NDSU MECHANICAL ENGINEERING

NDSU AIAA

Design-Build-Fly
2021

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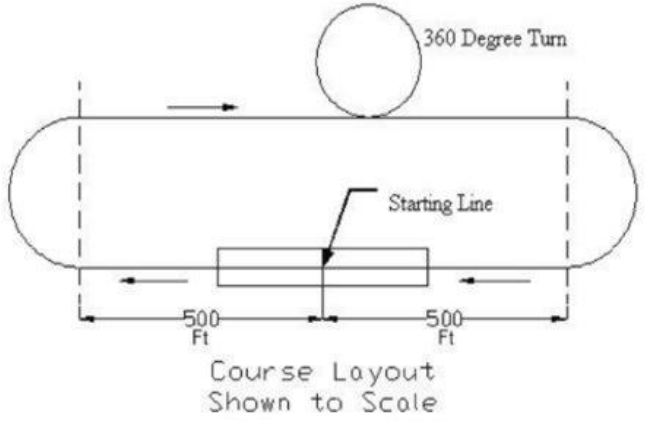
AIAA Design-Build-Fly

- American Institute of Aeronautics and Astronautics Design, Build, Fly competition
- Goal: Design a UAV to successfully complete a set of specified missions
- This year's Competition: April 15-18 in Tucson, AZ

Mission Requirements

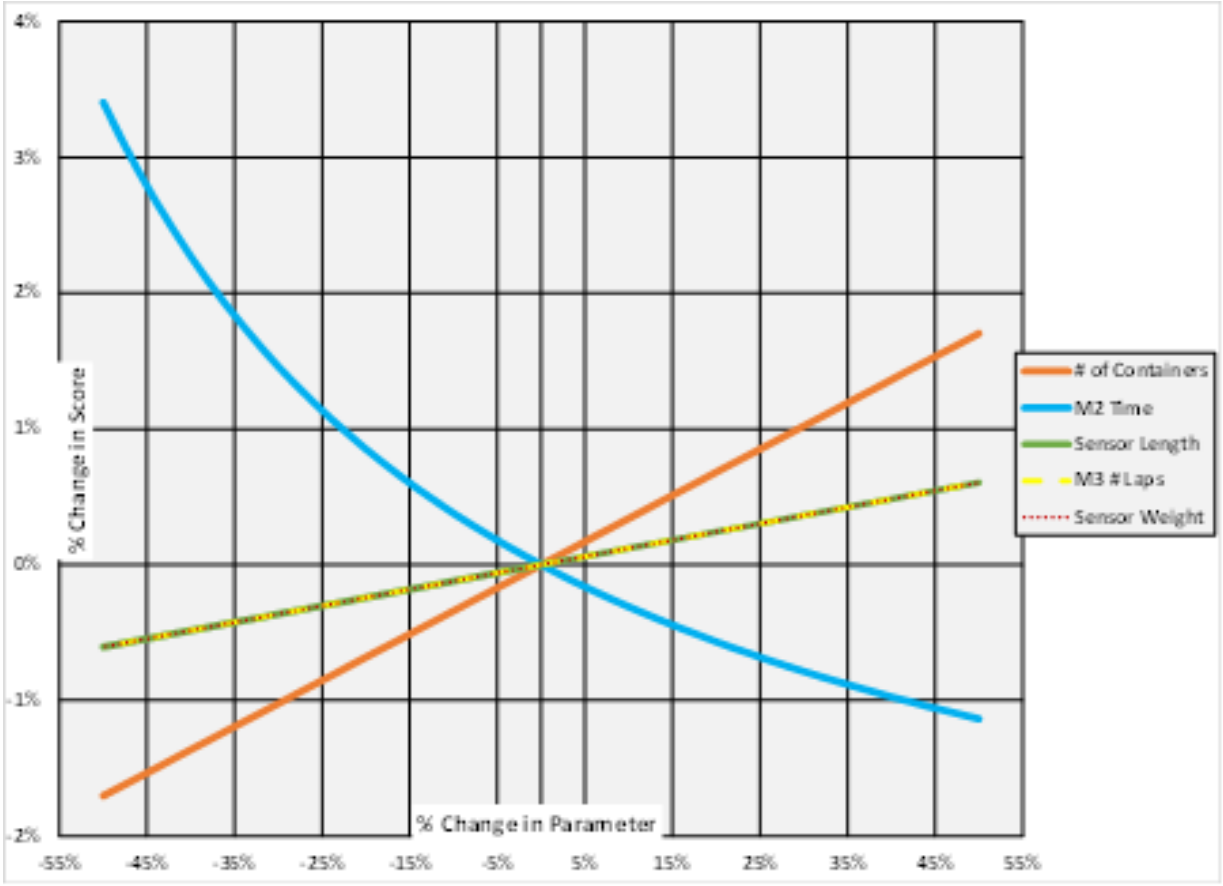


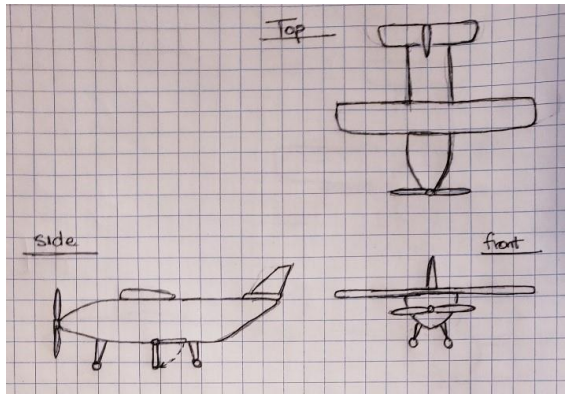
Missions	Mission Requirements/Scoring Criteria
Flight Mission 1: Staging Flight	5 minutes to complete 3 laps with no payload
Flight Mission 2: Delivery Flight	5 minutes to complete 3 laps with the sensor and simulator shipping containers
Flight Mission 3: Sensor Flight	10 minutes to deploy sensor and recover it before landing
Ground Mission	• Demonstrate timely loading and unloading of shipping containers, • Demonstrate sensor deployment and recovery • Demonstrate all flight controls

