UCI Design, Build, Fly 2022-2023

Chang Hoon Lee, Chaz Fazio, Deepak Gupta, Lucia Benjamin, Luis Zamora, Rahul Donnaganti
Department of Mechanical and Aerospace Engineering at University of California, Irvine
Sponsored by Professor Huynh

UCI Undergraduate Research Opportunities Program

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Executive Summary

The goal of this project is to explore a modular aircraft design for an annual competition held by American Institute of Aeronautics and Astronautics. The mission criteria include the transport of a payload and a jamming antenna on an unmanned aircraft which is applicable for electronic surveillance missions

What is DBF?

Design, Build, Fly is a national, annual competition held by the American Institute of Aeronautics and Astronautics. Universities nationwide compete in three predetermined missions, where the competition is being held in Tucson, Arizona this year.

Design Requirements

Mission 1:
- 3 laps in 5 mins

Mission 2:
- Maximum amount of laps within 10 mins
- Carrying a minimum payload weight of 30% of gross aircraft weight
- With a minimum payload size of 3”x3”x6”

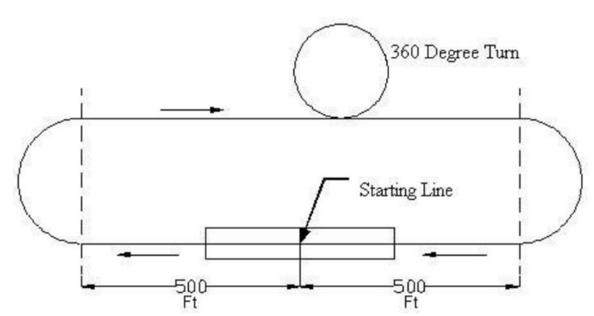


Figure 1: Course Map

Mission 3:
- 3 laps within 5 mins
- Custom fixtures on the wing tip to hold an antenna of chosen length

Ground Mission:
- 10 mins
- Wing bending test with highest payload

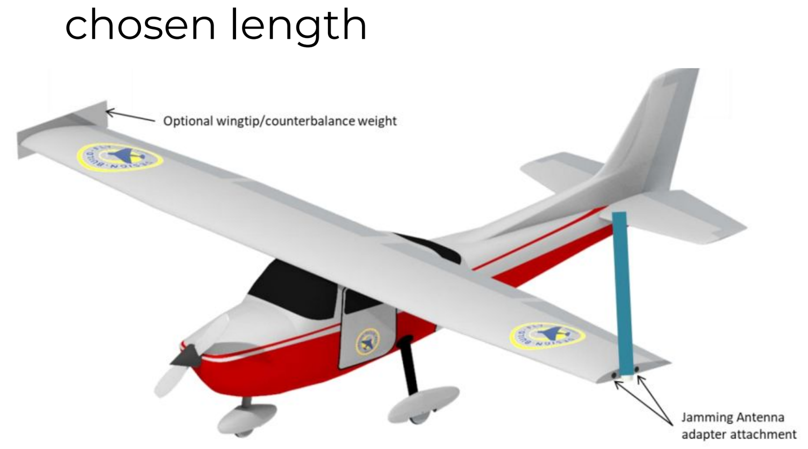


Figure 2: Mission 3 Example

Figure 3: Ground Mission

Efficient installation	Less than 10 mins, including placing weights for ground mission
Strong/Light wings that can withstand loading	Wing Loading < 2.75 lbs/(ft^2)
Wing fixture to support aircraft at wingtip	Withstand added weight to fuselage < 100 lbs
Aircraft components that can fix within a box with dimensions equaling 62.00”	Ensuring maximizing the length to maximize wing span
Maximize wing surface area	Dependant on box dimensions and propeller data to ensure lift is still within acceptable range

