UNH AERO

Team Members: Matt Barricklow, Aaron Chapman, Kimia Fereydooni, Yanyuan He, Jon Lewis, Haoming Ni, Joe Roylance, Brennan Smith, Hongjie Zhang

Team advisor: Alireza Ebadi **Team Pilot:** Daren Hudson

SAE Aero Design East Overview

Design a plane that can deliver colonists and supplies safely to the surface of Mars

Plane Requirements:
- Maximum wingspan of 144 in
- Maximum gross weight of 55 lbs.
- Electric powered with 750-watt power limiter

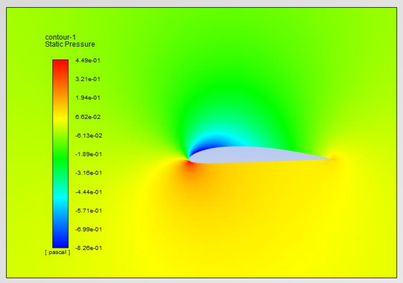
Payload Requirements:
- Use unmodified water bottle and football (as supplies)
- Deliver ping-pong balls (as colonists) through Colonist Delivery Aircraft (CDA) with the following requirements:
  - Maximum weight of 9.0 oz.
  - At least two degrees of freedom must be controlled autonomously

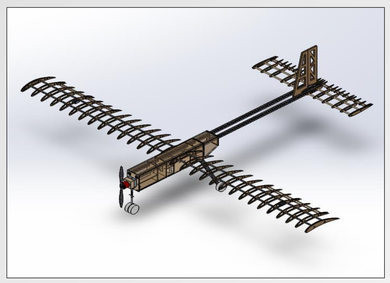
Analysis

ANSYS Fluent:
- 2D simulation of airflow around ClarkY, Eppler 423, S1223 airfoils
- Theoretical lift and drag coefficients for each airfoil at different angles of attack

SolidWorks:
- Stress analysis of plane during takeoff and landing
- CG location determination for plane and glider

MATLAB:
- Motor and propeller analysis
- Optimize number of dynamic payloads to maximize score





Design and Dimensions

Main Wing:
- Eppler 423 Airfoil
  - Chord – 14.6 in
  - Aspect Ratio – 8.1

Fuselage:
- Length - 34.5 in
- Width – 5.0 in

Empennage:
- Horizontal stabilizer (NACA 0012)
  - Chord - 10.24 in
  - Span - 42.12 in
- Vertical stabilizer
  - Height - 17.5 in

Controls

Flight Controls:
- Radio transmitter to control surface servos and motor

Mission Controls:
- Pixhawk for dropping mechanism control, altitude and direction readings
- First-person view camera
- In-flight data recorded in Mission Planner

Manufacturing

Laser Cutting
- Airfoil geometry (Balsa wood)
- Fuselage components (Poplar wood)
- Water bottle dropping mechanism (Acrylic sheet)

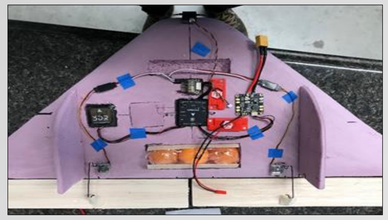
Machining
- Carbon fiber tubes holes
- Front landing gear

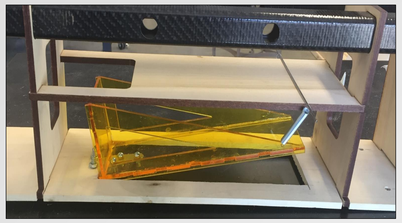
3D Printer
- Payloads' dropping mechanism
- Vortex generators

Glider and Payloads

Glider Design:
- Weight - 8.9 oz.
- Number of colonists – 3
- Flying wing shape
  - Wing taper: 2.3 in to 23 in
- 2 vertical stabilizers

Glider Controls:
- Pixhawk programmed for autonomous control
- Pitch and roll maneuverability
- GPS for landing location
- Radio transmitter for fail-safe





Payloads:
- One 16.9 fl oz. water bottle
  - Carried internally
  - Released via spring door
- Two footballs
  - Carried externally
  - Released via tension wire

Dropping Mechanism:
- Water bottle and footballs released simultaneously through an interconnected pin system
- Glider released separately via servo-pin system

Test Flight and Resolutions

Plane Issues:	Plane Solutions:
1. Front landing gear rigidity	1. Reinforced welding spot and collar on landing gear
2. Weak controllability between elevator and servo	2. Replaced servo arms and horns
3. Insufficient lift force	3. Changed propeller, added nose cone to motor
4. Dropping mechanism failure	4. Adjusted payload tension wires

Glider Issues:	Glider Solutions:
1. EPP foam provided insufficient strength	1. Changed to insulation foam
2. CG issues, tail heavy	2. Traditional glider shape changed to flying wing design
3. Unstable control system	3. Adjusted PID controller gain, added vertical stabilizers
4. Failed to safely release from main plane	4. Removed tail skids from plane

Results:
Design report – 14th place
Oral presentation – 12th place
Flight score – 9th place
Overall – 15th place

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