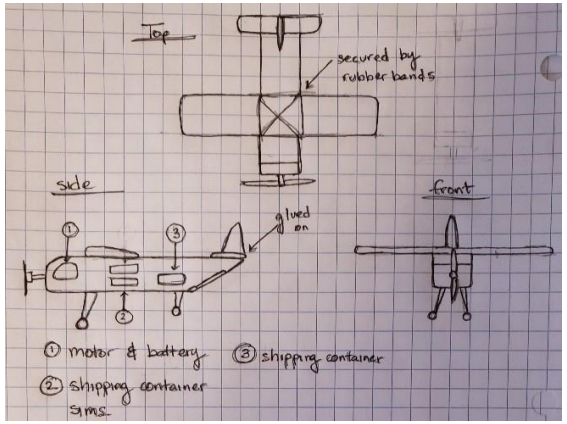
Sensitivity Analysis

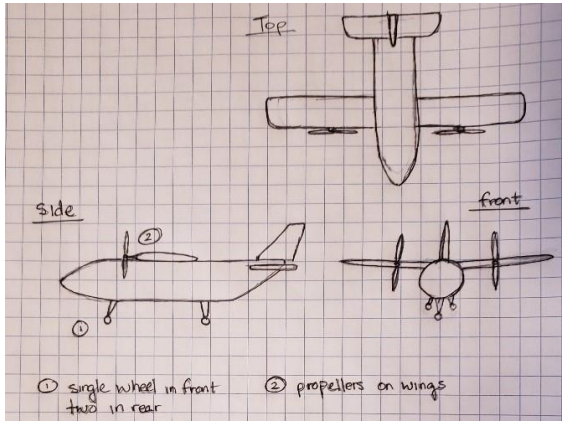
- Each mission scored with its own scoring equation
- Purpose: to evaluate effect of each scoring equation parameter
- Baseline parameters chosen based on initial designs
- Each increased and decreased by 2% up to 50% change
- Greatest percent change in score:
  - Mission 2 Time
  - # of shipping containers

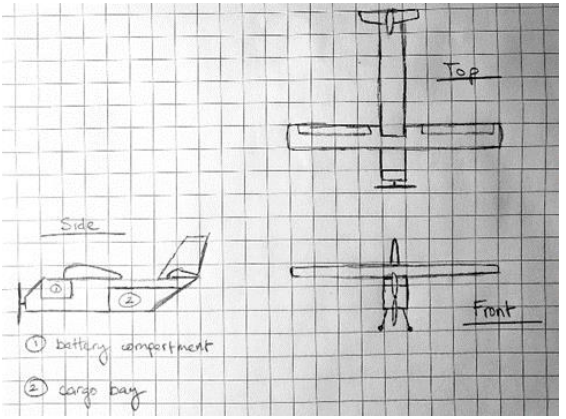
	Scoring Equation
Flight Mission 1	M1 = 1.0
Flight Mission 2	M2 = 1 + [N_(#containers/time) / Max_(#containers/time)]
Flight Mission 3	M3 = 2 + [N_(#laps * sensor length * sensor weight) / Max_(#laps * sensor length * sensor weight)]
Ground Mission	GM = [Min_time / N_time]
Total Score	M1 + M2 + M3 + GM + Report Score