Petr’s Plane

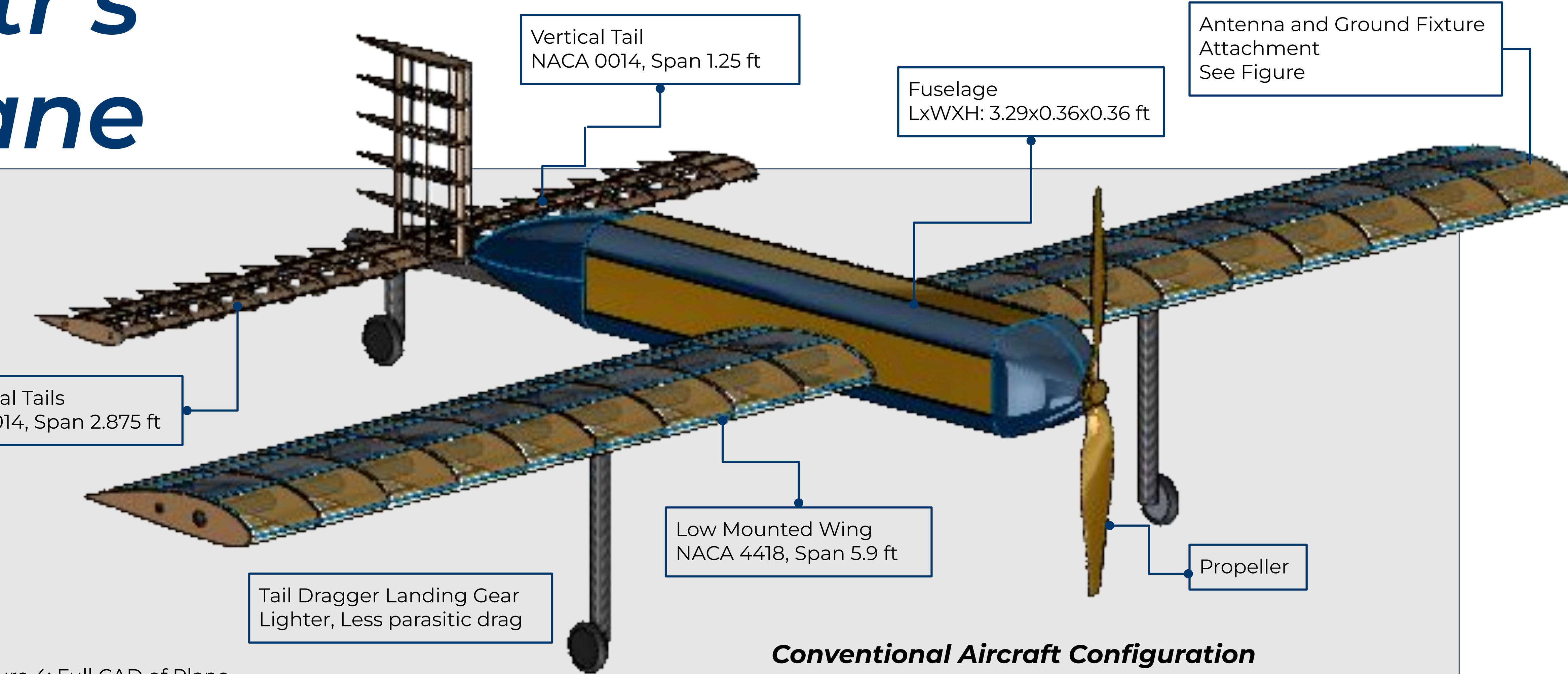
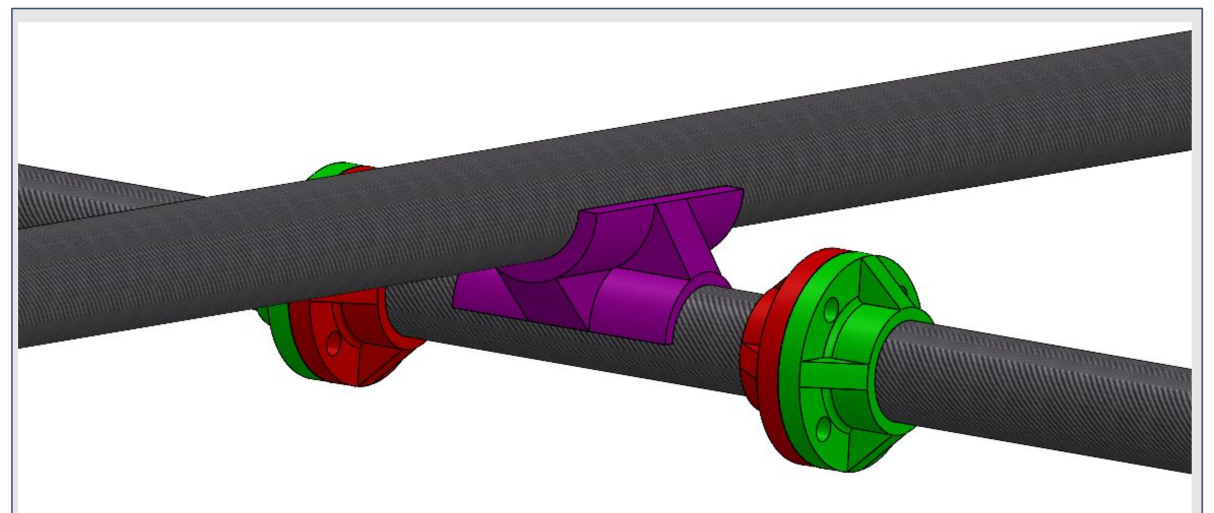


