3D Printed Aircraft Competition

Team MACH-3D

Department of Mechanical Engineering

2024 - 2025

San Diego State University

Project Overview

MACH-3D has designed, manufactured and tested a 3D printed aircraft within the rules and regulations of the California 3D Printed Aircraft Competition (C-3DPAC) which is hosted by Cal State Los Angeles.

The teams aircraft was designed for the three (3) separate competition in C-3DPAC; Flight duration, Aircraft Design and Simulation. The most defining requirements of C-3DPAC are that structural components of the aircraft must be 3D-printed; the aircraft is also limited to eight (8) seconds of powered flight and must stay within the boundaries of Jesse Owens Field (300'x160'x 30').

Meet the Team

Yumi Kawata
ME
Procurement Specialist

Noah Richards
ME
Team Lead

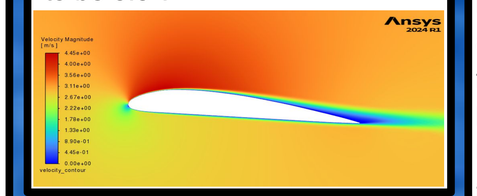
Sukhbir Randhawa
ME
Electronics Specialist

Tyler De Silva
ME
Materials Specialist

Jonathan Gurrero
ME
Solidworks Specialist

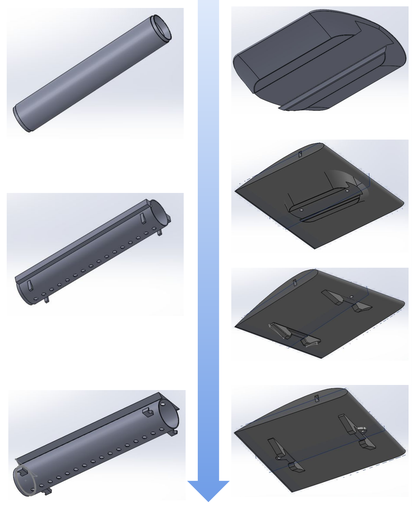
Simulations

ANSYS Fluent CFD (Computational Fluid Dynamics) simulations with our target airfoil (GOE 285) and anticipated environmental conditions helped us find the ideal angle of attack to be 5.3°.



Wing Mounting

Initial Design



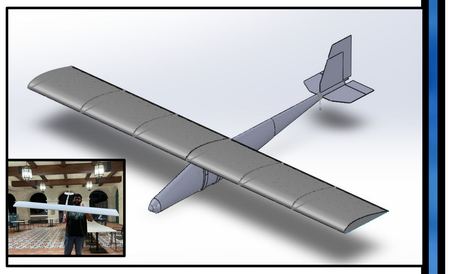
Final Design

Prototypes

The first prototype, named Mach 1 was made up of foam wings and tail, connected with a thin metal rod using duct tape.

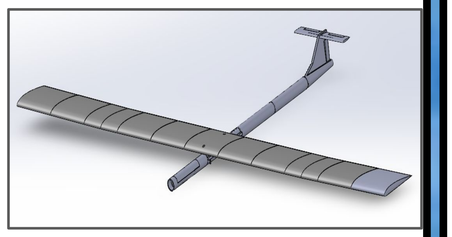
"Mach" 1

Mach 2 used a six airfoils with a conventional tail and the fuselage loosely based on the Night Radian RC plane. U-brackets were used to affix the wings to the aircraft which were found to slide during flight.



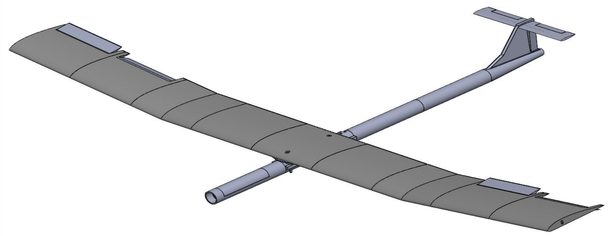
"Mach" 2

With Mach 3, the wings were adjusted to slide in and bolt into the fuselage. The T-tail increased stability, and the 11-airfoil, dihedral wingspan helped maintain greater lift and stability.

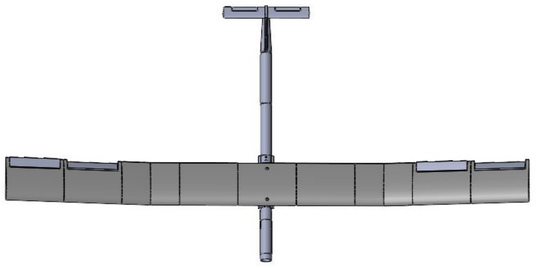


"Mach" 3

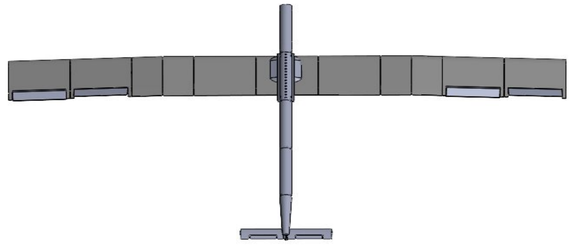
Final Design



Isometric View



Top View

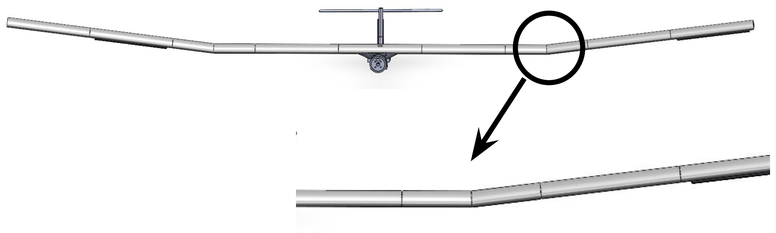


Bottom View

Design Decisions

- 7° Dihedral wings with Ailerons
- Fuselage upper rail system allows for wings to be shifted for Center of Gravity
- Wings constructed of PLA Aero
- Fuselage constructed of PLA Basic

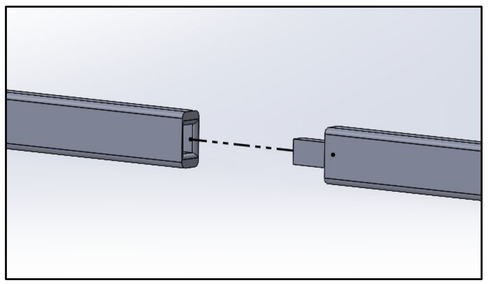
Dihedral Wings



The dihedral airfoil adds a 7° bend to each side of the wing. A dihedral wing design increases roll stability by causing the lower wing in a bank to generate more lift, helping the aircraft to maintain level flight. A traditional dihedral wing has its angle at the fuselage however MACH-3D's Team design has the angle located further on the wing increase surface area allowing the aircraft to glide more effectively.

Interconnecting Carbon Fiber Spars

The Interconnecting Spars were a design evolution after the team faced challenges with structural weak points between the spar parts. We had trouble finding the right fittings and sizes as changes in tolerance in 3D printing required us to experiment with many different iterations.



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