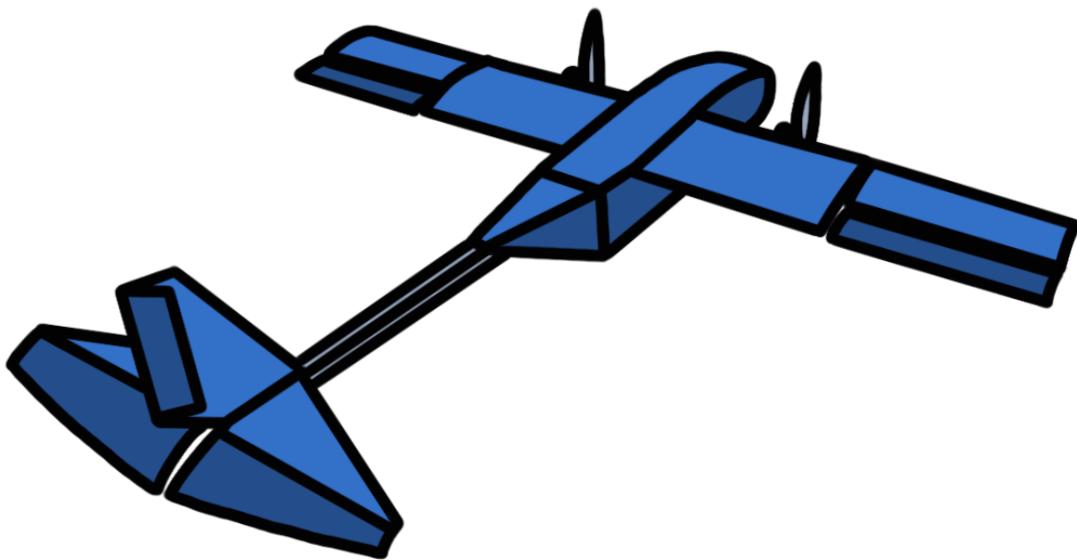


# Thomas Jefferson Unmanned Aerial Vehicle Club



## Sponsorship Information 2022-2023





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# Our Team

The TJ Unmanned Aerial Vehicle (TJUAV) Club aims to teach students about the basics of aeronautical engineering, flight, and programming by designing and manufacturing an autonomous aircraft for the annual, international, and collegiate Student Unmanned Aerial Systems (SUAS) Competition. The team uses a fixed-wing aircraft, payload deployment system, custom ground station, PID flight computers, and computer vision to achieve autonomous navigation, object detection & classification, and payload delivery.



**Left** The TJUAV team at the 2022 AUVSI SUAS Competition.

**Above, Top** Seven members of the original TJUAV team holding the X8, a flying wing, while at the testing field.

**Above, Bottom** Avalon Mk 3.5 in flight.



# The Competition

AUVSI SUAS is an international, collegiate competition that has hosted over 75 teams in recent years. AUVSI's mission is to simulate an unmanned search and rescue situation.

**The competition will be held at St. Mary's County Regional Airport in California, Maryland in June of 2023.**

There are three deliverables:

## Technical Design Paper (20%)

The Technical Paper is a rationale for and technical overview of the system design.

## Flight Readiness Review (20%)

The Flight Readiness Review is an introductory video showing the team, system design, and capabilities.

## Mission Demonstration (60%)

The Mission Demonstration is a live demonstration of the UAS's ability to perform competition tasks in a restricted timeframe. These tasks include autonomous flight through waypoints, maneuvers around obstacles, detection and classification of ground targets using onboard imagery systems, and submission of live telemetry data to the competition servers.



### TJ UAV - Avalon Mk3.5 Technical Design

AUVSI SUAS 2022 - Thomas Jefferson High School for Science and Technology

#### Abstract

This document lays out the process the Thomas Jefferson High School for Science and Technology Unmanned Aerial Vehicle Team (TJ UAV) took to create the Avalon Mk3.5 aircraft. This system is capable of flying autonomously, detecting and interpreting targets, and delivering payloads to a drop zone while maintaining safe operation. Twenty high school students specialized in various fields, including aerospace, physics, mathematics, and computer science came together to make the team's second AUVSI SUAS competition a success.



Top The Avalon Mk 3.5 Technical Design Paper.