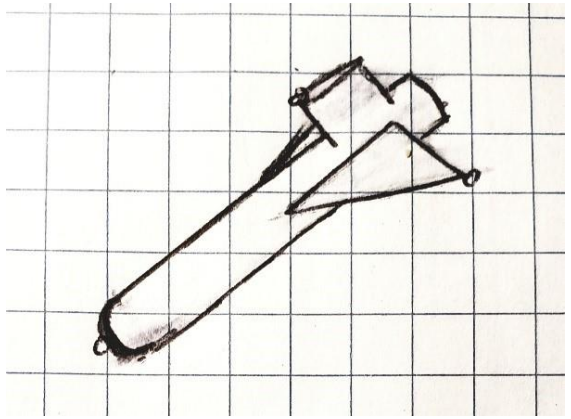


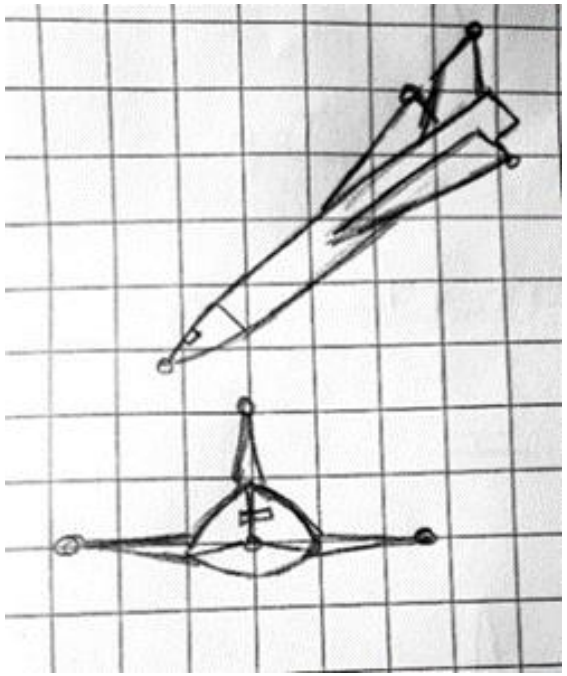


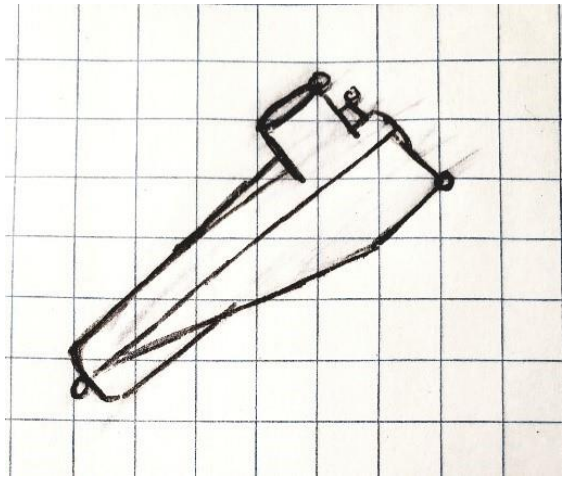


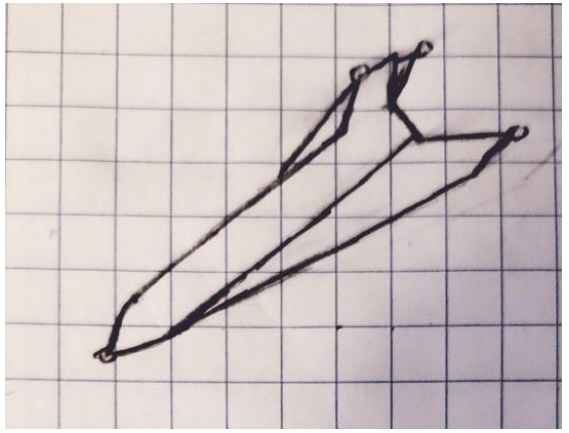


Concept Generation: UAV

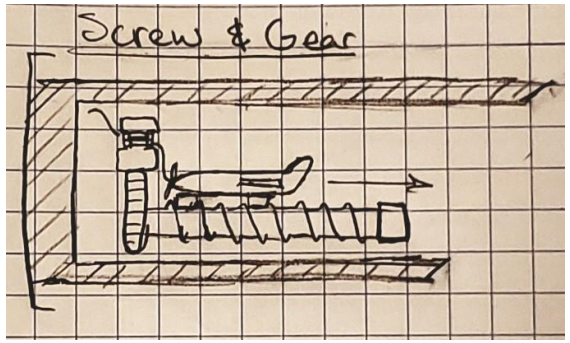


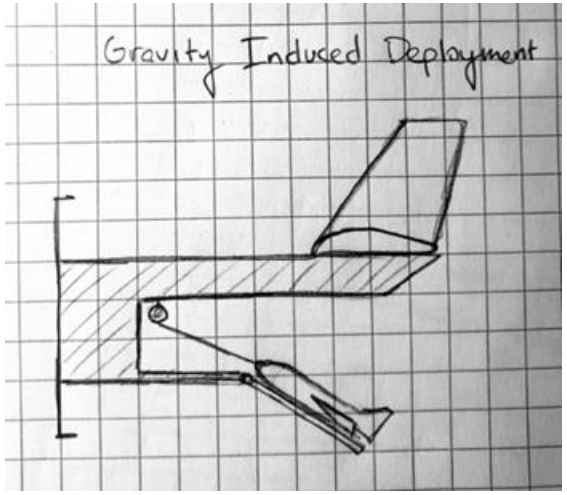


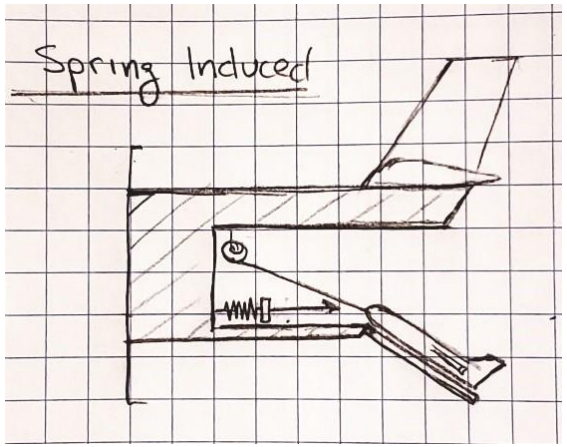


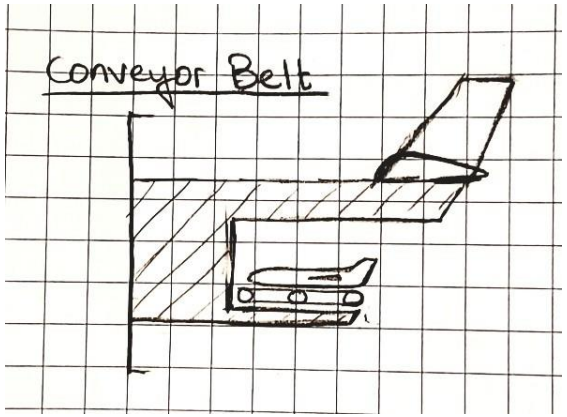


Concept Generation: Shipping Container

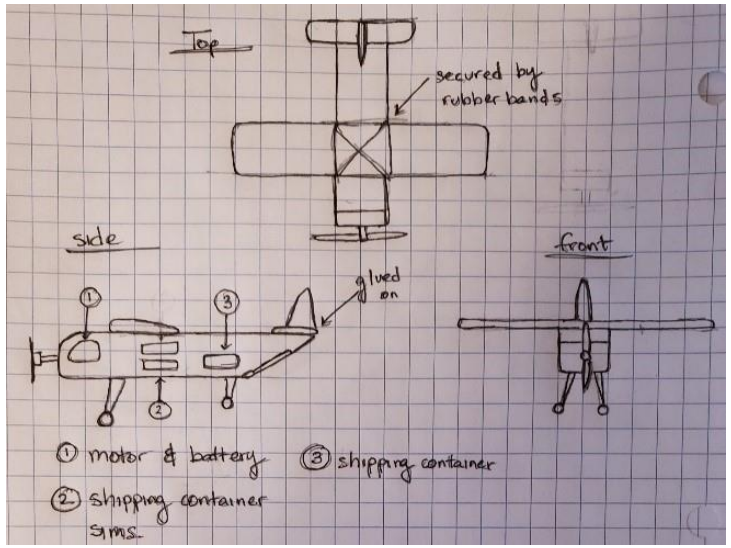


