Team Penguins
3DPAC Competition
Class of 2020

Left to Right

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Overview

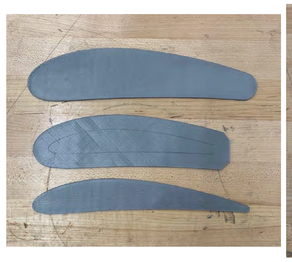
For our Senior Project our goal was to design, 3D print, and test a lightweight aircraft that meets all requirements for the Fixed Wing Category for the Annual 3D Printed Aircraft Competition at University of Texas Arlington. The goal of the competition is to maximize flight time by optimizing overall design of internal and external structure of our aircraft. With a lightweight and effective internal structure the group will be able to improve flight time and structural integrity.

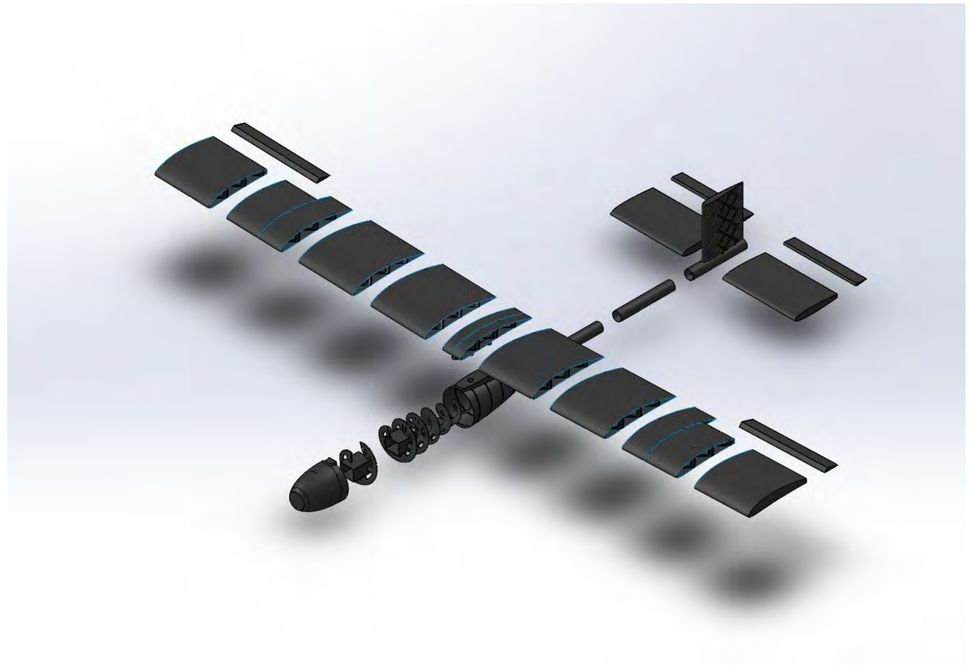
Competition Rules

- All airframe components, including all aerodynamic surfaces and control Surfaces must be printed using a purely (not hybrid) 3D printing Technology
- There are no size, configuration, weight, or material restrictions
- Aircraft may be unpowered or powered using a safe propulsion Method for a maximum continuous duration of 5 seconds
- Flights must stay within 300 x 160 foot boundary and remain under 30 feet in altitude
- Design work must be performed by undergraduate or graduate Students enrolled full time at an accredited university

Material and Testing

- We tested both High Heat PLA and classic PLA and noticed a huge difference in terms of weight. To test we printed a vertical stabilizer in both materials and the High Heat PLA came out to almost half the weight of the classic PLA (37 vs. 64 grams)
- Group went with PUSH PLASTIC High Heat PLA, 1.75 mm, chosen for having a high Ultimate Tensile Strength of 50 MPa, low cost of $20 per kg spool, and accessibility
- In order to keep the aircraft light we decided to go with single wall prints which successfully printed with our unique internal structure
- One major printing problem the group face was the fact that our wing sections experienced heavy warping, enough to cause a problem when gluing each section together.
- In order to avoid the warping the group tested out different raft sizes to find the smallest raft which would also eliminate the warping





Design Characteristics

- Aircraft has a wing span of 50.2 inches, with 9.5 inch ailerons and a dihedral of 2 degrees
- Fuselage derived from NACA 0024 airfoil and has a cord length 12.32 inches which is printed in 3 sections, which connect to the 12 inches boom
- The fuselage, tapered helix internal structure has a height of 10 inches, 7 revolutions, pitch of 1.43 inches and a diameter of 4 inches
- Fuselage is to secure motor, battery, multiple servos, and ESC

Internal Structure

Fuselage

Wings

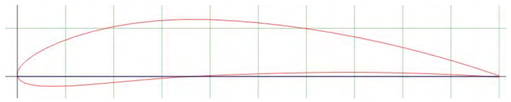
Electronic Components Used

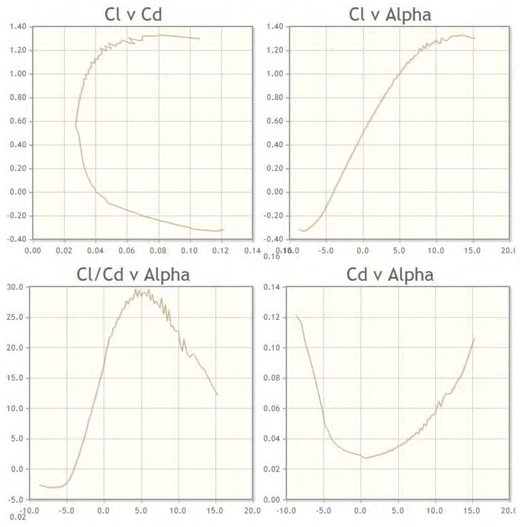
- Motor: Suppo 2814/8 Brushless Motor
  - 1000kv, 3-4 cell, 15-25A
- Battery: Dino Ultra Graphene 2.0
  - 3 cell, 1300mah, 11.1V, 80C
- ESC: HobbyKing BlueSeries Brushless Speed Control
  - 30A, 2-4 cell
- Steering Servo(s): Hextronik HXT900 (4)
  - 9 grams each

Lift and Drag Characteristics for NACA 6412 Airfoil

Source: Airfoiltools.com

- Cd - Coefficient of Drag
- Cl - Coefficient of Lift
- Alpha - Angle of Attack





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