Middle The 2022 Flight Readiness Review Video on YouTube.

Bottom The team's setup at the 2022 AUVSI SUAS Competition.



# Recent Accomplishments

## 2022

At the beginning of 2022, the team began constructing Avalon Mk 3.5, the last iteration of the Avalon series. Avalon Mk 3.5 utilized 3D-printed components clamped to an aluminum spar for maximum modularity, and its wing consisted of a laser-cut, plywood rib and truss structure covered by Doculam, a laminate covering.

In June, the TJUAV team competed in the 2022 AUVSI SUAS Competition with Avalon Mk 3.5 at St. Mary's County Regional Airport. The team placed 23rd out of 71 schools and represented one of three high schools that attended the competition. TJUAV also placed 18th in Mission Demonstration, 19th for their Flight Readiness Review video, and 11th for their Technical Design Paper.



Above, Left Avalon Mk 3.5 at the field.  
Above, Right The TJUAV team at the 2022 AUVSI SUAS Competition.

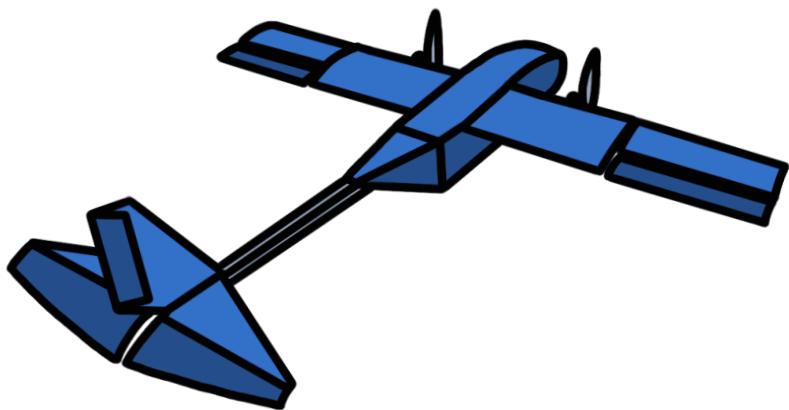
Left The teams that competed in the Mission Demonstration at the competition.

## 2023 & Beyond

The team is now focused on building their next plane for the SUAS 2023 Competition, which is scheduled to take place from June 20-22.