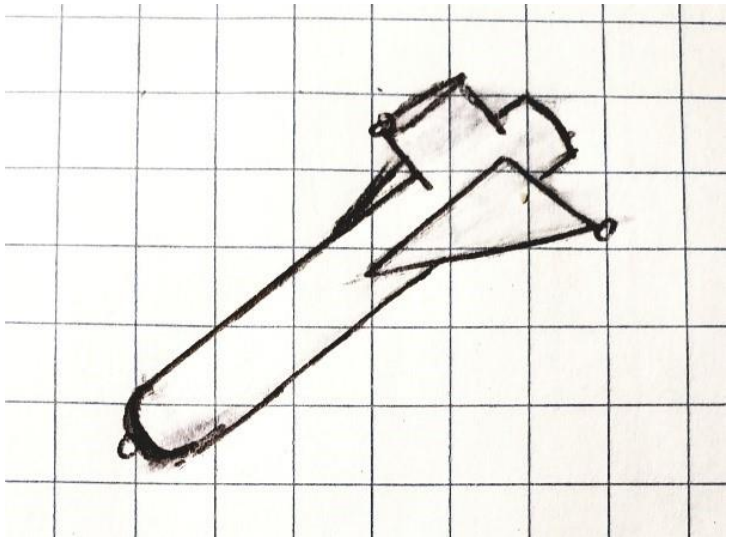


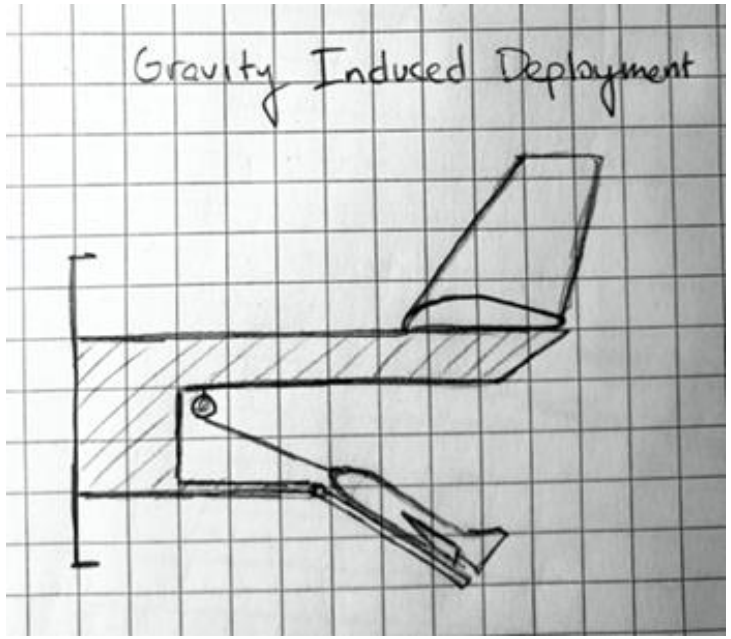




Concept Generation: Deployment Mechanism



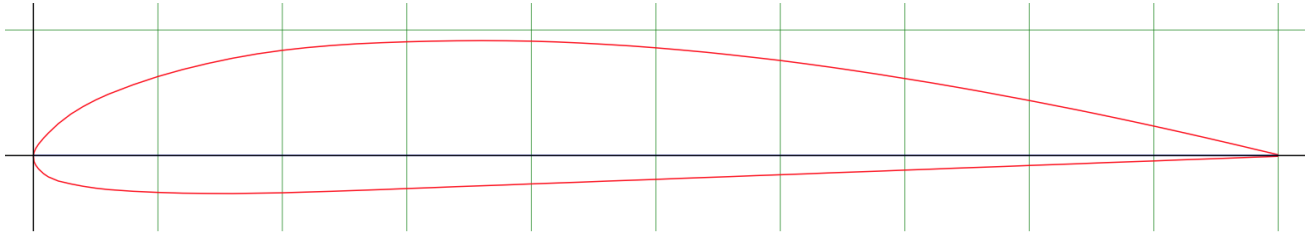


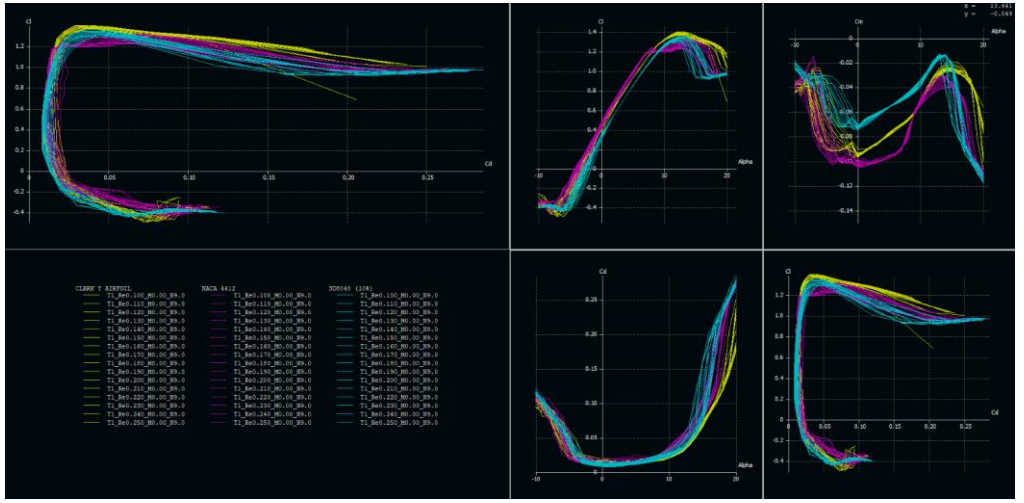


Final Concepts

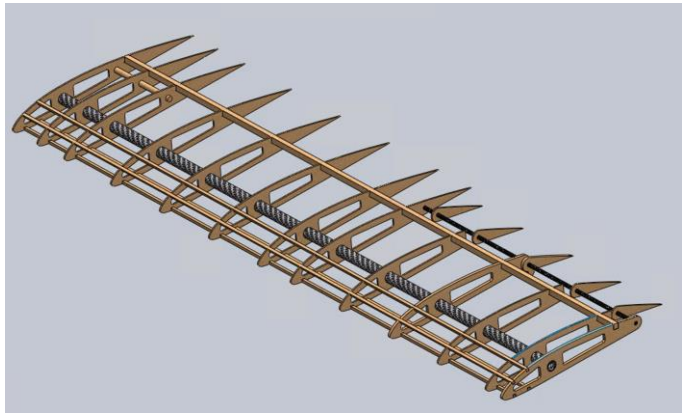
Design: Wing

Clark Y Airfoil

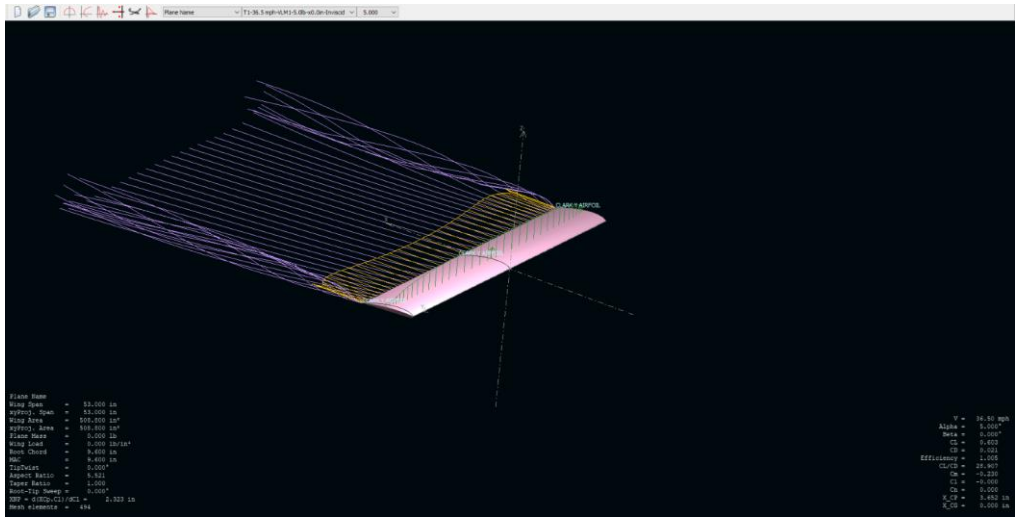




Wing span: 5 feet
Cord:9.6 inches

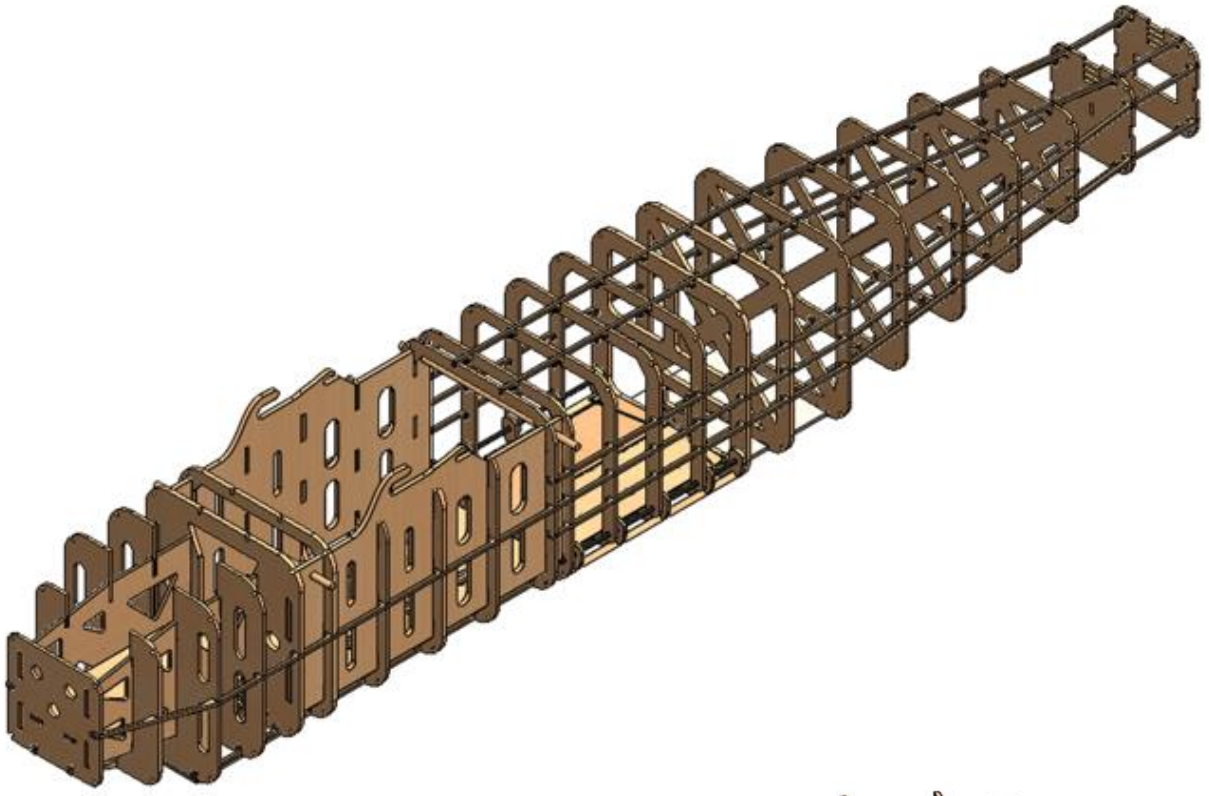


