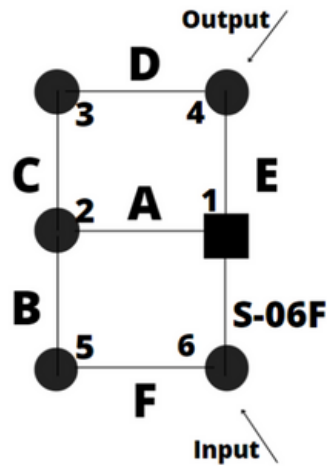
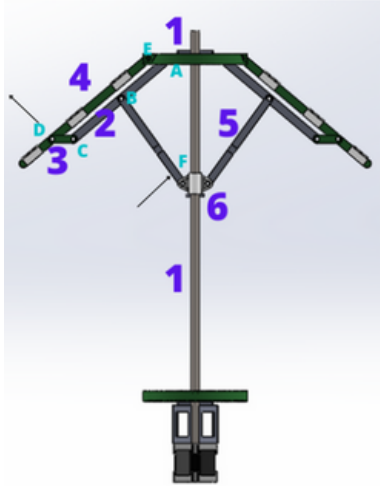


## DEPLOYABLE FIN MECHANISM



### What?

- Design and fabricate a **one-degree-of freedom** mechanism that deploys fins through a servo motor that is controlled via a switch and an **Arduino** board

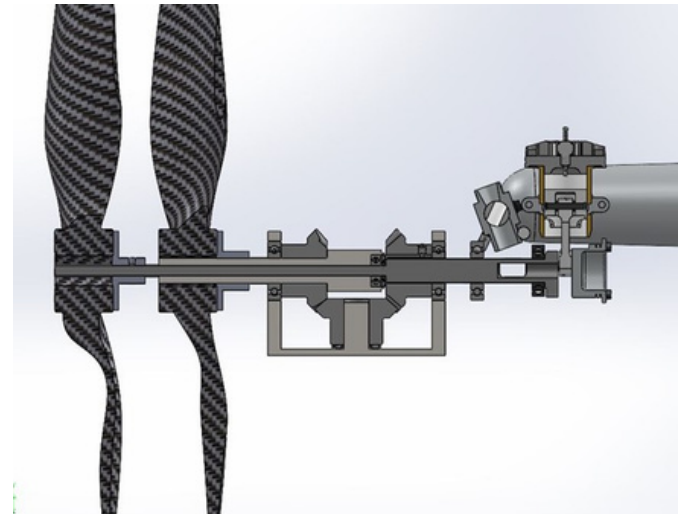
### How?

- Used **SolidWorks** to design this
- Constructed through **3D Printing** tolerance parts and off the shelf threaded rod, servo and screws.

### Results

- Using the **change point** for the mechanism as the locked position, the maximum output angle of the fins were **66.81 degrees**.

## CONTRA-ROTATING PROPELLER AND GEARBOX



### What?

- Design of contra-rotating propeller and gearbox system for RC plane.
- Analyze** the effect of material selection with respect to the life cycle of the motor through **Sodaberg** and **Goodman** failure analysis

### How?

- Designed on **SolidWorks**
- Selection of parts were done through McMaster-Carr to assure that this product could be constructed if budget permitted.

### Results

- A safety factor of **2** was successfully achieved for each part of the system.
- Implemented **DFMA** principles to reduce overall part production cost

# FRANK ALVAREZ

MECHANICAL ENGINEERING AT THE UNIVERSITY OF SOUTH FLORIDA



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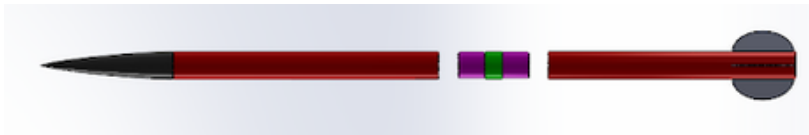
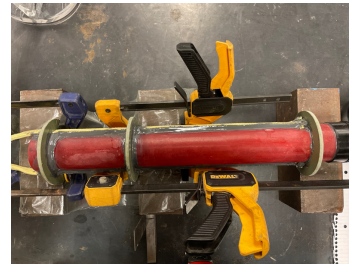
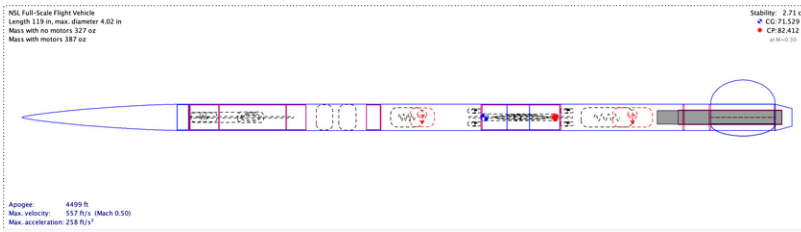