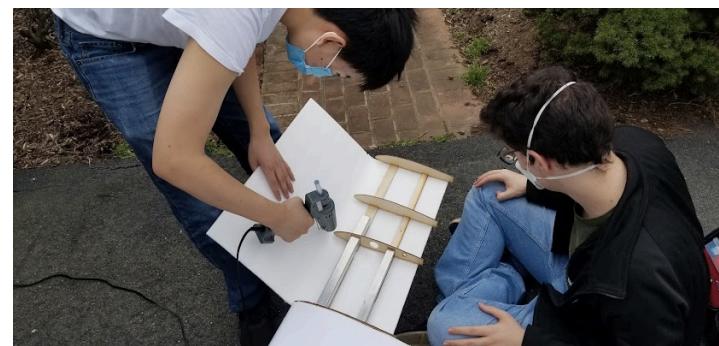
# How We Got There





September, 2020 - June, 2021

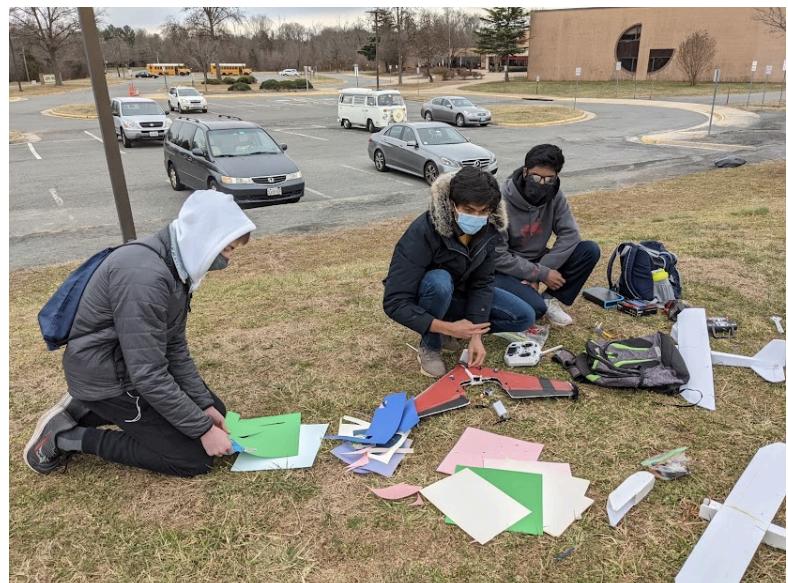
# Building Avalon Mk 1





# Winter Fun Fly

January, 2021





# Testing Plane

September, 2020 - June, 2021



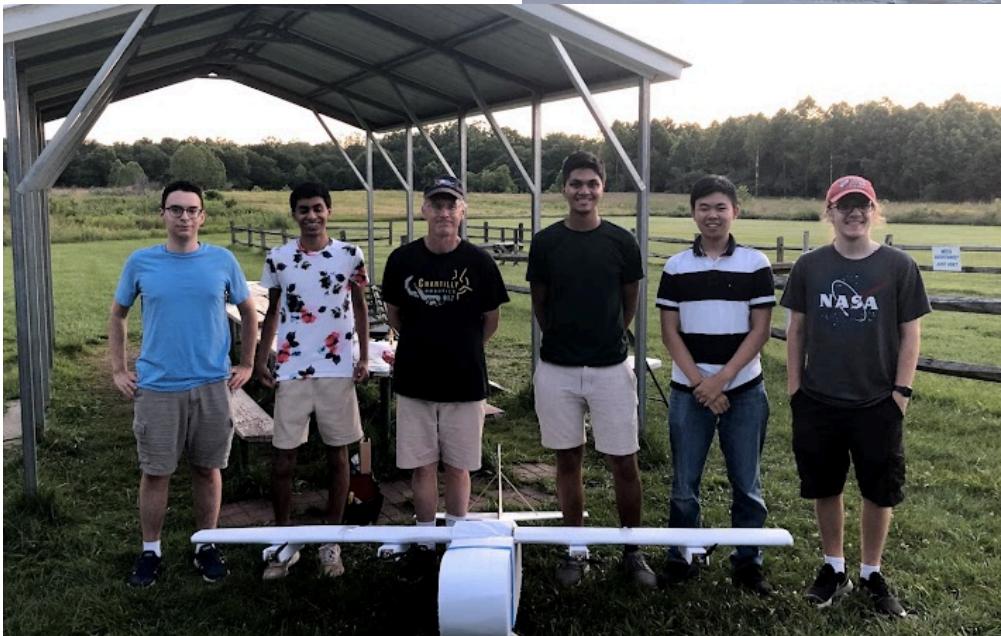
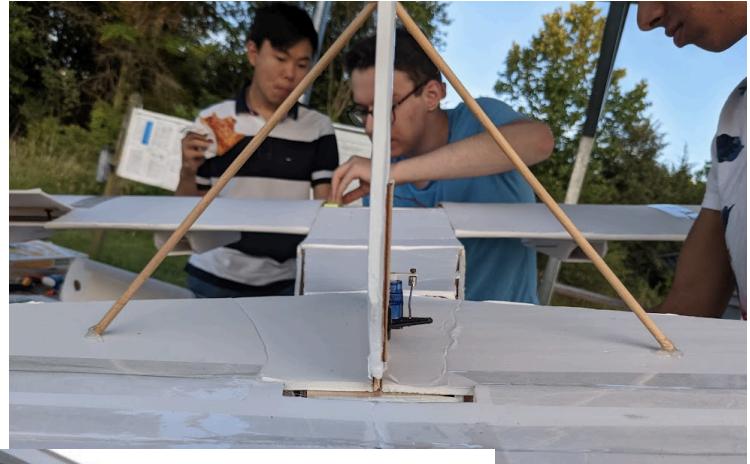