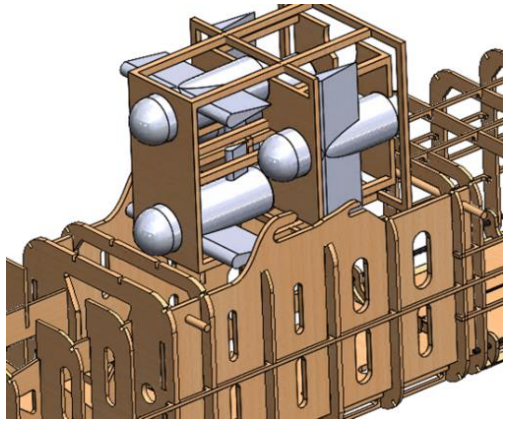
Half the wing

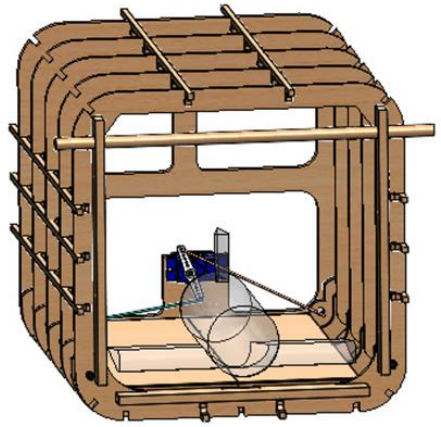


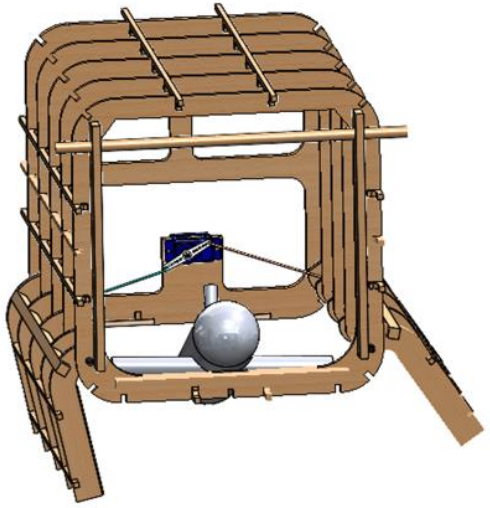
Design: Fuselage

- Length: 5 feet
- 4 sections: Nose, cargo bay, bomb-bay, tail



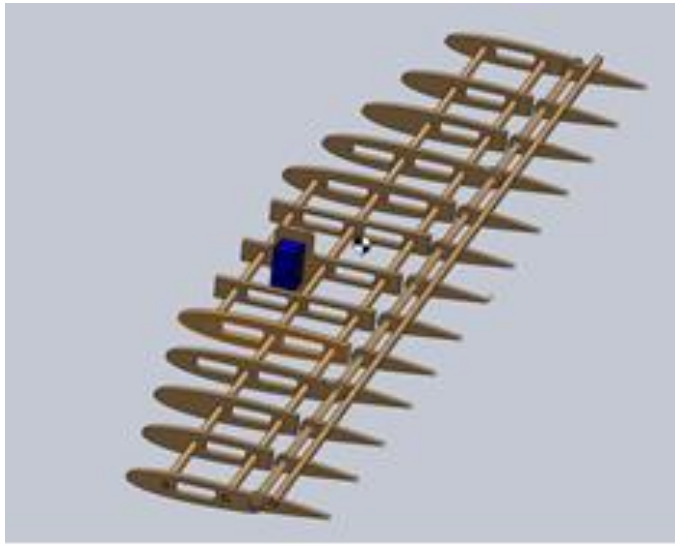


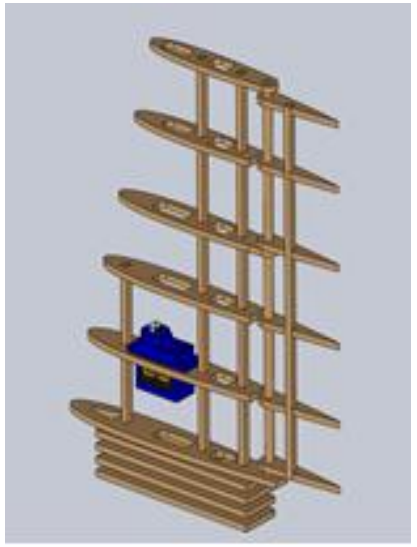


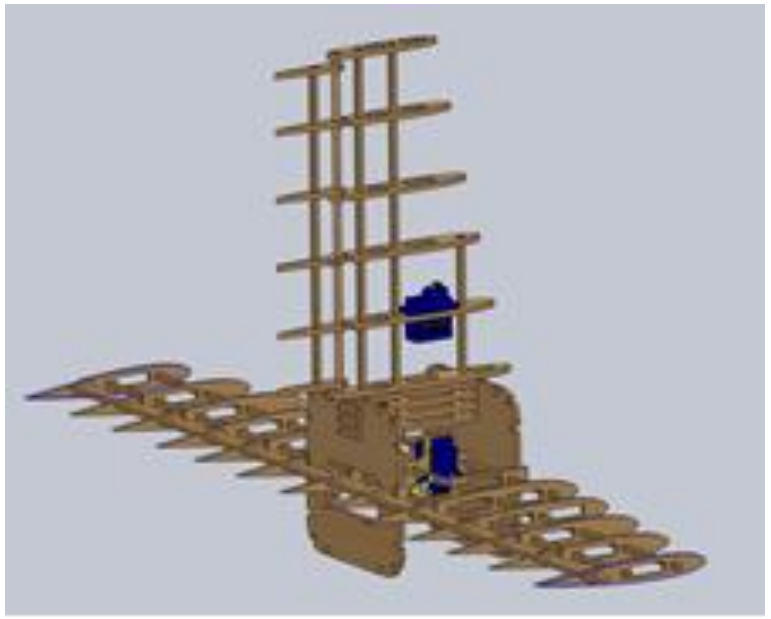


Design: Tail

- Conventional tail
- Symmetrical airfoil (NACA0012)
