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College of Engineering

IAM3D Discus Launch Glider

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IAM3D GLIDER

Objective

The objective is to design, fabricate, and test a discus-launched glider (DLG) that is:

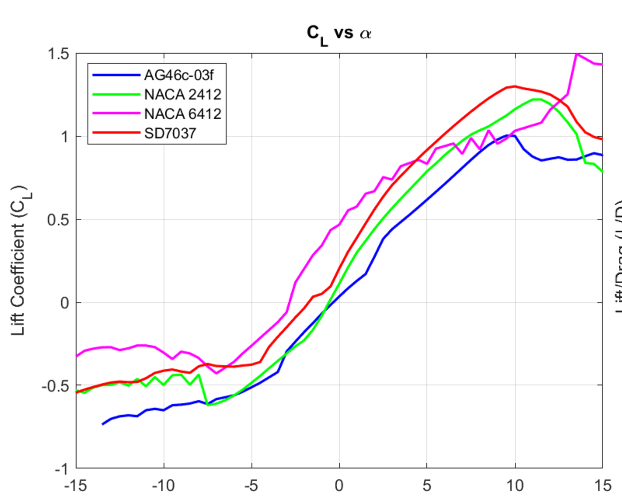
- Composed primarily of 3D printed components
- Optimized for additive manufacture and assembly
- Resulting from an iterative development process
- Capable of performing aerobatic maneuvers

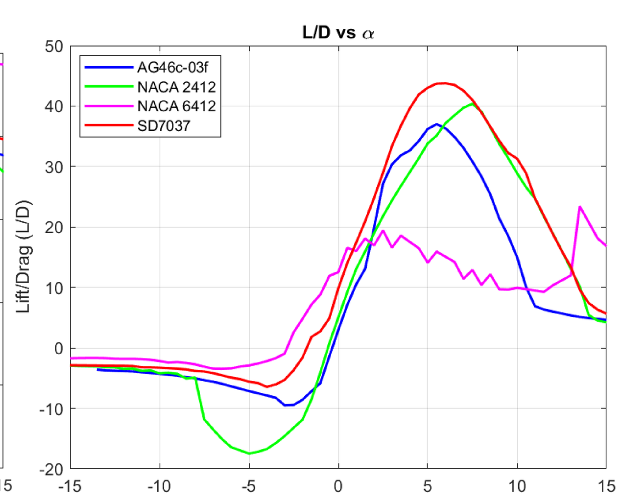
Performance Requirements

- Fit within a 5' x 5' x 3' volume
- Minimum climb height of 100 feet
- Minimum glide time of 30 seconds
- Maximum total mass of 500 grams

Research

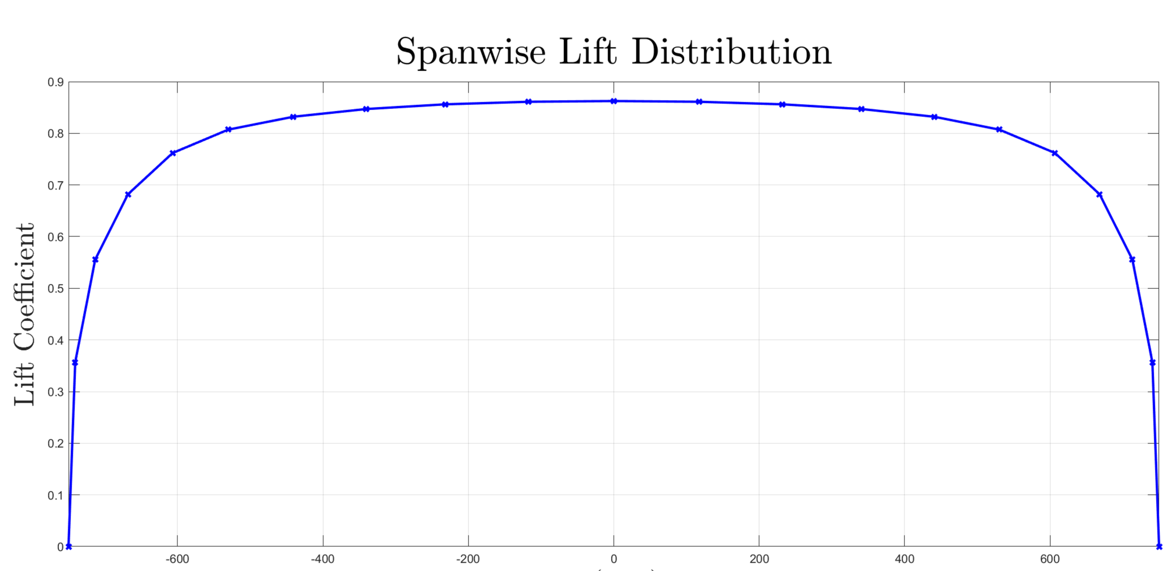
The team performed a preliminary existing technology trade study to determine typical aerodynamic specifications for high-performing DLGs. These values were utilized as a starting point to research airfoils that were capable of meeting lift and drag requirements.