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## NASA STUDENT LAUNCH FLIGHT VEHICLE



### What?

- **Design, manufacture, and assemble** a reusable solid motor rocket that can transport the payload system to its mission target.

### How?

- Rocket Stability software was used to verify and improve design
- **Solidworks** modeling to fit payload and avionics system.
- **CNC machining** and **resin curing** to assemble competition rocket

### Results

- Flight ready vehicle to be used in the NASA competition with proper space for the recovery system and payload system.

## MATLAB SCRIPT FOR ROCKET RECOVERY SYSTEMS

```
1 % Drogue Calcs
2 clc, clear
3
4 fprintf('~~~~~DROGUE DEPLOYMENT INFO~~~~~ \n' );
5 fprintf('\n' );
6
7 % Inputs
8 D_inch = 15; %inches
9 m_lb = 23.2; % lb
10 Cd = 1.5; % Drag of parachute
11 Apogee = 4500; %ft
12
13
14 D = D_inch*0.0254; % meters
15
16 % Surface Area
17 A = pi*D^2/4;
```

Command Window

~~~~~DROGUE DEPLOYMENT INFO~~~~~

The velocity with the drogue parachute is 102.971358 ft/s

The TIME it takes to reach main deployment from apogee is 37.874610 seconds

The kinetic energy of the rocket is 3819.750520 ft-lb

~~~~~MAIN DEPLOYMENT INFO~~~~~

The velocity with the main parachute is 19.981297 ft/s

The total kinetic energy of the rocket is 127.091161 ft-lb

The kinetic energy of the upper body tube is 65.119283 ft-lb

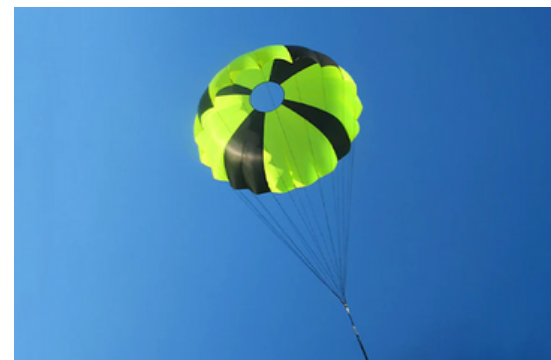
The kinetic energy of the upper body tube is 17.816217 ft-lb