- Calculations used to determine dimensions
- Horizontal and vertical stabilizers interlock with last two ribs of fuselage
- 0.125-inch-thick ribs
- 4mm carbon fiber rods used at the control surface hinges



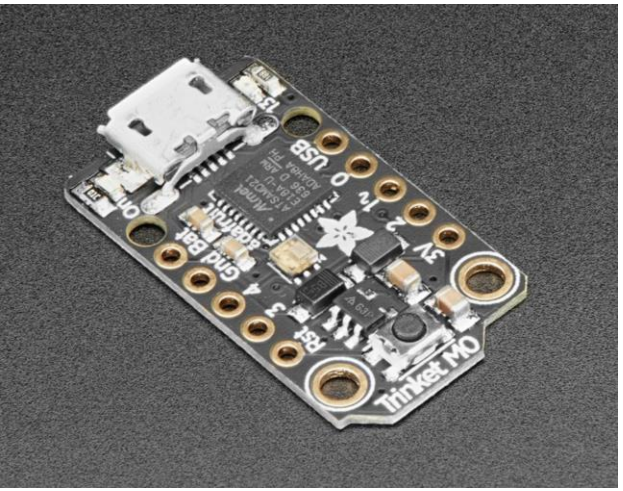




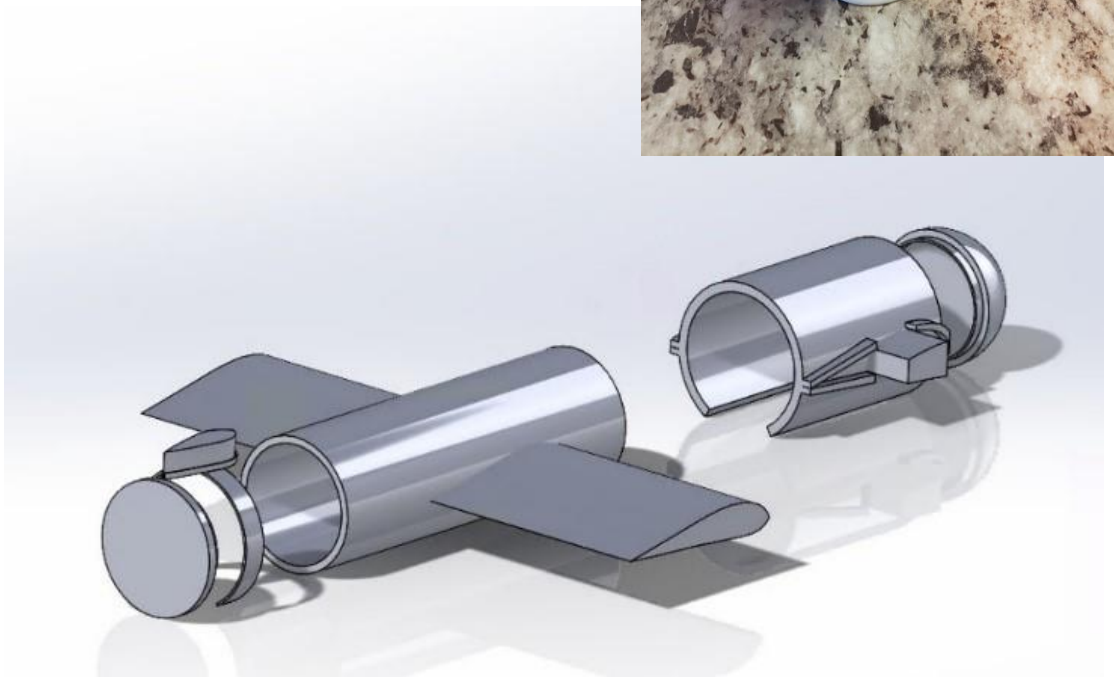
	Horizontal Stabilizer	Vertical Stabilizer
Span (in)	20.875	7.5

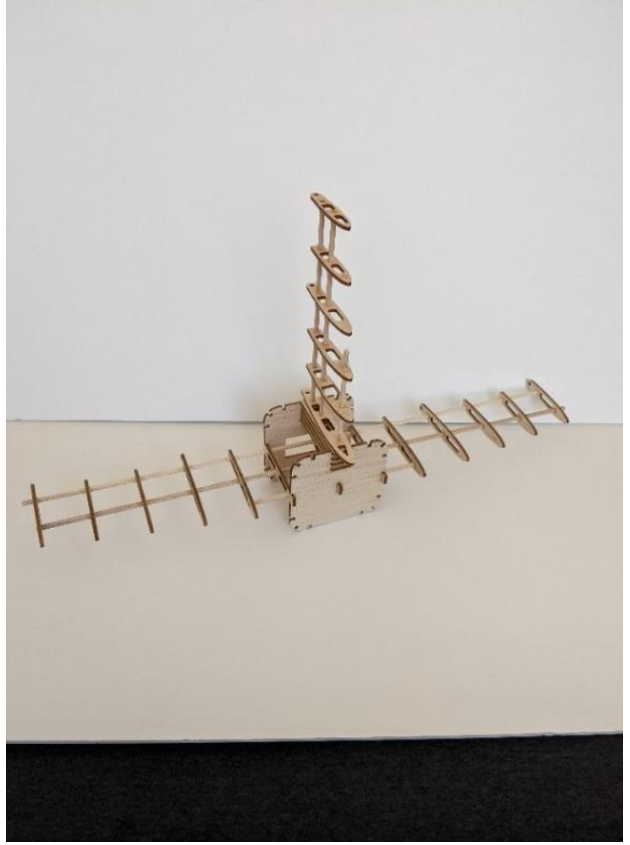
Design: Shipping Container

- Towable
- Holds the “sensor”



