3D-PAC Fixed Wing Aircraft

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Project Background

Advancements in manufacturing technology have significantly enhanced the ability to develop and produce complex products. The accessibility of 3D printing has revolutionized the process, enabling efficient and cost-effective part fabrication. In our senior design project, we leveraged this technology to design, prototype, and manufacture components for our own RC aircraft. This approach allowed us to iterate and refine our design more rapidly, optimizing performance throughout the engineering process.

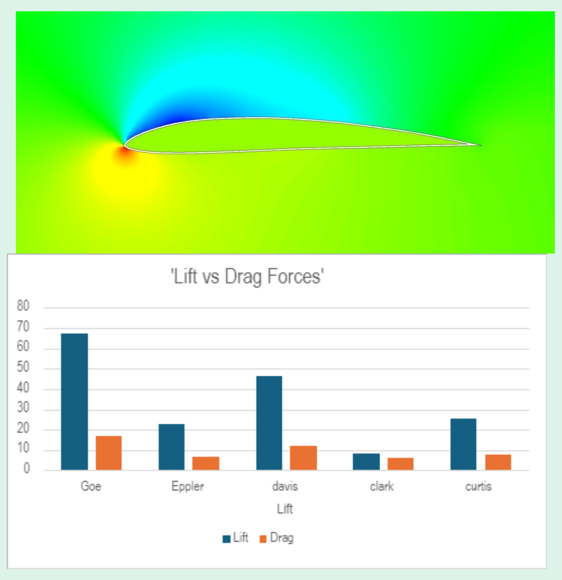
Project Goal/Requirements

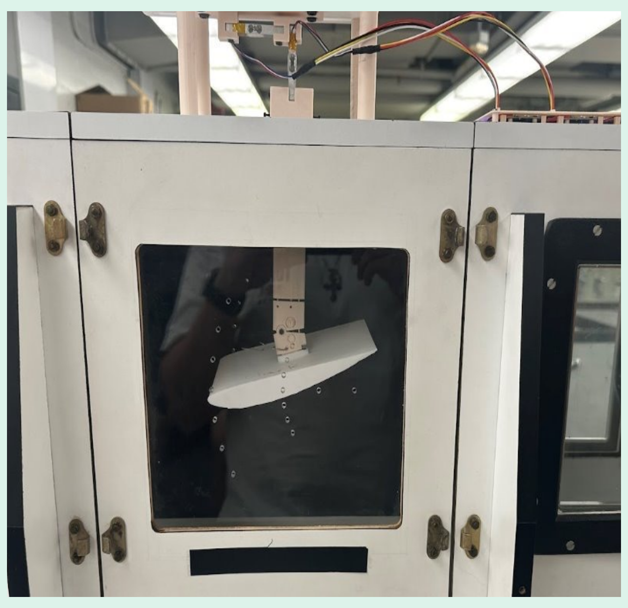
The primary objective of this project was to design and manufacture an aircraft frame entirely through 3D printing technology, with the goal of winning in the 3DPAC Cal state LA competition. The competition recognizes two categories: Innovative Design and Duration of Flight. The project requirements are that the aircraft's motor must provide thrust for a maximum of 8 seconds in which it is then cut off to begin gliding. After this the aircraft is required to then glide using the control surfaces to help it remain in the air. The field constraints require our aircraft to reach a maximum height of 35 ft with the field being 300ft x 160ft. Also, our team had a personal goal of having our aircraft be less than 500g.

Overall Design Approach

Our design approach for this aircraft was to first research a variety of different components, airfoils and general aircraft designs. In the beginning we performed simulation testing with many different airfoils which lead us to the GOE 723 which we believe met our requirements the best. Once research and simulation testing was complete, we then began creating preliminary designs which then lead us to prototyping using components we researched. After many design changes we then finalized our design and created a fully functional aircraft in which we are flight testing to practice our flight capabilities for the upcoming competition.

