Who We Are

The University of Connecticut's American Institute of Aeronautics and Astronautics (AIAA) student branch is a fast growing group on campus. The branch's activities can be separated into three main categories: General Body, Design, Build, Fly, and Propulsive Landing.

General Body

At our core, we are an organization that strives to advance the professionalism of all those pursuing aeronautics and astronautics. In our view, this goes further than just our own membership. We aim to participate in outreach activities to help create future leaders in these industries.

During the Fall semester, 'Space Night' was set up at the Student Union in collaboration with Student Activities. This event was open to all UConn students and featured a plethora of space related activities. In total, around 200 students attended!

This past December, we were invited to give a presentation to students at John Wallace Middle School (JWMS) in Newington, CT. We gave an overview of our organization, our experiences in college, and various concepts of rocketry and aircrafts. At the end of the presentation, the students participated in a paper airplane competition.

Members Hunter and Will (Front) presenting to JWMS.

To further our outreach efforts, we connected with UConn's National Society of Black Engineers (NSBE) to assist in a NSBE Jr. (K-12) program. This program gave us the opportunity to teach a group of early high school students how to code autonomous drones. At the end of the program, they had made a drone takeoff, land, and fly a predetermined flight pattern using Python.

Member Nathan (Right) with NSBE Jr. members (Left).

Outside of outreach, the General Body also holds professional development seminars at different points across the semester. One such seminar includes an internship panel of senior branch members with previous internship experience. This is a great way for younger students to learn more about how internships work and how older members obtained them.

One of the goals of the General Body meetings is to help facilitate connections between industry leaders and students. This past academic year, we invited a guest speaker from SpaceX. He gave a talk on his career path; from being an engineer at UConn to landing a job at SpaceX.

The branch's most recent undertaking has been setting up a mentoring program. This new program works to directly pair Junior/Senior members with industry professionals. The CT Section of AIAA graciously provided us with volunteer mentors who were then paired with 1-3 student members. So far, the program has been a big success with initial feedback being overwhelmingly positive. We expect to continue this program next year as seniors graduate and new members join.

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Design, Build, Fly

Research

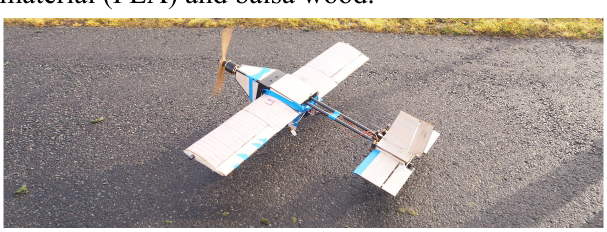
The 2022-23 Design, Build, Fly (DBF) challenge was to build a plane capable of being fully deployed from a TSA sized suitcase. The team immediately went to work buying the largest suitcase we could and setting the length to our wingspan. Additionally the suitcase had to include an extra set of wings that could be used interchangeably with the main pair.

From given constraints, we sized our plane configurations and aerodynamic surfaces. This year, we began using a software that we saw was common amongst other winning teams, XFLR 5. Many days were spent running through the documentation, but eventually we were able to build our plane in the software. XFLR 5 allows us to view different stability characteristics based on our design of the aircraft.

Lastly, one of the missions involved placing an antenna vertically on one side of the wing. In turn, our team used ANSYS CFD to determine the effect of drag for different antenna lengths.

Manufacturing

This was our first year reaching the competition stage of the DBF annual challenge. Along the way, we had plenty of manufacturing difficulties to overcome. While our classes prepare us for the aerodynamic analyses, the only way to learn in manufacturing is trial and error. We used a CNC router to cut polystyrene wings. Epoxy and fiberglass were then used to seal and add strength to the wing. The fuselage and tail of the plane were built using a combination of 3-D printed material (PLA) and balsa wood.



First aircraft rendition and taxi test.

UConn DBF 2023 Competing in Tucson, Arizona.

Competition

Meeting other teams working on the same design challenge was an extremely worthwhile experience. We were beyond amazed with all the techniques and tools that different teams utilized in building their planes.

Sadly due to some last minute design changes to minimize weight, we failed safety inspection making us ineligible to fly. However, this allowed us to enjoy the competition and truly learn from other teams. We became very close with the team from the University of Massachusetts Amherst, eventually setting up times to meet next year to test each other's planes before competition. Ultimately, we believe we will use a Spread Tow Carbon Fiber that San Diego State University's team recommended instead of epoxy fiberglass.

Aside from competition, the UConn DBF team had a great time exploring a completely different area of the country. We ate great food every day, transversed Saguaro National Park, and finished up some homework by the pool! The team bonded through it all and now have big dreams for next year's plane. Goal for 2024: finish Top 25% of teams at the competition in Wichita, Kansas!