Trinket MO microcontroller



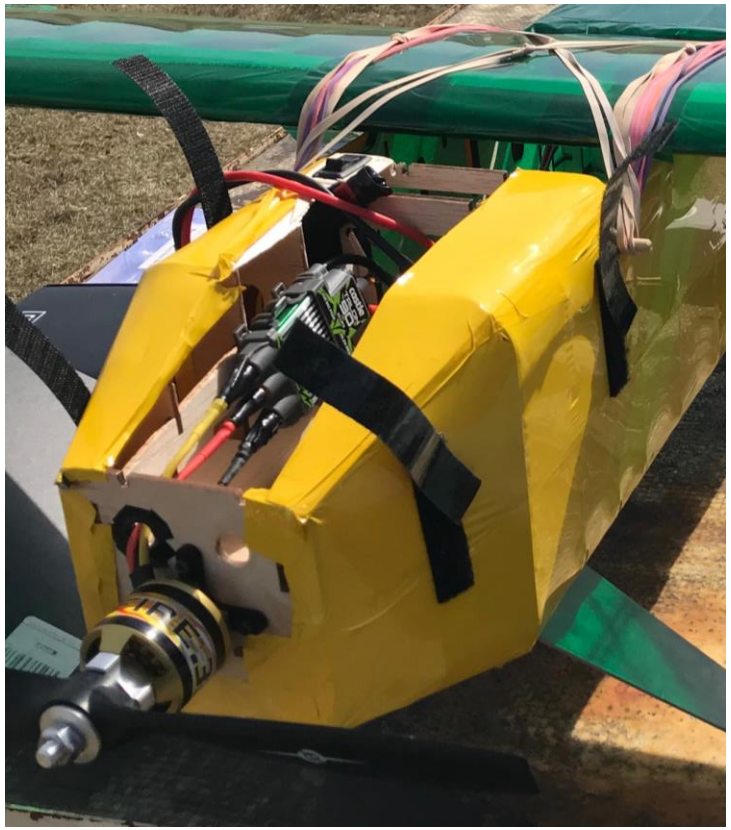


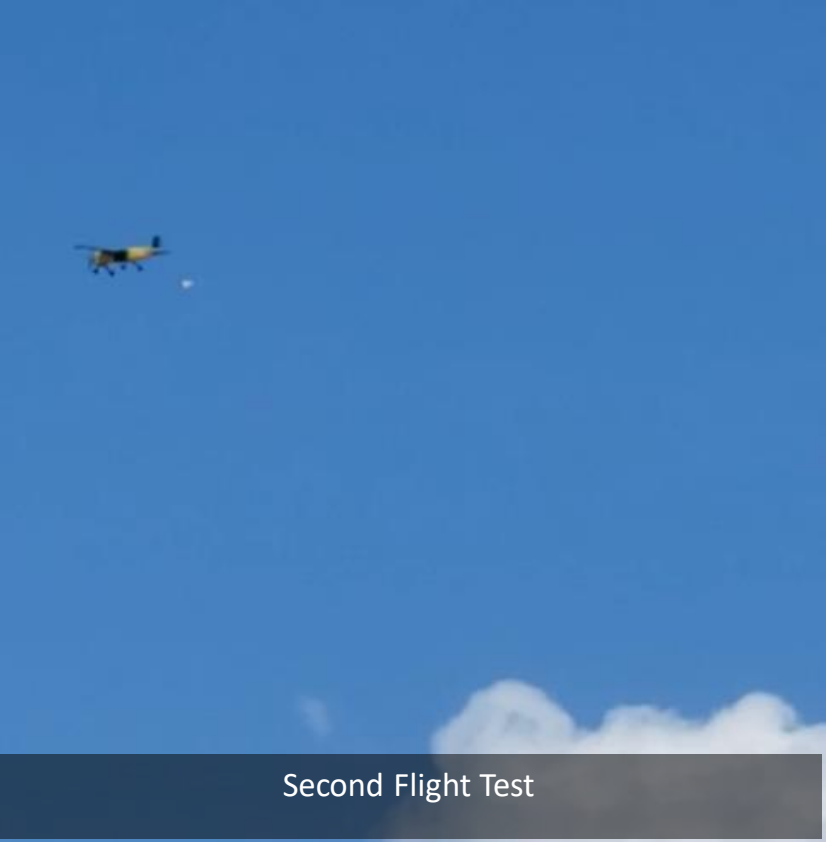
Manufacturing

- Built with balsa cut with a laser cutter
- Glued with super glue
- Covered with Monokote

Electronics

- Rimfire .32 electric motor
- 13x8 inch propeller
- 90 Amp ESC
- 3 and 4s LiPo batteries
- 8 channel Receiver
- 9 gram servos