Simulations / Verification





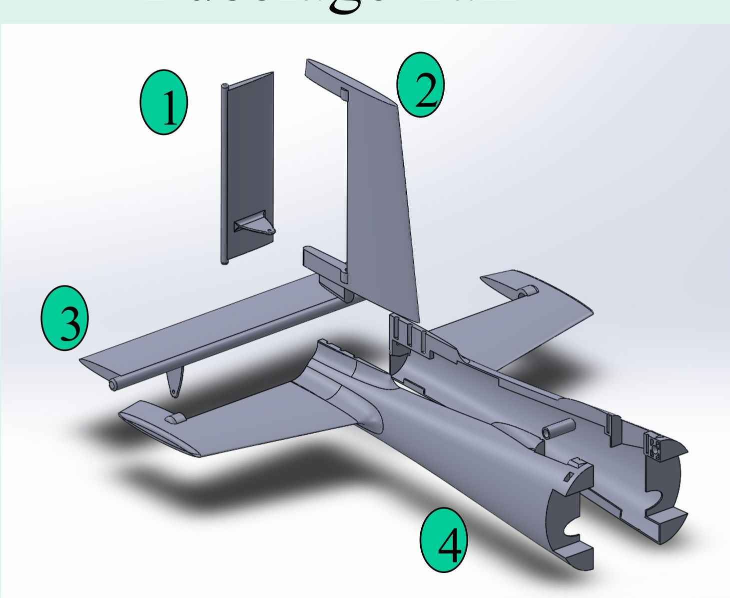
Prototyping

Final Design

Test flying/ Competition

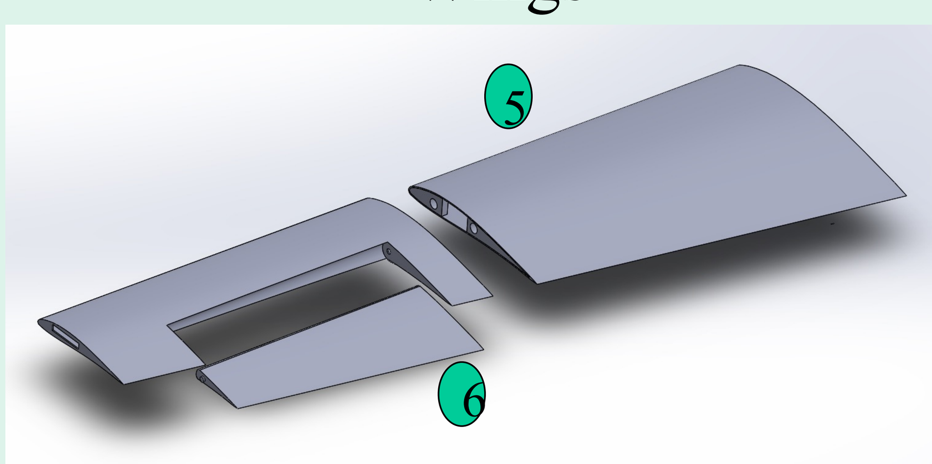
Results

Fuselage Tail



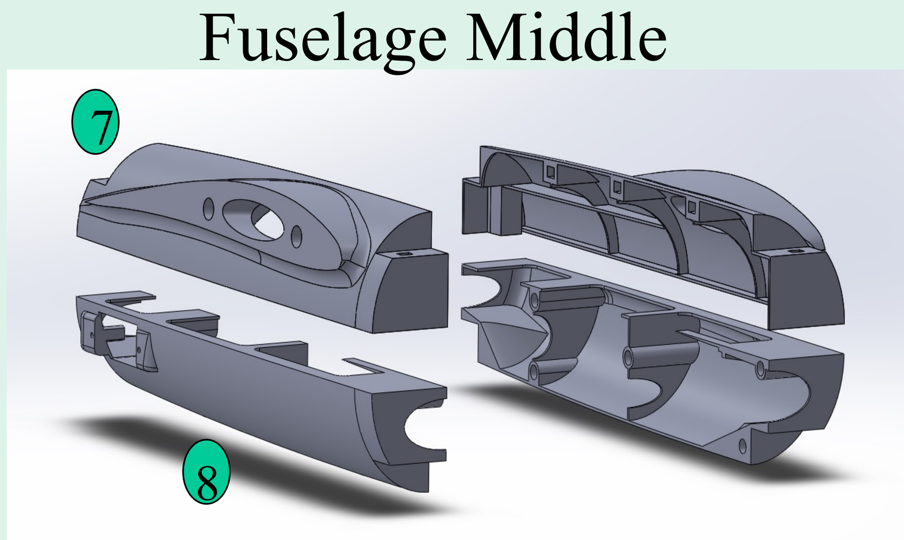
1 Rudder Flap (Yaw Axis)
2 Rudder
3 Elevator Flap (Pitch Axis)
4 Fuselage Tail

