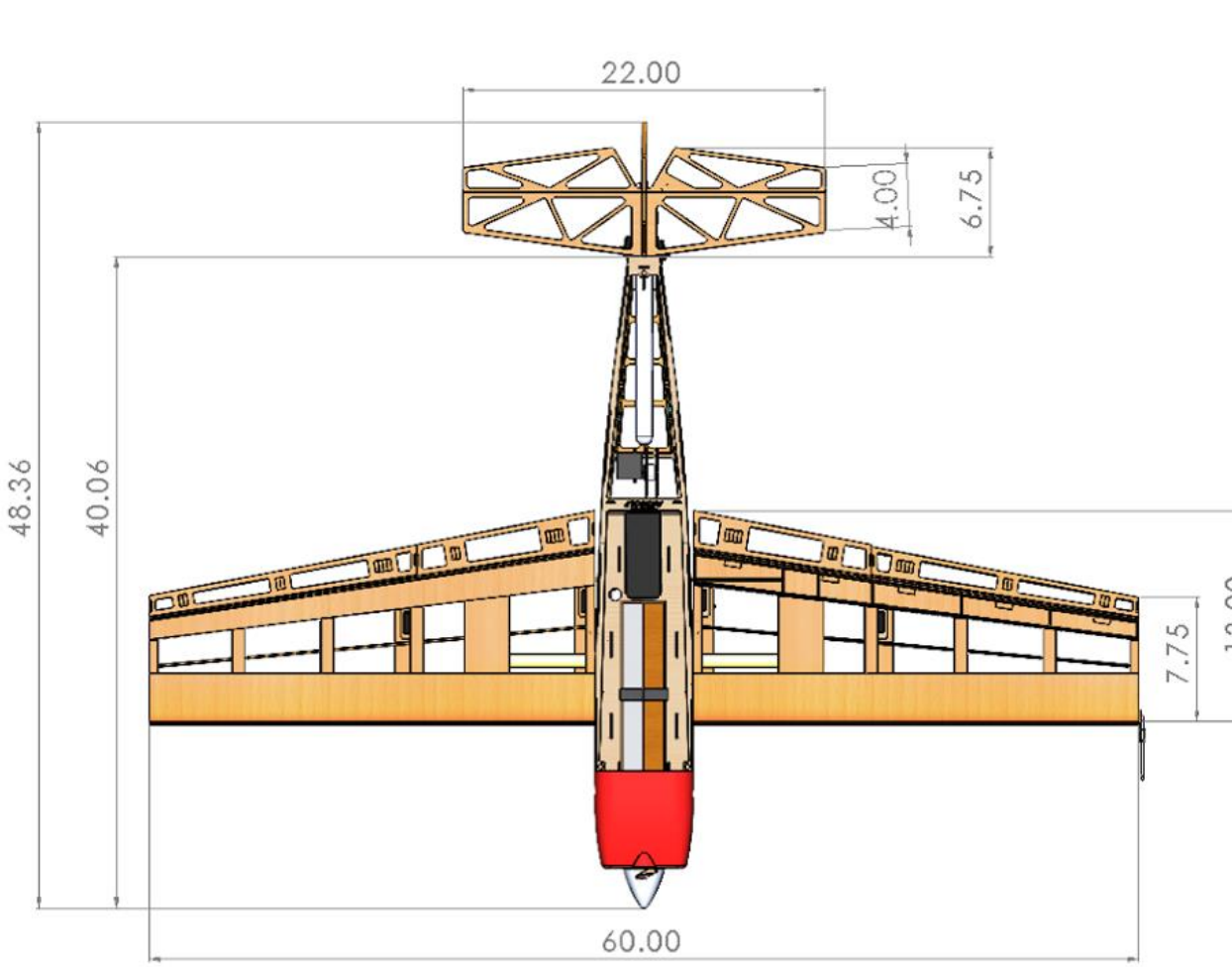


## Design Solution

**Design Goals :** A sensitivity analysis was conducted of the DBF scoring equations to determine the optimal design that maximizes potential competition points. The scoring analysis determined the optimal design featured: 4 containers, a 10" and 8 oz sensor and cruise velocity of 45 kts.