The kinetic energy of the Booster tube is 44.261193 ft-lb

The descent TIME from 600.000000 feet is 30.028081

~~~~~TOTAL DESCENT TIME~~~~~

The total descent time is 67.902690 seconds>>



### What?

- Adjustments to rocket weight and desired altitude can change **recovery dynamics**.
- Develop a rapid way of **testing** main and drogue parachute sizes without doing hand calculations.

### How?

- The equations that relate a parachute's coefficient of drag, diameter, and velocity were coded using **MATLAB** to find the flight vehicle's **velocity, kinetic energy, and descent time**.

### Results

- The calculated descent time was on average **2-3%** lower than actual time due to the variation in wind speeds.

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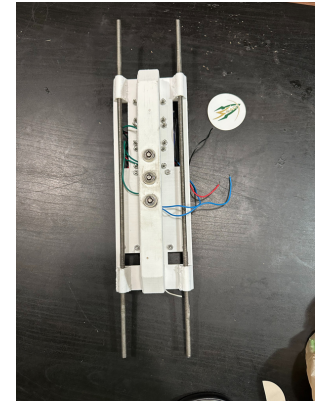
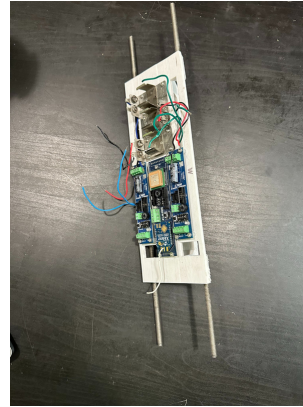
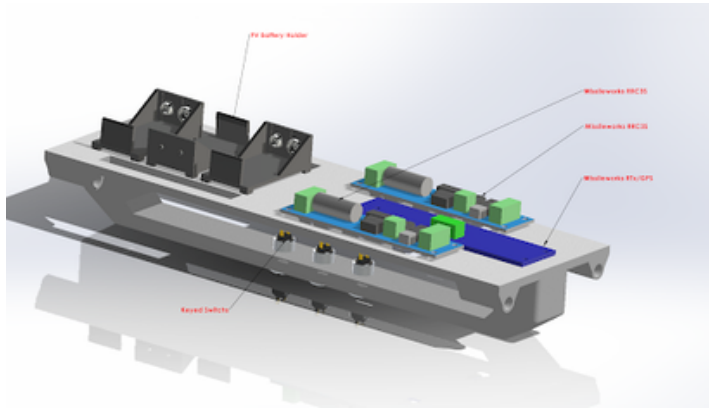


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## AVIONICS SLED DESIGN



### What?

- **Design** a sled to mount sensitive avionics equipment to withstand the flight time of the rocket.

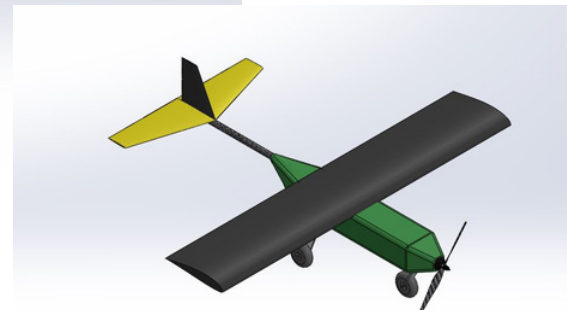
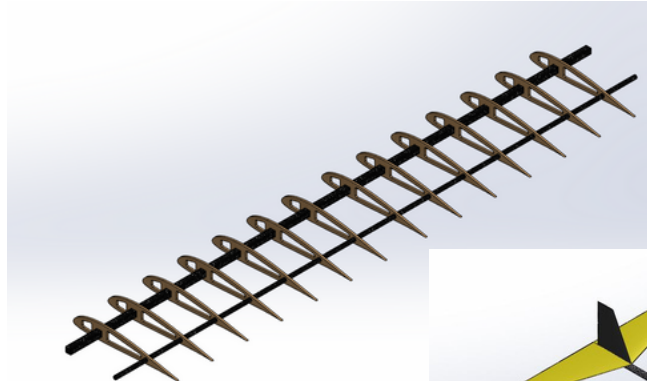
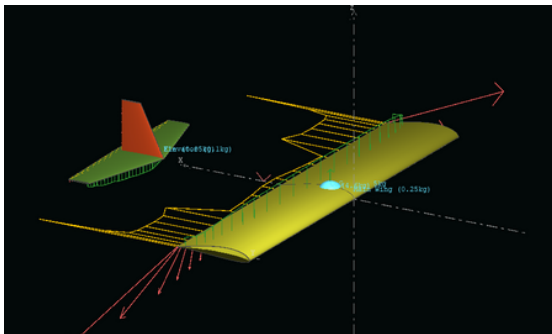
### How?

- Used **Solidworks** to design the sled and model avionics electronics
- **3D Printing** of the avionics bay provided a cost effective solution to the manufacturing of the sled.

### Results

- **Vibration** testing and **flight** testing verified the effectiveness of the sled design.

## DESIGN, BUILD, FLY



### What?

- Create a RC electronic plane from the **ground up** to fit the given mission requirements

### How?

- **XFLR5** software was used to give estimate of stability of plane design and flight characteristics.
- Used **solidworks** to create sub-assemblies, attachment points and **FEA** analysis.

### Results

- Current design is being manufactured through **CNC** milling of foam, **plasma cutting** of metal brackets, and a **carbon fiber-resin** skin will be laid on external stress points to **minimize** wing flutter.