# Avalon Mk 1

## Test Flight



July, 2021





# Successful Avalon Mk 2 Test Flight

October, 2021





# Avalon Mk 2

# Crash Flight

October, 2021

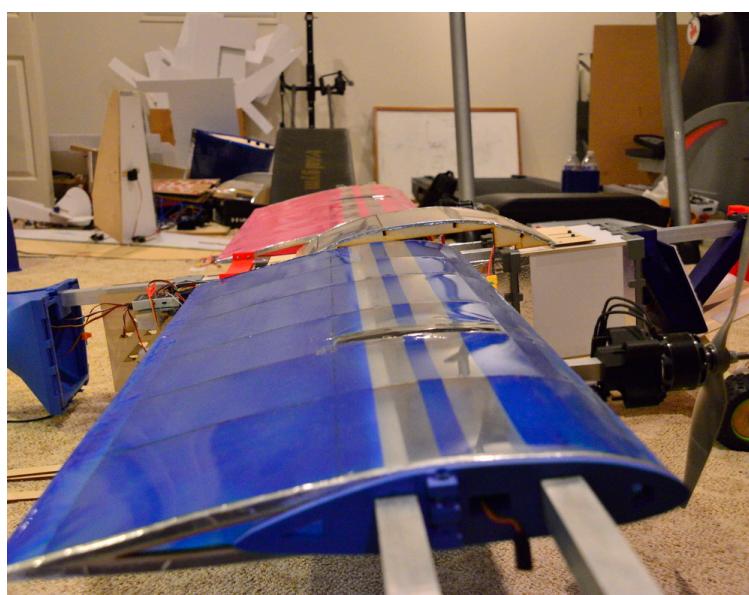
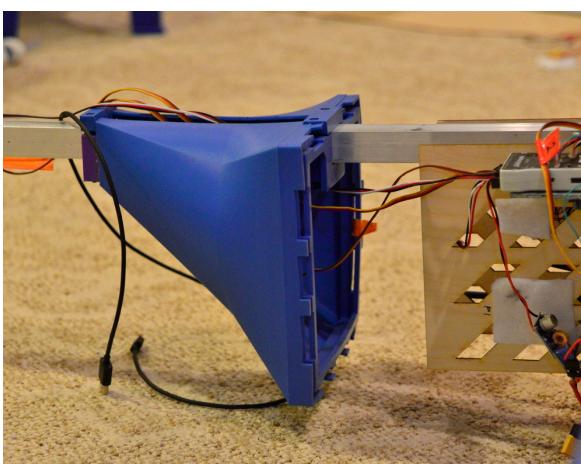
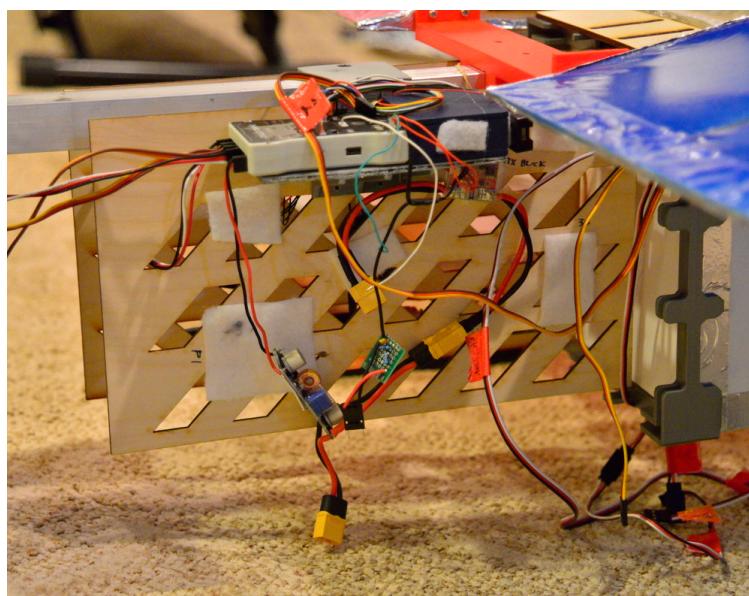
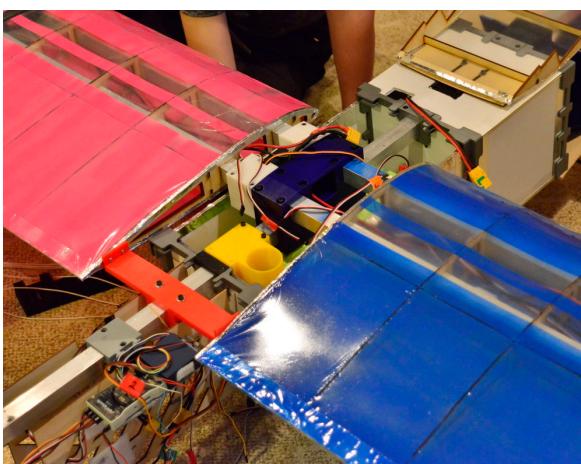