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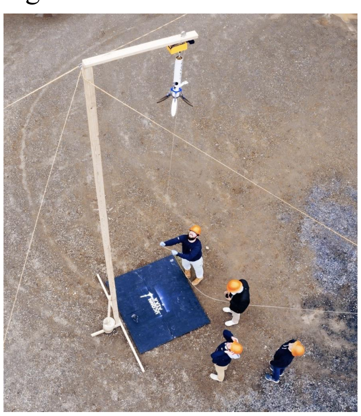
Propulsive Landing

The Mission

The Propulsive Landing (PL) Project is a first of its kind collegiate level team dedicated to actively controlling and softly landing model rockets using thrust vector control. Inspired by the SpaceX Falcon 9 booster landings, our team has steadily innovated unique mechanical, electrical, and software solutions to perform effectively at the model scale. This past year, we tested these systems through multiple drop tests and we will attempt to perform launch and land testing this upcoming year.

Drop and Land Test

The primary mode of testing this past year, drop tests, are critical to determining the viability of all systems. In this test, the rocket is dropped from a height of approximately 10 meters. The flight computer will then command ignition of its rocket motor and use the thrust vector control system to ensure stability as it descends; such that a soft landing is achieved.



Drop and Land Test tower at Ashford Memorial Park.

Launch and Land Test

Launch and Land Test represents the next critical step in determining the viability of our rocket systems. This test consists of two stages. During the first stage, we ignite the rocket from the ground, and once it reaches its apogee, it transitions into the second stage. In the second stage, our active stabilization system comes into play, allowing us to safely land the rocket by igniting the second motor in a manner similar to that of the drop and land tests.

Apr. 30, 2023. Successful stabilization during drop test.

Testing and Results

Our club conducted six drop tests this year, each building on the progress made previously. During the last few tests, we achieved a very low angular error; however, there was lateral velocity present in the rocket that caused it to not land properly. This was due to the fact that we did not control for velocity, and this is something we will improve upon next year. Further consideration will be put towards the shock-absorbing landing legs as well.

Avionics Sub-team

The avionics team is responsible for the following components:

- **Flight Computer -** A printed circuit board that connects our Raspberry Pi to all the electronics needed for flight.
- **Peripherals -** Selection and management of our peripherals such as the radio module, Inertial Measurement Unit sensor, camera, and servos.
- **Flight Software -** The software that runs on the rocket. Written in C++.
- **Navigation & Control -** Algorithms to track attitude and position and calculate appropriate actions in order to safely land the rocket.

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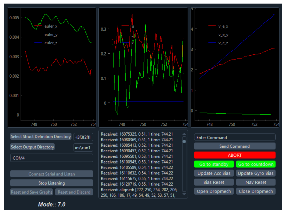
- **Ground Control Center (Right) -** An application to read live telemetry from, and send commands to, the rocket. Written in Python.

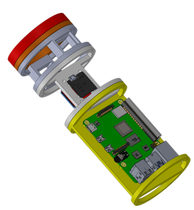


This year, the avionics team designed and built a new flight computer using a Raspberry Pi, which replaced the Arduino used previously. This replacement required that we rewrite much of the code base, which gave us an opportunity to improve code quality and readability. Another improvement made was the enhancement of control system tuning by adopting a more systematic approach. This involved conducting a multivariate analysis in Simulink to evaluate the performance of our control system.

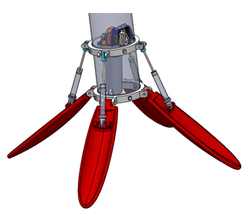
Mechanical Sub-team

The following systems fall under the purview of the mechanical team:

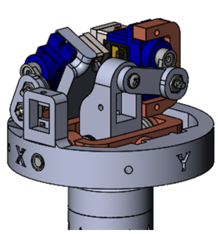
- **Avionics Bay (Right) -** The housing that contains the flight computer and other electronics.



- **Landing Legs (Right) -** Four 3-D printed PLA landing legs with integrated shock absorbers forming a dynamic, unfolding mechanism. Stainless steel structural support elements enable proper stress management under a wide range of spatial offset that ensure a soft landing every time.



- **Thrust Vector Control (Right)-** A four bar linkage system actuated by servos in order to redirect thrust in a desired direction.



- **Landing Pad -** A fiberglass platform for landing with attachment points for LEDs that are used for computer vision calculations.
- **Camera Mount -** A mount to attach the camera to facilitate computer vision based positioning.

Due to the changes in our flight computer, our avionics bay needed to be redesigned, which was successfully accomplished. We also improved our design of the landing legs to increase landing reliability and leg durability. The camera and camera mount was a new addition to the rocket which enables data collection for future computer vision systems.

What's Next

We will continue to use drop and land tests to validate our design iterations while we prepare for our first launch and land test. We look forward to sharing more updates in the near future!

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Thank you to everyone involved for your continued support! Without your help, none of this would be possible!

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