AIAA Design/Build/Fly Competition

NC STATE UNIVERSITY

Department of Mechanical and Aerospace Engineering
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Aerospace Engineering Capstone Senior Design 2022-2023
Department of Mechanical and Aerospace Engineering
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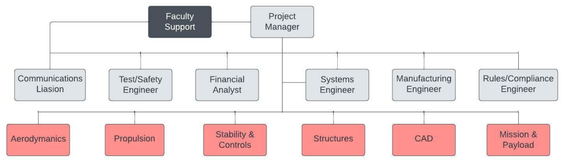
Team Organization

Team Members: Alec Lounder, Alex Keadle, Austin Stroud, Braedon Butcher, Holly Huffine, Jackson Corigliano, Siddharth Samal

7 sub-team leads
15 Underclassmen



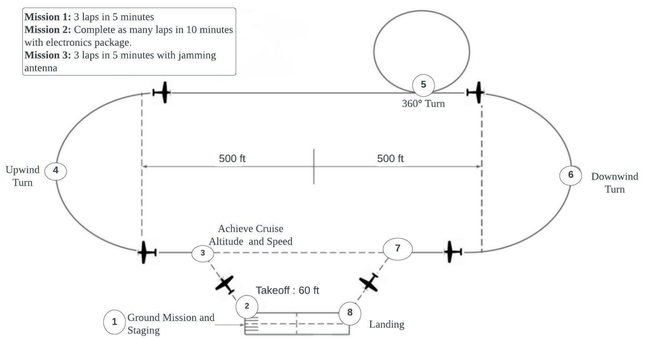
Project Overview

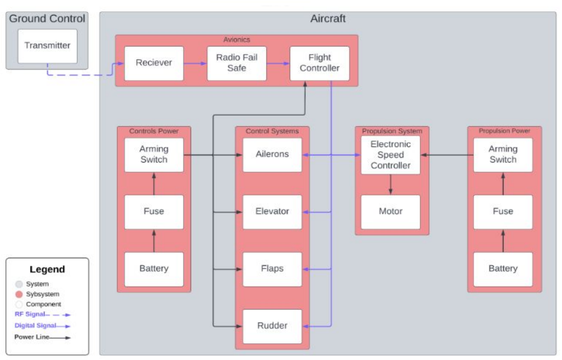
Mission Statement: "Positively Pitched will design, build, and fly an aircraft with the ability to carry an electronics package and fly with a wingtip mounted antenna within the parameters of the missions given by the Design, Build, Fly Competition hosted by the American Institute of Aeronautics and Astronautics. The aircraft, designated Wolfeye, will be capable of operating with unbalanced drag and center of gravity (CG) conditions while maintaining large static loads and maintaining an extended loiter time and high cruise speed"

Objectives: The aircraft shall be remote controlled, take off in 60 feet, carry a 3" x 3" x 6" simulated electronics package, carry a wingtip mounted antenna, weigh less than 50 lb, fit within an airline approved checked box with outer dimensions length + width + height no more than 62", optimize payload to receive maximum points, and land successfully without damage.

Mission Overview

Ground Mission: Test for structural deformation by placing weight on fuselage while wingtips are mounted to test fixture. Hold for 30 seconds and show all controls remain operational.
Mission 1 - Staging Flight: Complete 3 laps within the maximum allotted time of 5 minutes without carrying a payload.
Mission 2 - Surveillance Flight: Complete as many laps as possible in 10 minutes carrying the electronics package
Mission 3 - Jamming Flight: Fly 3 laps in 5 minutes with wingtip antenna and counterweight.





Wolfeye

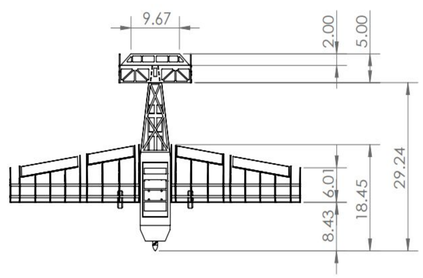
Design Solution

Design Goals: A sensitivity analysis was conducted using the DBF scoring equations to determine the optimal design that maximizes potential competition points. The scoring analysis determined the optimal design featured: a 4 lb electronics package, a 6" antenna, and a cruise velocity of 70 ft/s.

Design Features: To further refine the aircraft's design, a series of trade studies were conducted. These trade studies allowed the team to consider multiple avenues and choose the best design solution with consideration for manufacturability, cost, and overall support of competition missions. These trade studies provided the preliminary design for the aircraft. Each sub-team lead delved into the detail design for their individual subcomponents in an effort to optimize performance for each subsystem. The results of the detailed design are listed below.

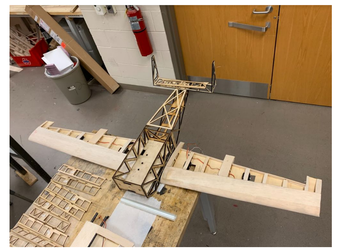
Specification	Value
Wingspan	58
Mean Aerodynamic Chord	8.218 in
Airfoil	Clark Y
Taper Ratio	0.613
Aspect Ratio	7.194
Dihedral	7°
Horizontal Tail Mean Aerodynamic Chord	2.205 in
Vertical Tail Mean Aerodynamic Chord	3 in
Center of Gravity	2.5 in from Wing Leading Edge
Cruise Speed	70 ft/s
Empty Weight	8.07 lb
Takeoff Weight (Mission 2)	11.52 lb
Electronics Package Weight	3.46 lb
Antenna Length	6 in

CAD & Final Design:



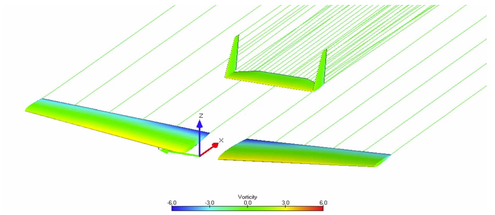
Manufacturing

Manufacturing began in January 2023 upon the team's return from Winter Break, with the bulk of materials selected and ordered over the break. The team needed to be flight ready by late January in order to have proof of flight included in the DBF Design Report, giving the team roughly 4-6 weeks of manufacturing time.



Verification Validation & Testing

FlightStream: The solidworks model of Wolfeye was imported into FlightStream and analyzed for stability. The simulation successfully converged and met the stability requirements set forth by the team. This convergence can be seen in the figure below.



Impact Drop Test: The purpose of this test was to demonstrate Wolfeye's structural strength, even in adverse conditions. The impact drop test was conducted at two different heights with the aircraft at two different orientations. Wolfeye was dropped 6in and 10in both at a 0° and 30° degree roll angle. The aircraft was outfitted with one test wing as to minimize any possible damage to the competition wings. The Wolfeye did not sustain any visible damages to the Ultracote skin or structural components throughout. The landing gear did not buckle or bend and maintained an acceptable degree of bounce back.

Flight Testing

After completing all pre flight checks, Wolfeye flew its first test flight on February 16, 2023. After a few minutes in the air, Wolfeye encountered a strong gust of wind, which coupled by an overcorrection to maintain control resulted in a catastrophic crash. The team began construction on a second Wolfeye, lighter and with a more desirable CG location and finished construction in mid March of 2023. Wolfeye's second test flight was on March 30, 2023 during which it experienced an aerodynamic stall and crashed, but was quickly repaired. Further flight testing will continue into competition week. The team is hopeful to perform well at the Design, Build, Fly Competition April 13-16th.