Figure 4: Full CAD of Plane

Conventional Aircraft Configuration

- Lower drag and increase lift design
- Versatility in flight situations



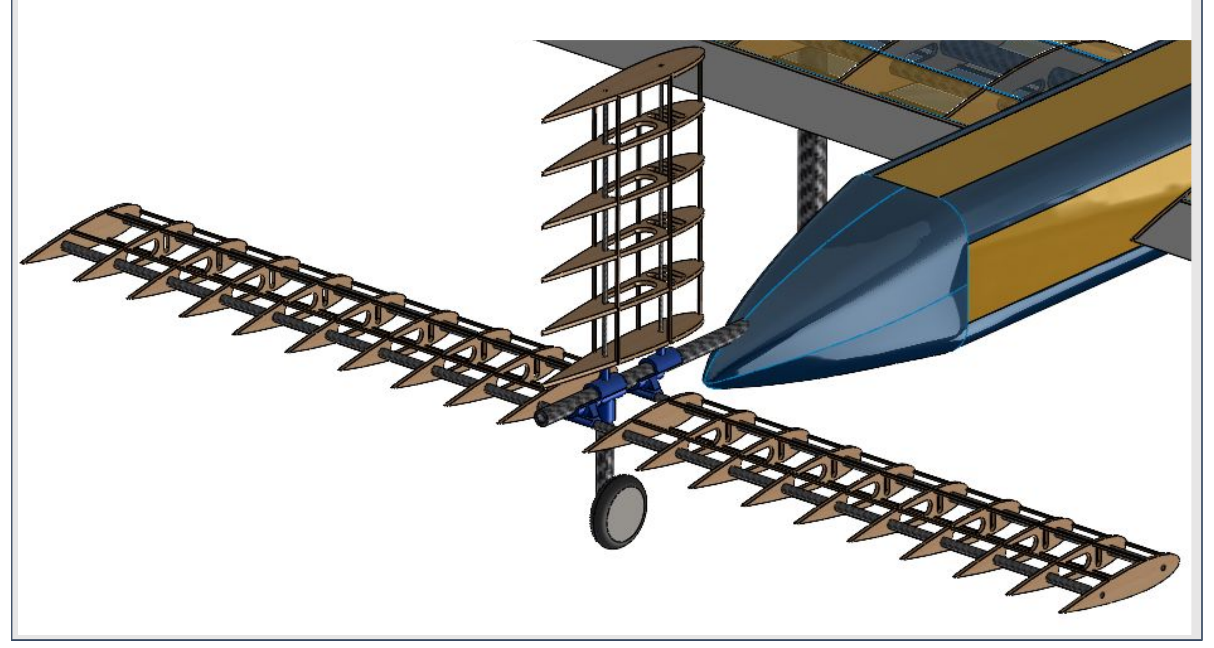


Figure 5
Fuselage to Wing Connection

Fuselage Carbon Boom to Wing Spar Connection
- 3D printed fixtures

Figure 6
Tail Assembly

V-Tail
- NACA 0014 and 6 inch chord

H-Tail
- NACA 0014 and 6 inch chord

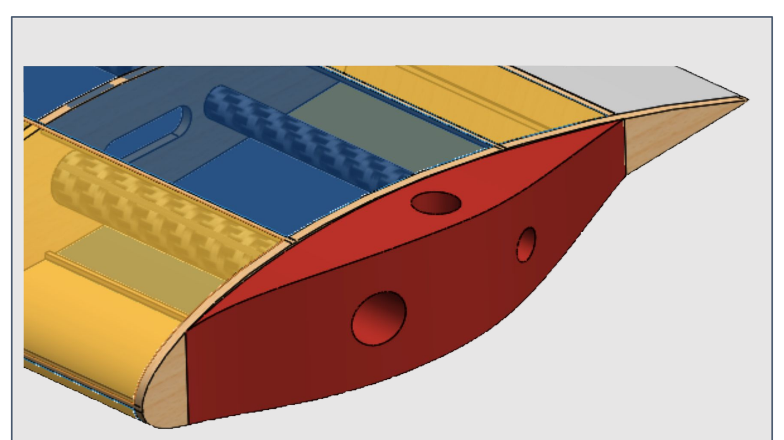


Figure 7: Wing Tip Attachment

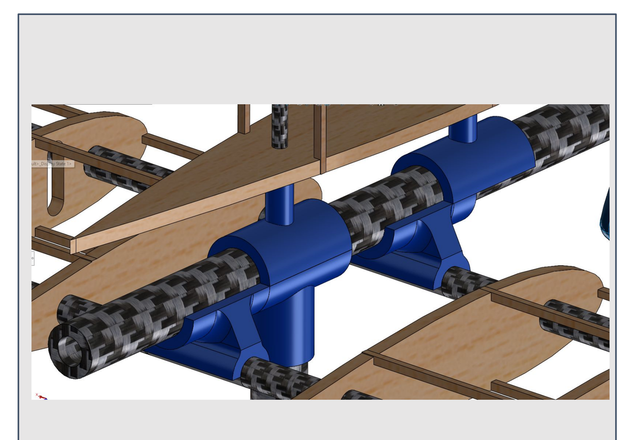


Figure 8: #D Printed Tail Attachment