Wings



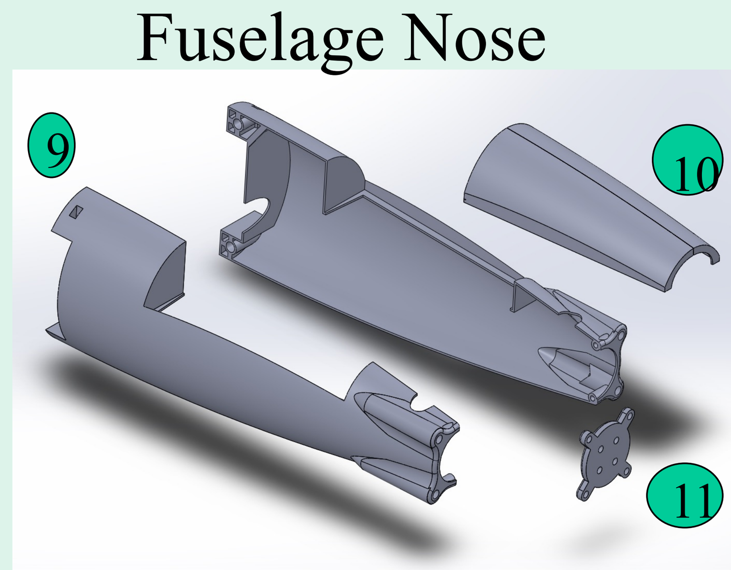
5 Wing (GOE 723 Airfoil)
6 Aileron (Roll Axis)

Fuselage Middle



7 Fuselage–Wing Connection
8 Fuselage Middle Underside

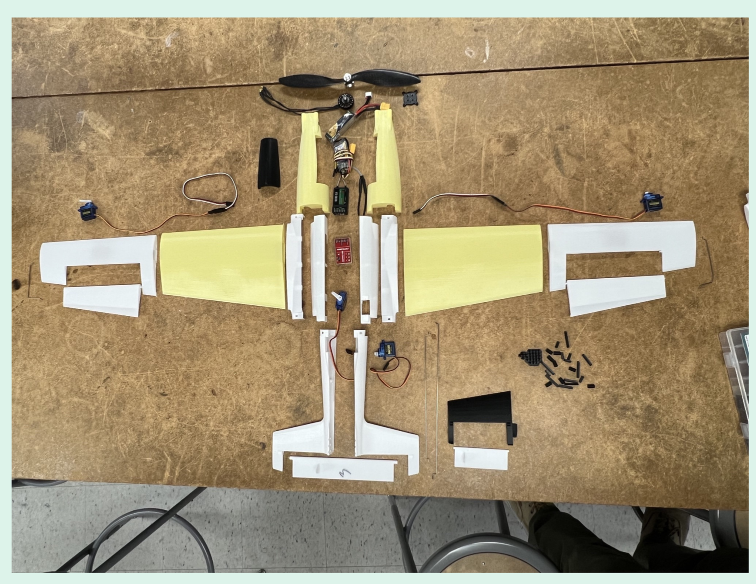
Fuselage Nose



9 Fuselage Nose
10 Fuselage Nose Cover
11 Fuselage-Motor Mount

Components	Model	Dimensions/Weight	Features
Battery	Tattu 3S Lipo Battery 11.1V 450mAh 3S 75C Lipo Battery	D: 62.99 mm × 16.00 mm × 21.08 mm W: 42.05 g	Lightweight, high C-rate output
ESC	20A 2-4S RC Brushless Motor ESC	D: 59.00 mm × 26.20 mm × 9.20 mm W: 33.78 g	Built-in BEC, supports 2-3S LiPo
Motor	iFlight XING 2205 2300KV 4-6S FPV Motor	D: 22.00 mm × 5.00 mm W: 29.42 g	High efficiency, lightweight
Receiver	Flysky FS-ia6b Receiver 2.4G 6CH	D: 39.88 mm × 20.07 mm × 12.95 mm W: 15.04 g	PWM-compatible, DSMX tech, telemetry
Gyroscope	SoloGood HOBBYEAGLE A3 Pro V2 6-Axis Gyroscope	D: 43.00 mm × 27.00 mm × 14.00 mm W: 10 g	Compatible with most standard PWM receivers, 32-bit MCU, 6 flight modes, 3 wing types
Servo	RC Servo SG90 9g Micro Servo	D: 22.8mm x 12.2mm x 20.5mm W: 10.96 g	High efficiency, lightweight
Propeller	Carbon Fiber Propeller	D: 251mm x 28mm	Lightweight, provides high trust

Our final prototype was able to successfully, effectively, and comfortably fly for over 10 seconds with power. The Final design weighs under 500 grams with all components and the usage of Bambu Lab's Aero PLA Series.



Conclusion

In conclusion, through numerous trials and design iterations, we successfully developed a fully 3D-printed aircraft that is now competition-ready. The integration of electrical components within the 3D-printed structure was thoroughly tested and proved effective. Extensive test flights were conducted, and we have now achieved a fully functional, flight-capable aircraft. We are confident that it is well-positioned to perform optimally and glide perfectly to compete for success in the upcoming competition in May.