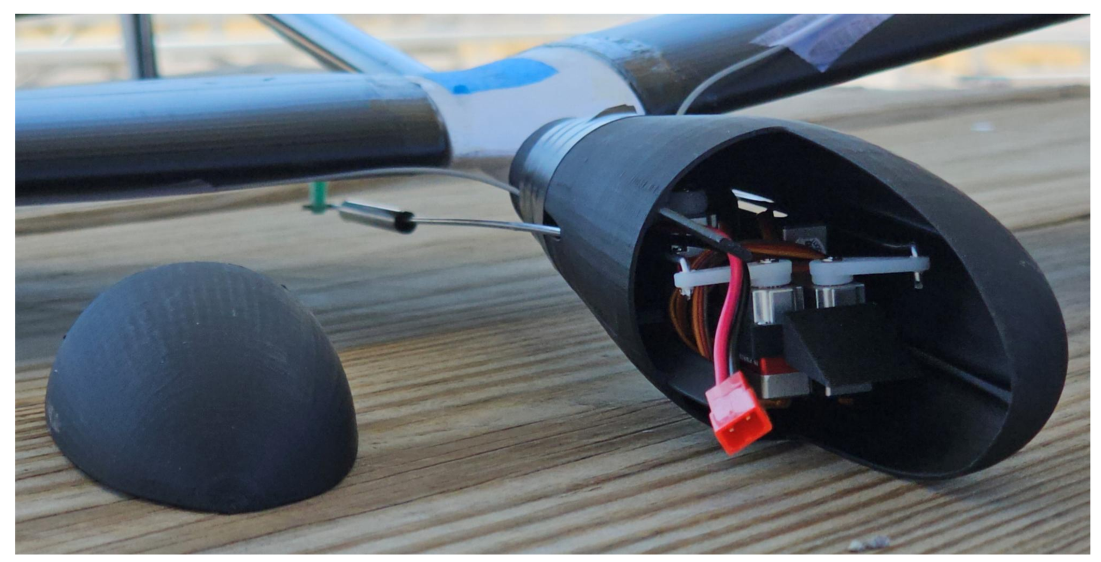


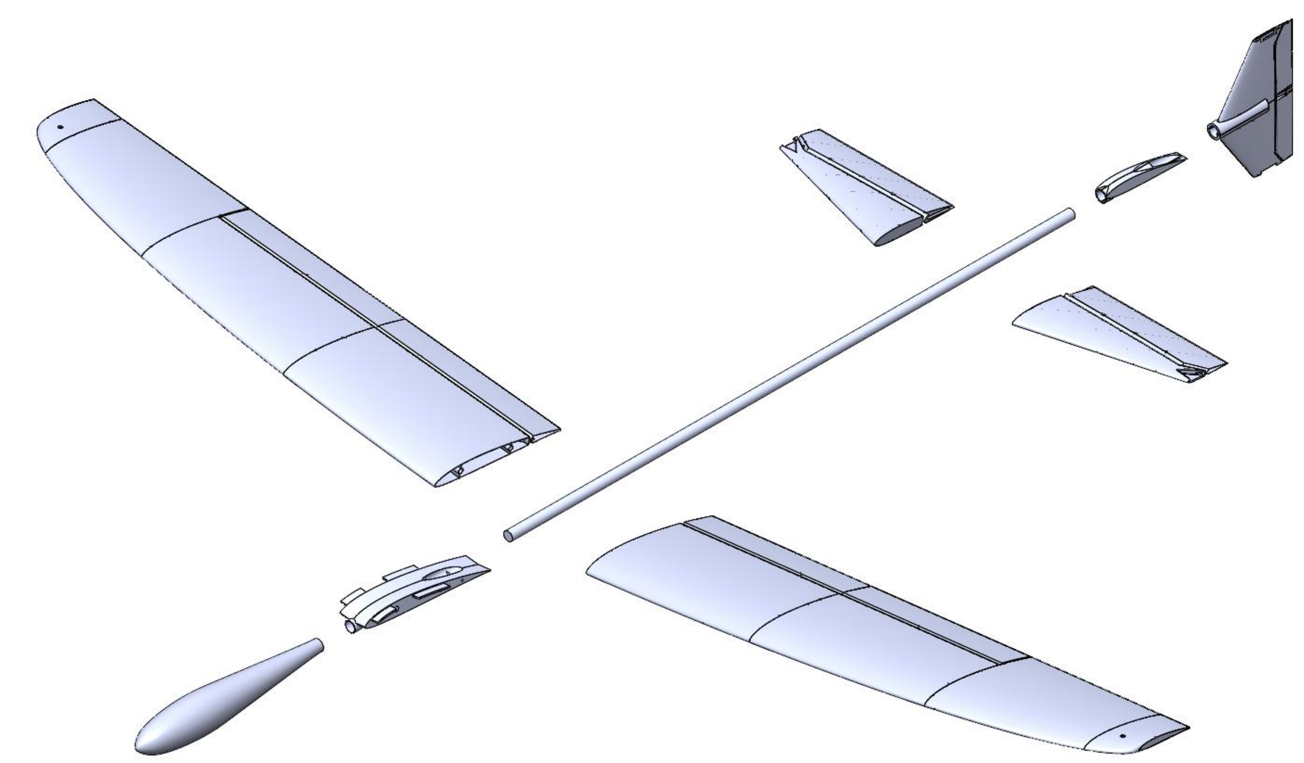
Lifting Line Theory (LLT):

- Models wing as a bound vortex line with spanwise variation in circulation, accounting for the effects of trailed vortex wake.
- Provides mathematical framework for determining spanwise lift distribution, induced drag, and aerodynamic efficiency of finite wing.