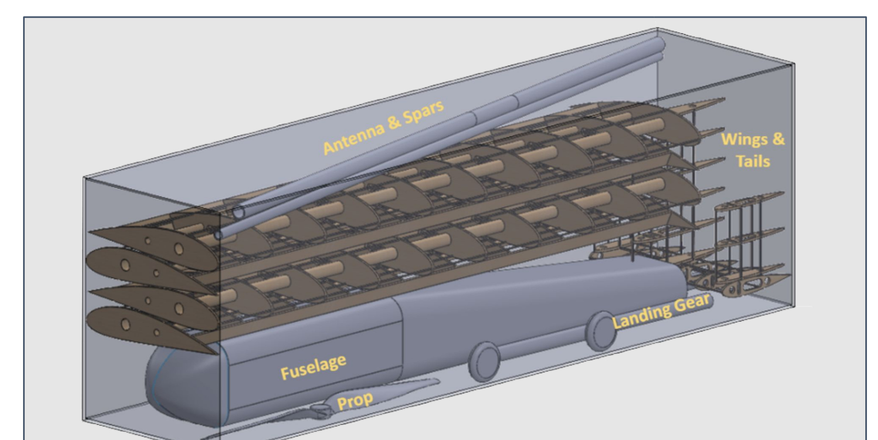


Figure 9: Shipping Box Assembly

Analysis

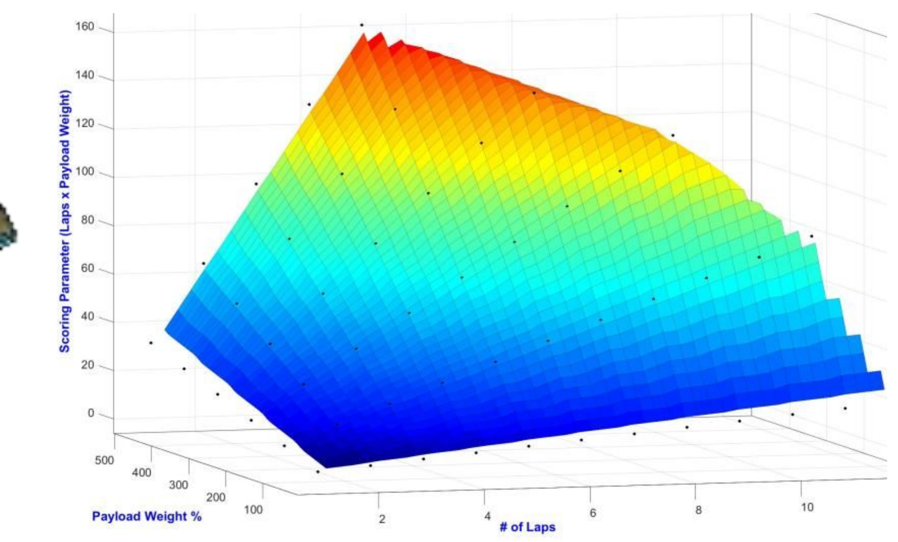
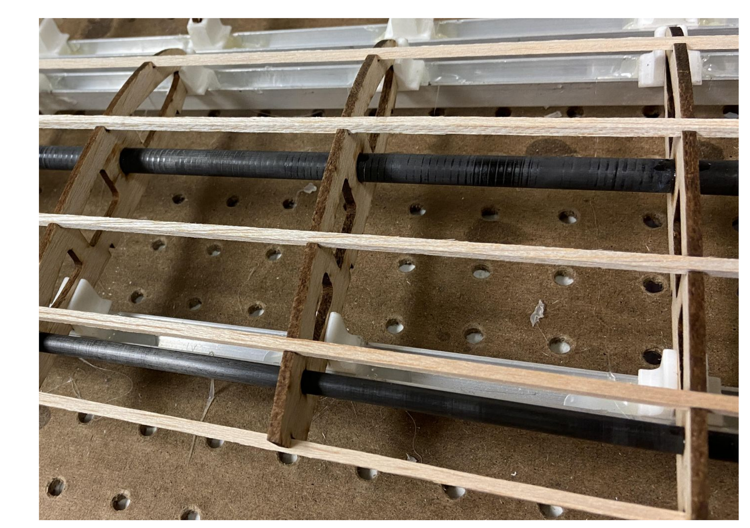


Figure 10: Mission 2 Scoring Analysis

- Power requirements determined by:
- Determined a value of
- By increasing laps and payload weight by this equation:
- Determined the best possible combination to obtain a top score
  - Payload most sensitive parameter

Hardware Performance



Future Improvements

Iterative Sizing	Changes based on testing results
Center of Gravity	Placement of electronics & payload based on testing results
Control Surfaces	Control surface sizing & implementation via servo control
Electronics	Location of components, election wiring & routing
Control System	Radio, receiver, transmitter placement & setup

Impact on Society/ Safety

- Teaching future engineers important designing skills
- Mishandling of flying

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References
Anderson. Fundamentals of Aerodynamics. McGraw-Hill Education, 2011. Shevell, Richard Shepard. Fundamentals of Flight. Prentice Hall, 1989.