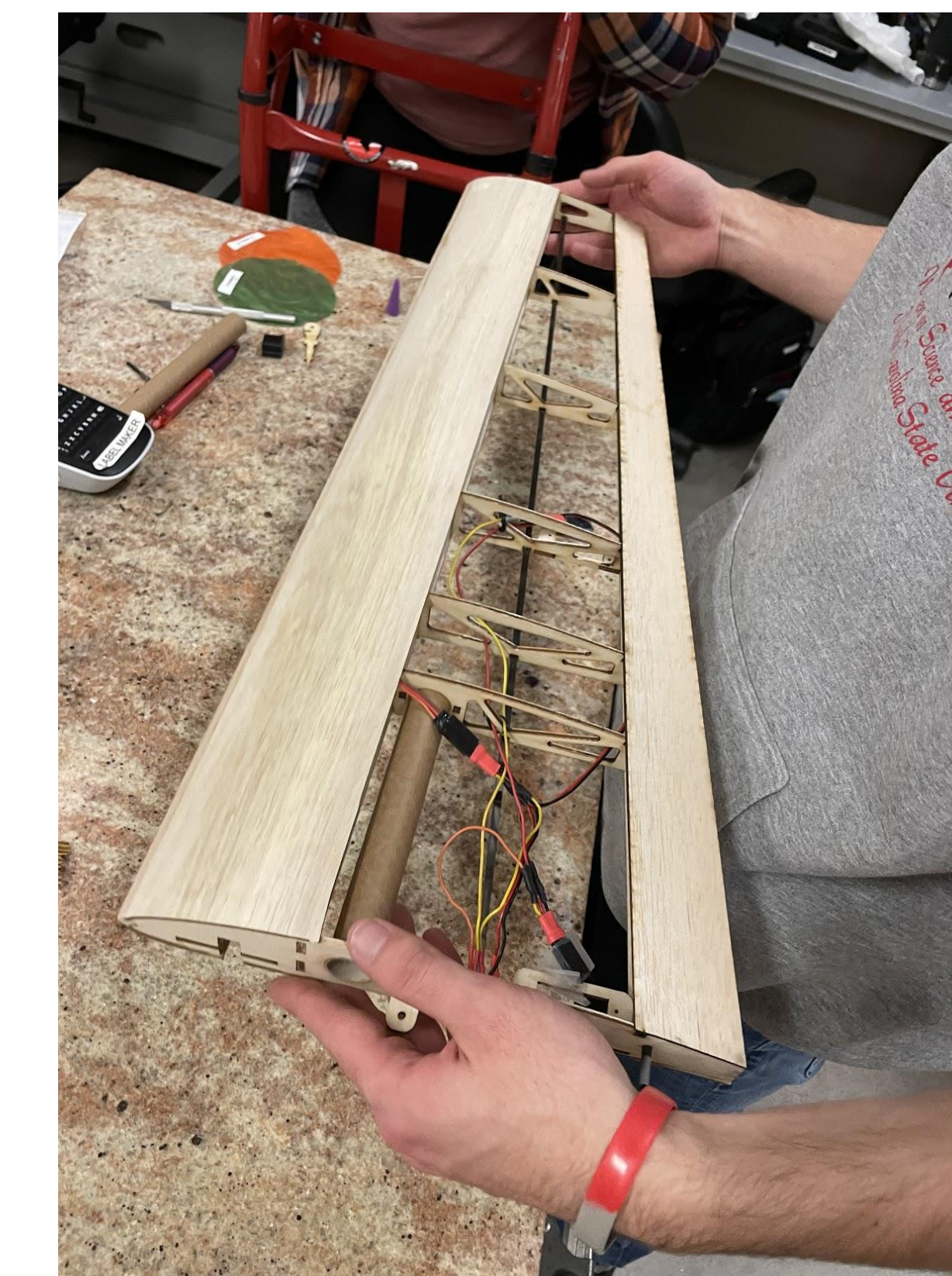
**Design Features :** Aside from the design outlined by the sensitivity analysis, the design was determined by a series of trade studies. The trade studies allowed the team to consider all possible design solutions and choose the best with consideration for manufacturability, cost, and support of the competition missions. The trade study process provided the preliminary design of the aircraft. The detail design of the individual components of the aircraft was undertaken by each sub-team lead with the goal of optimizing the performance of their individual subsystem. The results of the detailed design are listed below.

Specification	Value
Wingspan	5 ft
Mean Aerodynamic Chord	10.6 in
Airfoil	NACA 4412
Taper Ratio	0.6
Horizontal Tail Volume Ratio	0.5
Vertical Tail Volume Ratio	0.04
Static Margin	12 %
Cruise Speed	46.7 kts
Empty Weight	4.6 lb
Takeoff Weight (M2)	7.1 lb
Number of Shipping Container Simulators	4
Sensor Length	10 in
Sensor Weight	8 oz



## Manufacturing

Manufacturing began in December 2020 with most of the work completed in the fixed wing design lab over winter break. AirWolf had to be flight-ready by Jan 30, giving the team a 5-month window to go from DBF rules to completed aircraft.



## Flight Testing

After completing the necessary prechecks, the first flight was completed on Saturday, January 30. Flying steadily for about 4-5 minutes, the aircraft crashed on a landing approach. Analyzing the flight, the cause of the crash was stall due to low velocity out of the base leg. Repairing AirWolf in early March, the aircraft completed its second test flight on Wednesday, March 24. The aircraft successfully completed three flights and the team collected all video and data needed for the virtual AIAA competition. The goals accomplished during each flight are listed below.

- Flight 1:** Understood aircraft maneuverability, feel for competition flight course
- Flight 2:** Simulated timed laps of the CONOPS diagram. Laps completed in ~40s each.
- Flight 3:** Deployed, operated, and recovered the towed sensor while in flight.



## DBF Competition Results

The list below shows the teams accomplishments in the 2021 DBF Competition. For both the Proposal and Design Report, the team placed best in NC State MAE history. Though the competition was moved from Tucson, AZ to a virtual format, a video report will be submitted instead. The final competition results will be released May 14, 2021.



**Proposal** – October 31 – 18th of 117 teams  
**Design Report** – February 19 – 21st of 93 teams  
**Video Submission** – April 18 – TBA