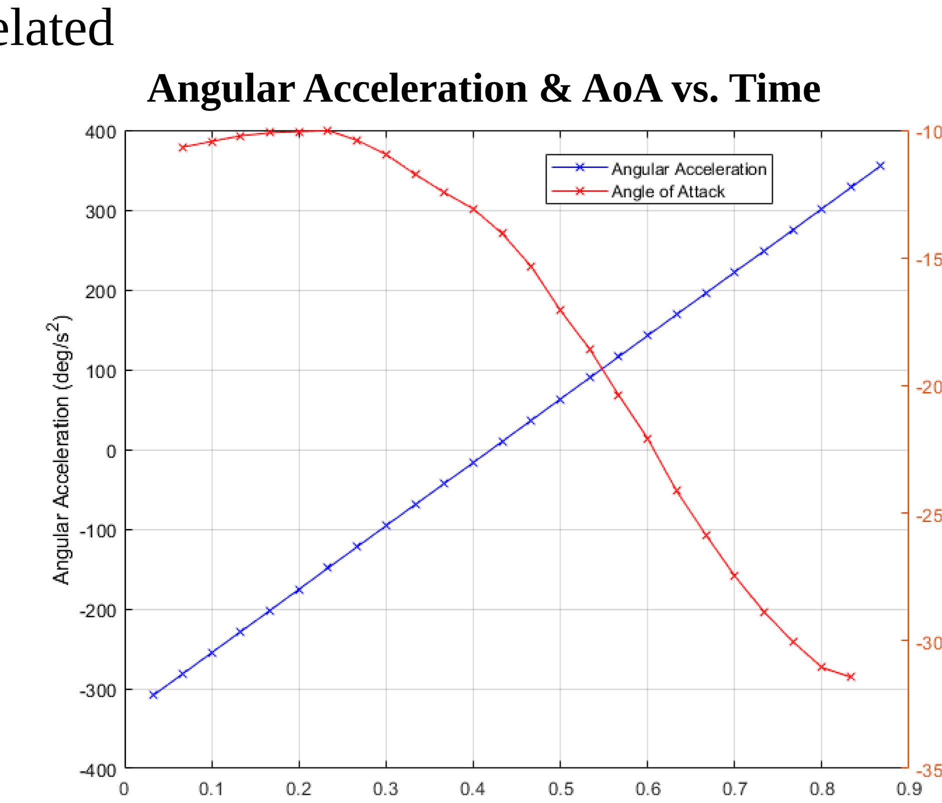
Final Design





Flight Test

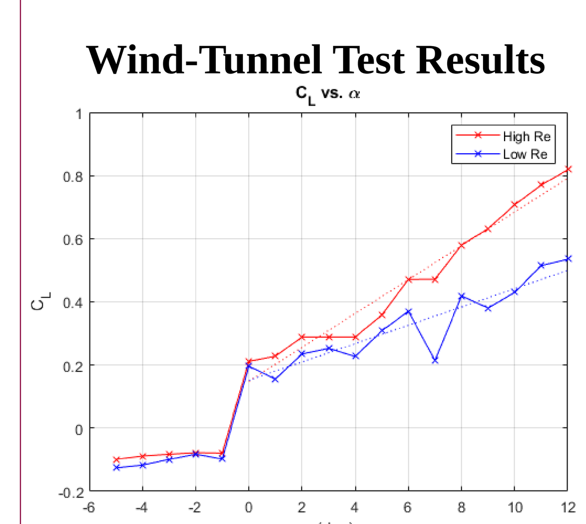
- Prototype weight was 825 grams
- A flight test was planned at the RC Airpark
- Based on stability analysis, the glider was expected to pitch up uncontrollably
- Weight was added to the fuselage and the elevator was positioned down
- Upon release, the glider began pitching down and crashed nose-first into the ground
- A positive restoring moment occurred at 0.42 sec
- Pitching moment and angle of attack were inversely related

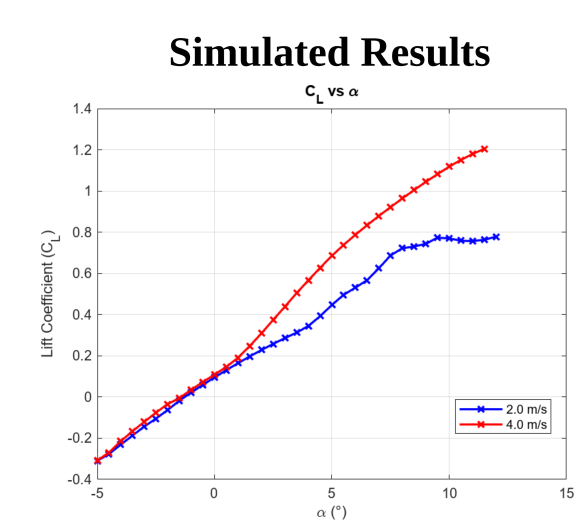


- Oscillatory pitching could have been due to low speed, launch attitude, elevator position, or mass distribution
- The climb height, glide time, and mass requirements were not verified

Small-Scale Wind Tunnel Test

- A 40% scale model of the prototype's wing was tested in NMSU's large wind tunnel facility. It underperformed significantly when compared to simulated data.
- Distorted airfoil geometry was discovered in the SOLIDWORKS model and was rectified before the full-scale prototype was manufactured.