# Avalon Mk 3.5

## Close-Ups

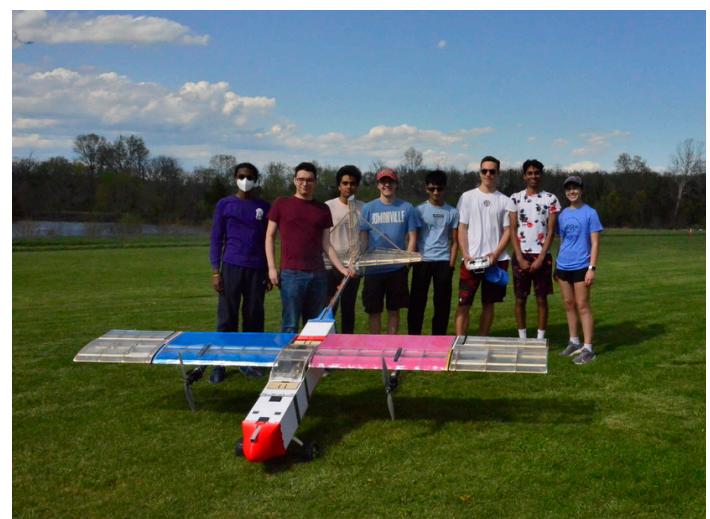
May, 2022

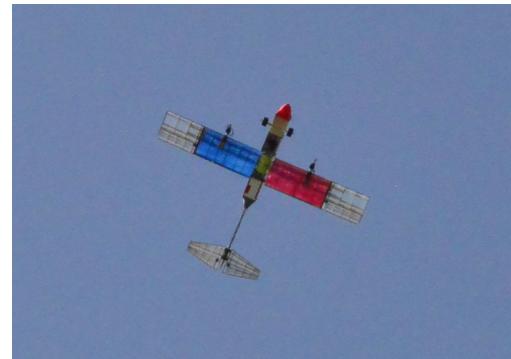




# Avalon Mk 3.5 At the Field

May, 2022





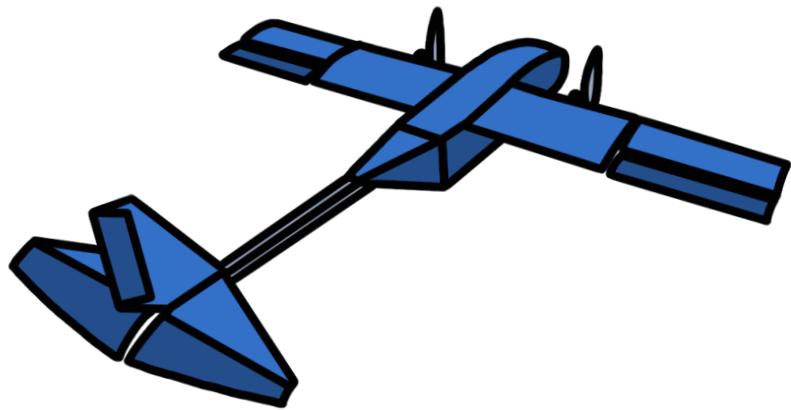
# 2022 AUVSI SUAS Competition

June, 2022





# About the Team





# Mechanical Subteams

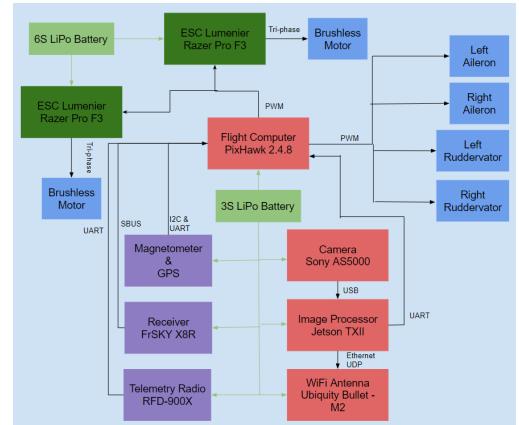
## Airframe

The Airframe subteam evaluates mission requirements to design and build an airframe that best meets the competition objective. The subteam plans plane components with CAD software, such as Autodesk Fusion 360, and realizes the designs by 3D printing, laser cutting, and assembling different parts of the airframe.



