SAE AERO Design Competition Micro Team

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Introduction

The SAE Aero Micro team was tasked with constructing a light-weight UAV style aircraft that can be quickly deployed from a small package and is able to carry a large, unwieldy low-density payload. Scoring for competition was to be determined by the ratio of carried payload to empty plane weight along with the time required to assemble the aircraft.

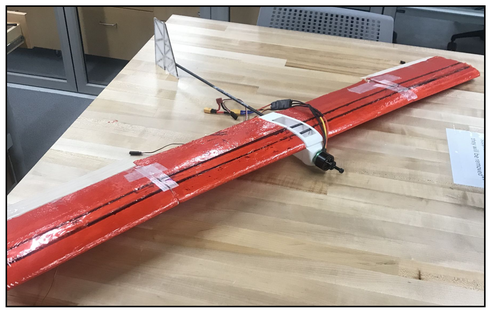

Figure 1 – Complete 2020 micro plane, *The Albatross*.

Design Decisions

The initial decision was made about the size of the plane. A larger plane would be able to carry more payload as it could generate more lift, but a smaller plane could be assembled faster, leading to a better assemble demonstration time. Considering both options, a plane with a 50 inch wingspan was chosen, as it was the smallest wingspan necessary to carry maximum payload.

The fuselage was 3D printed from PLA filament to give us more flexibility in terms of shape. The size of the fuselage was increased from last year's plane to provide an easier assembly. There were no moving parts on the fuselage, but a slot in the top where the battery could be accessed. The curved underbelly of the fuselage was for aerodynamic purposes, and made for a better handle when launching the aircraft.

The tail of the aircraft was a standard tail, with the exception that it did not have a rudder. The lack of rudder was spurred by feedback from the pilot who noted that he did not use a rudder when flying. Having a static vertical stabilizer allowed for a lighter aircraft by eliminating a servo motor and reducing the number of linkages.

With a total weight of 4.3 pounds after payload is added, the aircraft flew with a Cobra 2814/12 motor, which has an approximate thrust output of 52.9 ounces. The extra thrust made for an easier takeoff sequence and allowed the aircraft to carry more payload.

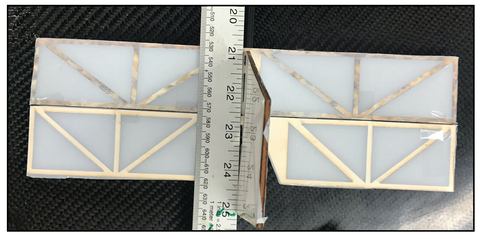

Figure 2 - Overhead view of the tail, displaying the horizontal stabilizer and elevator.

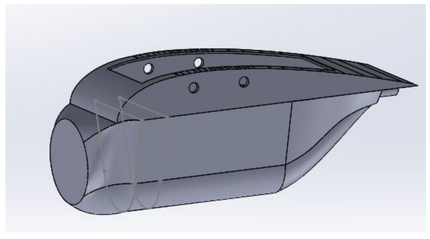

Figure 3 - SolidWorks model of the fuselage.

The Wing

Each material considered for the wing went through thorough trade studies, and the resulting best option was an Expanded Polystyrene foam with an Ultra-Coat surface. The foam was the lightest material and was durable enough to hold payload and survive an impact. Wing sections were connected to each other using headphone jacks, which were quick and easy to snap together, and to the fuselage via friction fit. The profile of the wing was an N-22 airfoil, chosen for its simplicity in construction and smooth under-surface for carrying payload.

Figure 4 - Cutoff area of the wing with headphone jack connections.

Figure 5 - View of the wing sections from above, including the headphone jacks, spars, and aileron.

Flight Testing

The aircraft was flown on March 2nd to see the progress of the plane in flight, and further diagnose more unknown issues. The set of flights revealed an issue with the wiring where control to the ailerons failed after takeoff as stress on the wings caused the wires to separate. After temporarily fixing this with some tape, in a second flight it was discovered that the unloaded plane had too high of a thrust to weight ratio, as the motor had been picked to lift a 4.3 lb aircraft and was moving an aircraft one quarter as heavy. This unnecessary thrust made the plane difficult to control, and after a short, wobbly flight, it crashed.

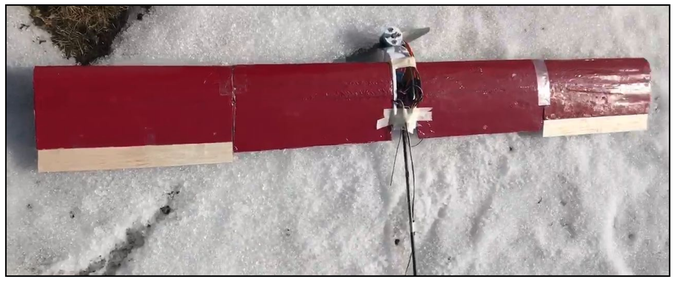

Figure 6– Plane with front of fuselage broken off after flight testing.

Conclusion

We were unfortunately unable to compete at SAE AERO International in 2020. During practice assembly trials, we managed to have the plane out of the box and together in 45 seconds. This would have added an extra 9.8 points to our final flight score. We did not have the chance to fly with payload, but based on feedback from our pilot, we were producing enough lift to be able to do so. However, without actually testing the plane with payload, it is not possible to give an accurate estimation of how we could have done.