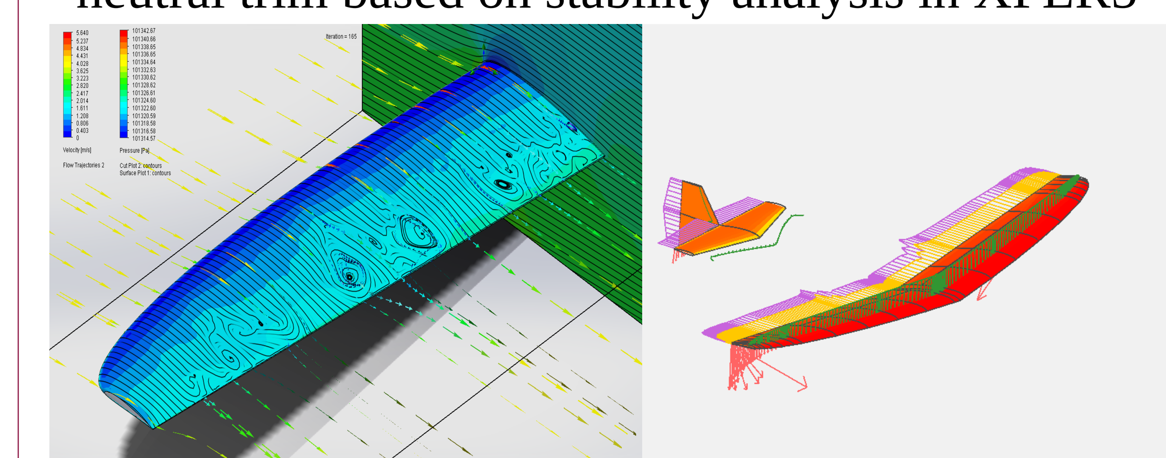


	40% model	Full-scale prototype
Airfoil	SD-7037	SD-7037
Max Chord	80 mm	200 mm
Span	0.6 m	1.5 m
Planform Area	0.040 m^2	0.250 m^2
Dihedral	6°	6°

Concept Development

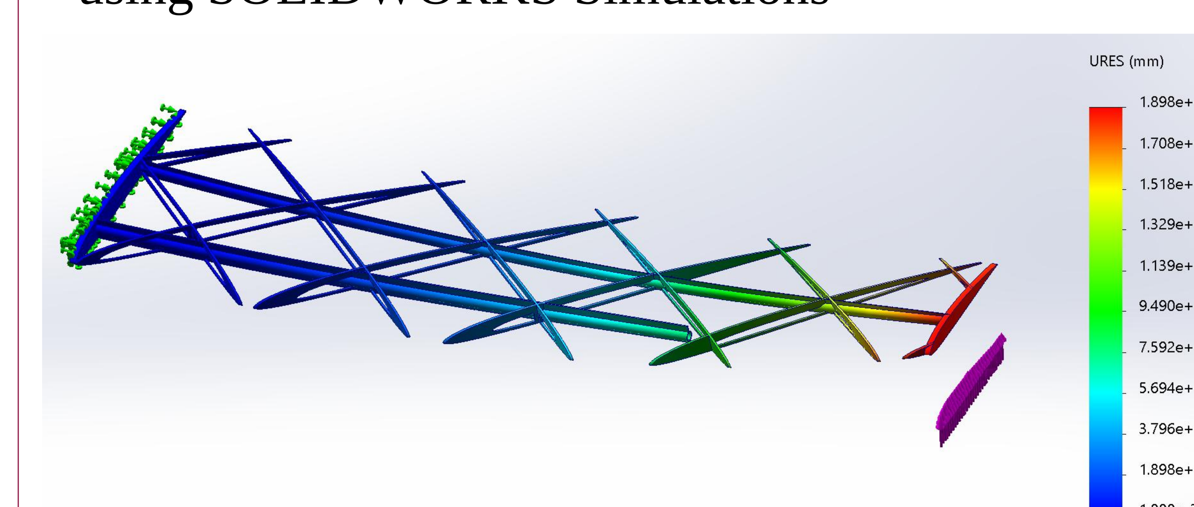
Aerodynamics

- Performance requirements, airfoil research, and LLT were the basis of preliminary wing designs.
- Rectangular, tapered, and elliptical wings were simulated in XFLR5 and SOLIDWORKS.
- A tapered wing with an elliptical leading edge balanced performance and manufacturability
- Tail specifications were determined to provide neutral trim based on stability analysis in XFLR5



Structures

- Semi-monocoque with ribs at ±45° to the chord and two carbon fiber spars
- Ribs were designed as infill for 0.4 mm skin surface
- Weight and material requirement was minimized using SOLIDWORKS Simulations



Avionics and Controls

- Onboard avionics included four servos, a 6-channel receiver, and a battery
- The flaperons were each linked to a servo via a pushrod.
- The rudder and elevator contained springs that pulled against Kevlar strings attached to servos
- The transmitter was programed with flight modes for launch, climb, cruise, and braking

References

- Anderson, John D., Jr. 2016. *Fundamentals of Aerodynamics*. McGraw-Hill Education.
- Johnson, Eric Raymond. 2021. *Aerospace Structures. Kevin T. Crofton Department of Aerospace and Ocean Engineering in Association with Virginia Tech Publishing eBooks*. https://doi.org/10.21061/aerospacestructures.
- Leishman, J. Gordon. 2023. "Lifting Line Theory." Pressbooks. January 1, 2023. https://eaglepubs.erau.edu/introductiontoaerospaceflightvehicles/chapter/lifting-line-theory/.
- Sadraey, Mohammad H. 2012. *Aircraft Design: A Systems Engineering Approach*. John Wiley & Sons.