## Electronics

The Electronics subteam is responsible for organizing and wiring the electronics in the aircraft to allow for proper power distribution and wired communication between components. They also configure electronics in the ground station, such as the antenna tracker, telemetry antennas, and router, that connect all of the ground station computers together.



## Payload Deployment

The payload deployment subteam designs and builds a system that is capable of delivering a standard 8oz water bottle to a target location. Additionally, the payload deployment subteam must design a drop mechanism so that the payload lands safely and is as close to the specified location as possible.

**Top** Plywood wing manufacturing being tested for feasibility.

**Middle** Systemic electrical diagram for the plane.

**Bottom** UGV testing on tabletop.



# Programming Subteams

## Autopilot

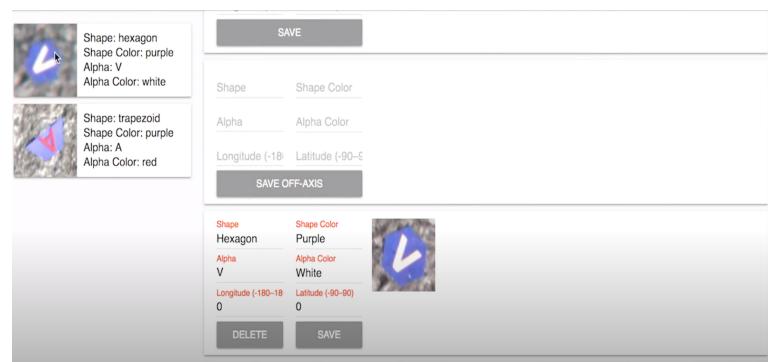
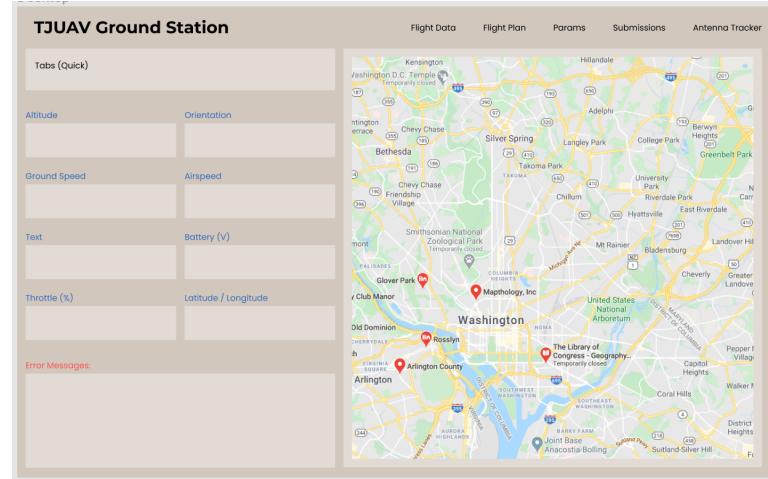
The Autopilot subteam programs and tests a system that can fly the aircraft without the need for human intervention. They also work with the ground control station to plan a flight path that hits all of the waypoints while avoiding obstacles.

## Communications

The Communications subteam designs and programs a method to wirelessly relay data between the aircraft and ground station so that the plane can be tracked by the ground station at all times. They also communicate with the competition server to submit telemetry data and any targets that are found.

## Imaging

The Imaging subteam programs an algorithm to capture images in flight, parse them, and return useful information to the ground station. Additionally, they program a computer vision algorithm that is used to autonomously detect the presence of targets in the aerial images and classify them.