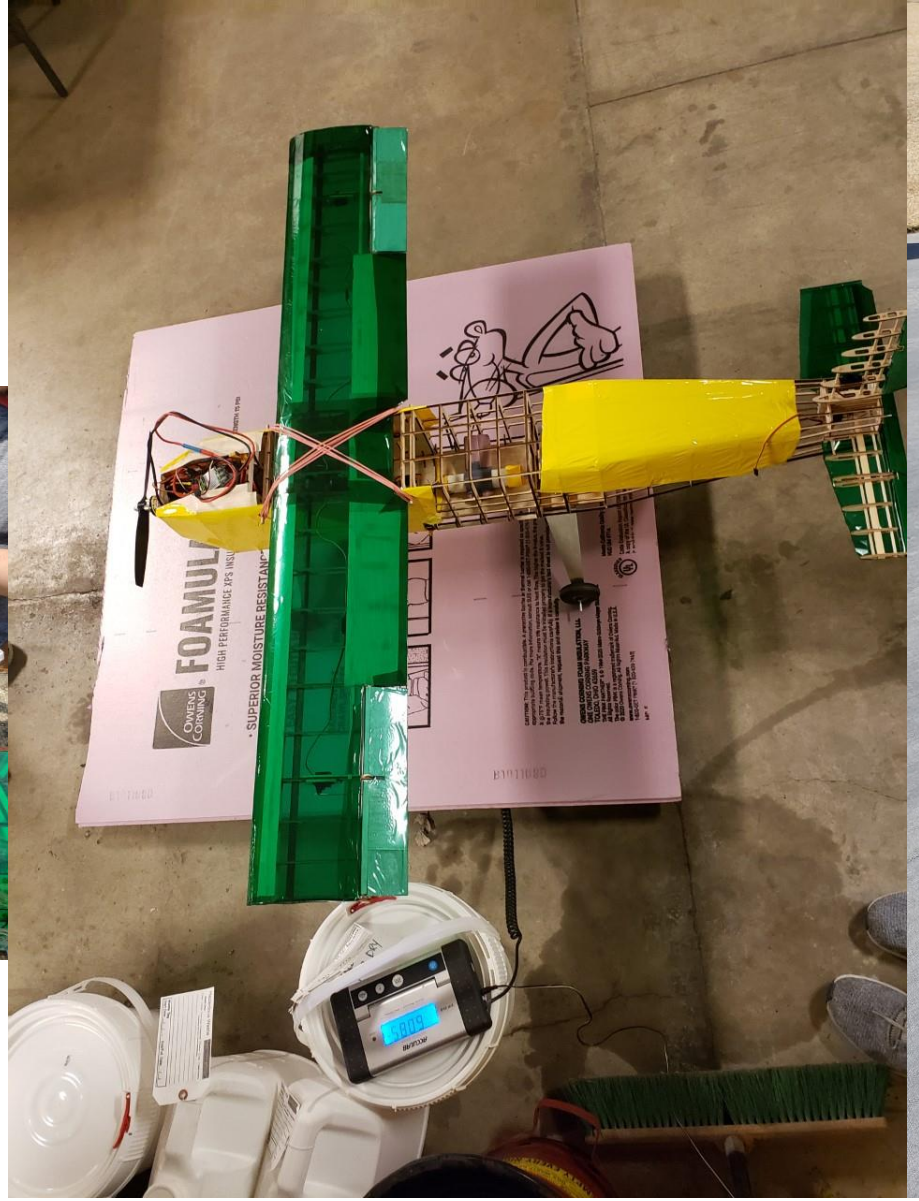
Second Flight Test

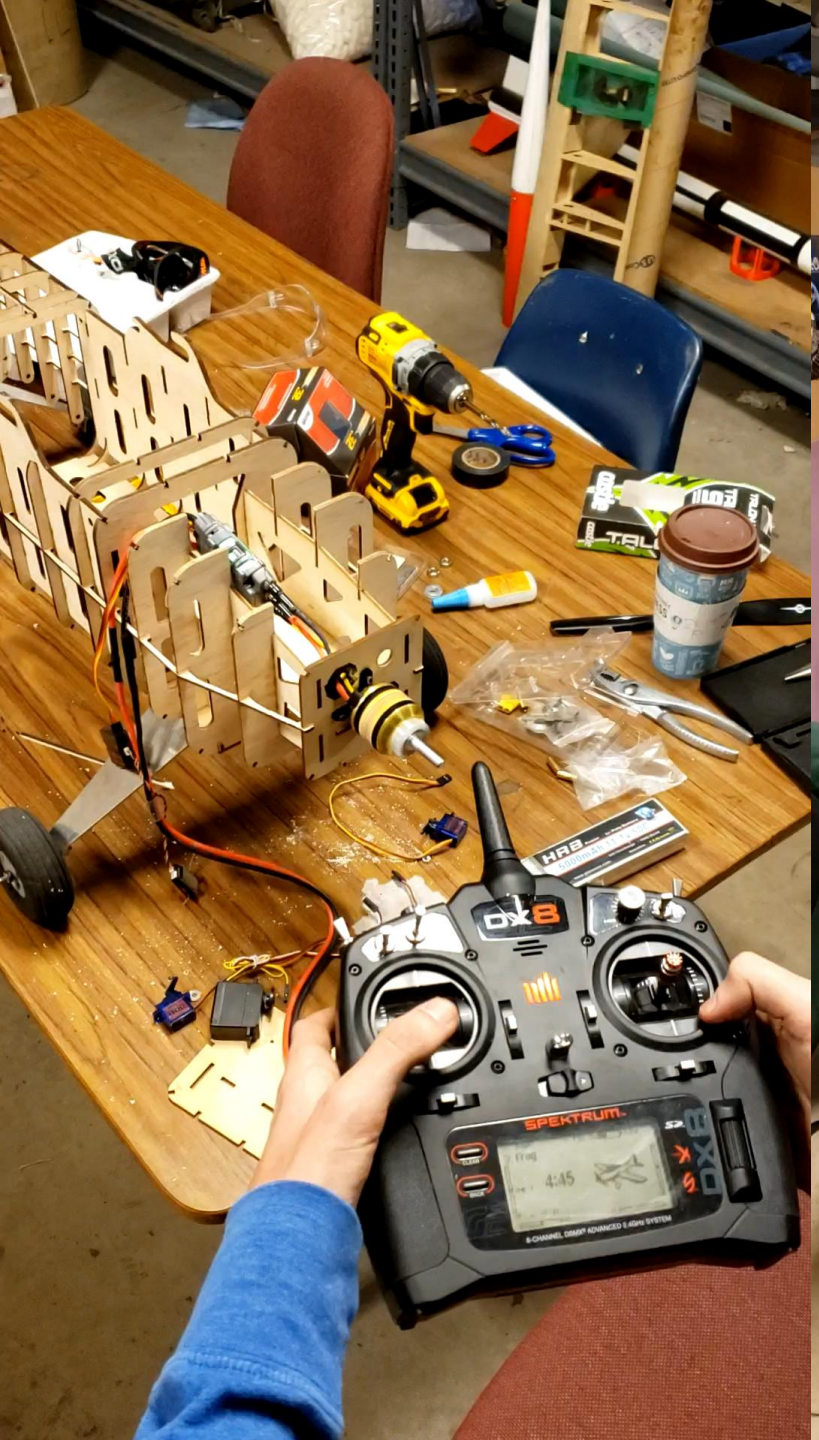
First Ground Test

First flight test

Testing

- Tested electronics with ground tests
- Then brought it to a RC park to fly, got suggestions from the knowledgeable pilots
- Added a larger rudder than what we designed. Used a 4s battery for extra power.


OWENS CORNING
FOAMULA
HIGH PERFORMANCE XPS INSU
• SUPERIOR MOISTURE RESISTANC


DX8
SPEKTRUM

Champ RTF
RC
RTF

Acknowledgments

- We’d like to thank the NDSU Mechanical engineering department for the opportunity to do this project
- NDSGC for their funding and support
- Our mentors Dr Suzen and Dr Zhang
- NDSU’s AIAA Club

Questions?