AIAA Design Build Fly Competition

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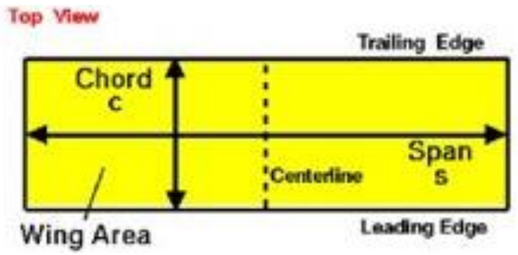
Abstract

The purpose of this project is to design an aircraft that will be able to complete the missions of the 2020-2021 AIAA DBF competition. The aircraft must be able to fly three missions with no payload, the max payload, and the deployment payload. The first and second flight missions are 3 laps of a 2300-foot course in under five minutes. The third flight mission requires that the aircraft flies as many laps as possible in ten minutes while towing the deployed sensor.

To accomplish this objective our team reviewed the requirements, developed concepts, and created a critical design. Our design is made primarily of balsa wood and carbon fiber. The wing and tail surfaces are wrapped in Monokote wrapping providing a more aerodynamic surface.

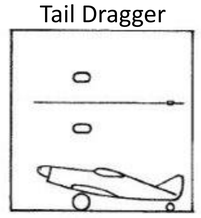
Customer Needs and Requirements



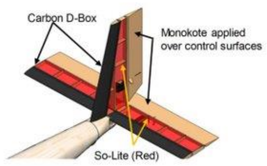
- Place above other Indiana entrants
- Highest scoring Trine University team
- Max wingspan: 5 ft
- Max take-off distance: 100 ft
- Technical Inspection/Ground Mission – multiple angles of plane and demonstrate deployment, flashing lights, and retraction
- Take-Off and Landing – successfully take-off and land
- Sensor In Flight – deployment, stable, and retracted all during flight

Concept Selection

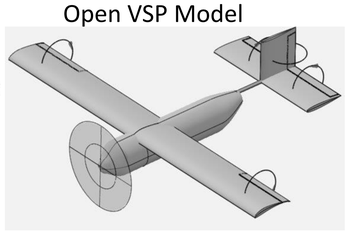
Tail Dragger



Tail Configuration



Open VSP Model



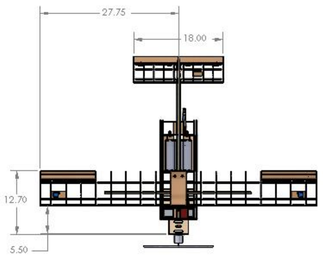
High Mount

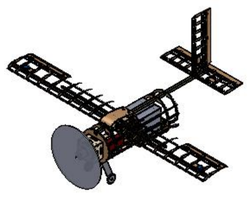
S1223

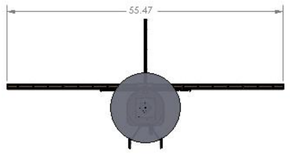
- Tail dragger landing gear
- High mounted wing
- S1223 airfoil for wing
- NACA 0012 airfoil for tail configuration

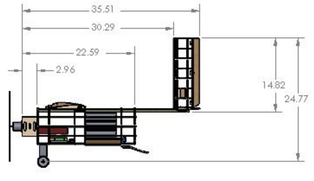
Design Solution

A code was generated on MATLAB in order to size our aircraft. It would provide us with the aspect ratio (AR), span, and other variables needed.







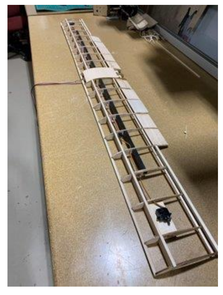


Manufacturing

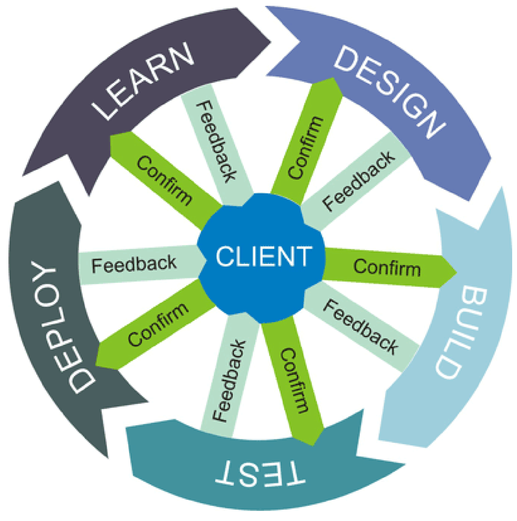
Fuselage, Boom, Landing Gear

- Fuselage: Laser cut craft plywood for the ribs
- Boom: Hollow carbon fiber rod
- Landing Gear: Tail dragger method

Wing



- Balsa for the ribs, leading and trailing edges, spars
- Hollow carbon fiber spar for additional structural support
- Servo motors attached to control the ailerons



Design Process

- Clients: Dr. Canino and Dr. Koch
- Very iterative
- Required multiple design solutions to problems
- Each section of aircraft (wing, sensor, deployment, etc.) had design matrices
- Learning why certain designs work better than others
- Built 4 main iterations of the aircraft

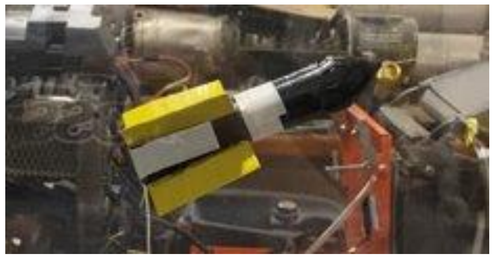
Testing and Validation

Wing Tip Testing

- Ensured the wing was able to withstand the weight of the aircraft during flight

Wind Tunnel Testing

- Various propeller sizes and decide on one
- Various sensors with fin lengths to make the sensor as stable as possible



Flight Testing

- Allowed each individual part to work as one
- Integrated parts as flights progressed
- Only source of testing real-life conditions

Acknowledgments

A special thanks to Levi Neuzerling for piloting our aircraft. Also, thank you to Dr. James Canino, Dr. Jon Koch, and Joe Thompson. They have provided us with priceless experience and knowledge that will only propel us in our future careers. Finally, a huge thanks to the Indiana Space Grant Consortium for providing the funding needed to make our project possible.