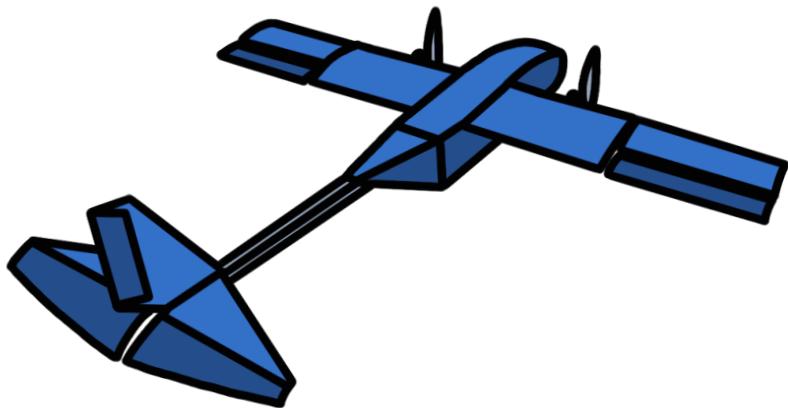
**Top** Custom-made ground station software during development.

**Middle** Human verification system for computer-recognized targets.

**Bottom** Training target data.



# Past Accomplishments





# Past Accomplishments

## 2019

AUVSI SUAS 2019 was TJUAV's first time competing. The team developed the Razgriz, a Skywalker X8 airframe that was modified to fit radios in the fuselage for communication and a camera in the nose for imagery.

Out of the 75 teams competing at the 2019 AUVSI Competition, TJUAV placed 23rd overall and 18th in Mission Demonstration. The team achieved over 20 minutes of flight at the competition.



## 2020

The team developed Hyperion, a Skywalker Titan airframe that was modified to fit a UGV payload drop mechanism, radios for communication, and a camera gimbal for the imagery system.

Due to the threat of COVID-19, the 2020 AUVSI SUAS competition was cancelled.



**Above** The Razgriz doing the Mission Demonstration.  
**Left** The Hyperion before flight at the testing field.



# Past Accomplishments

## 2021

The team constructed the Avalon v1, the first plane entirely of their own making.

The team also developed a testing plane to gain building experience and assist the programming subteams with gathering training data.



Due to the threat of COVID-19, the 2021 AUVSI SUAS competition was cancelled.

## 2022

At the start of the school year, the team modified Avalon Mk 1 by interchanging its foam board wings for a monokote covering, a plastic shrink wrap material.

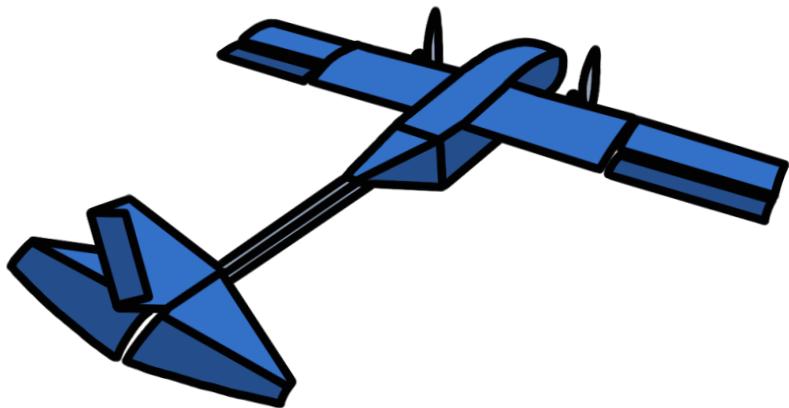
After a mechanical failure that led to crashing Avalon Mk 2 at a recent test flight, the team decided to switch gears and use previous experience to design a more efficient and compartmentalized aircraft.



**Above** Avalon v1 after a successful test flight.  
**Left** Avalon v2 before a test flight at the field.

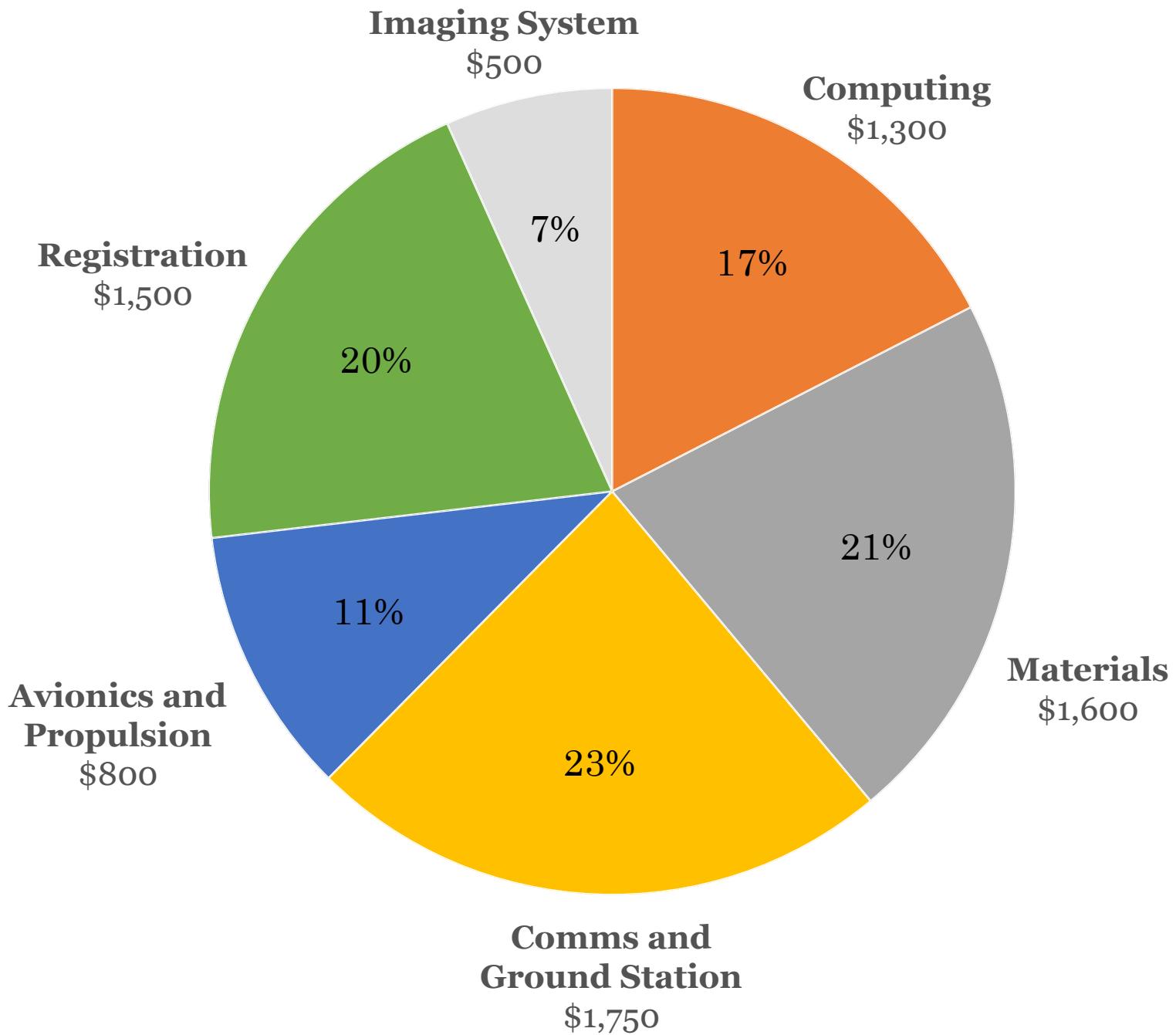


# Future Directions





# Projected Expenses



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**Total**  
\$7,450



# Why Contribute

## **By contributing, you will:**

- ✓ Support a 501(c)(3) nonprofit
- ✓ Help provide necessary funds for an elaborate UAS in the future
- ✓ Promote the learning of 30+ high school students and the greater community
  - ✓ Thomas Jefferson (TJ) Techstravaganza: An outreach program hosted by TJ for elementary and middle school students. Every year, we TJUAV sets up a booth to demonstrate the use of RC aircraft and allow younger students to further explore STEM
- ✓ Promote your company to high school and college students who will soon be entering the workforce

# Sponsorship Benefits

## **Upon any donation, sponsors will receive:**

- ✓ Your logo on our team shirt
- ✓ Your logo on our website
- ✓ Your organization's name on our competition deliverables: Technical Design Paper, Flight Readiness Review video, promotional video, and competition plane

# Contact Us

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