NASA Student Launch

Aerospace Engineering Senior Design 2022-2023

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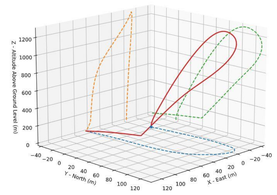
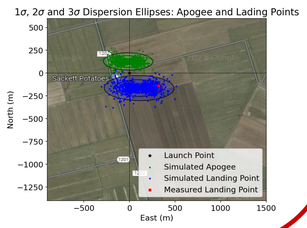
Course Instructor: Dr. Ewere | Section Instructor: Vivek Mohan | Customer: NASA

Mission Performance

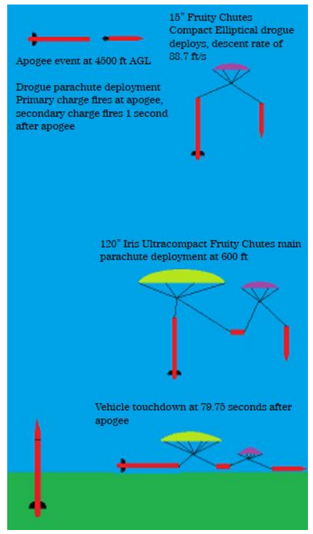
The designed launch vehicle utilizes an AeroTech L1520T Motor and has a projected stability of 2.16 at rail exit and weight of 41 lbs. The vehicle has a thrust to weight ratio of 8.35 and will descend from apogee in 79 seconds. Simulation software such as Rocksim and RocketPy were utilized to simulate these results. RocketPy generated rail button optimization and vehicle flight path based on Monte Carlo Dispersion Analysis shown to the right.

Target Altitude: 4500 ft.

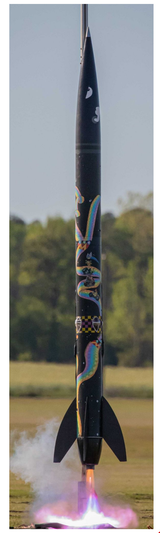




Concept of Operations



1) Vehicle is launched
2) Vehicle reaches apogee and drogue parachute is deployed via black powder
3) Main Parachute deploys via black powder at 600ft.
4) Upon landing, payload starts receiving APRS commands
5) IMU determines which camera is upwards
6) APRS Commands are sent to selected camera and servo
7) Camera rotates, captures, and saves images



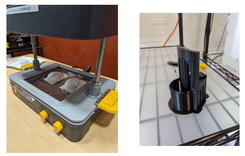
Manufacturing

Launch Vehicle

- Airframe made of G12 fiberglass.
- Fins were a balsa wood sandwich composite
- All permanent connections were epoxied
- All hardware purchased from manufacturers

Payload

- Structural components 3D printed in PLA
- Components secured using bolts and epoxied connections
- Camera housings vacuum formed



Testing

Launch Vehicle

- Bulkhead Stress Test
- Fastener Shear Test
- GPS test
- Altimeter Test
- Composite Fin Bending Test

Payload

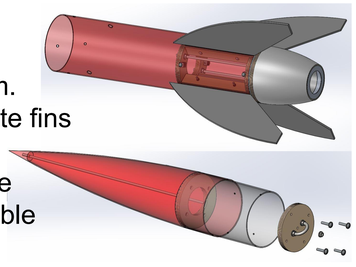
- Camera Clarity Test
- RAFCO test
- Payload Structural test
- Servo test

Vehicle Design

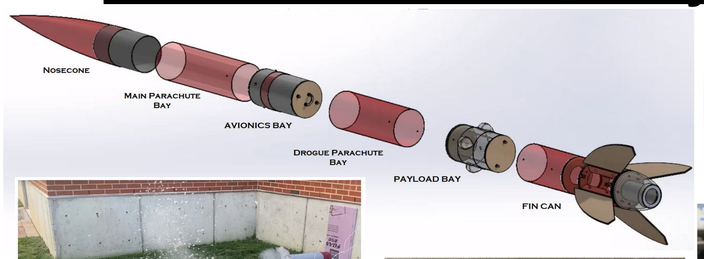
The launch vehicle goal is to reach target apogee while safely housing the payload. Vehicle requirements include reusability, flight force survivability, payload retention and mission support.

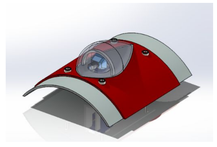
Key Vehicle Features:

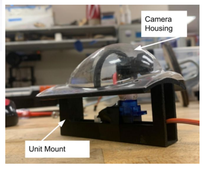
- Removable fin system.
- Carbon fiber composite fins
- 3D printed tail cone
- Removable nose cone bulkhead and adjustable ballast system.



CAD Models and Prototypes

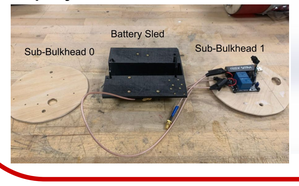


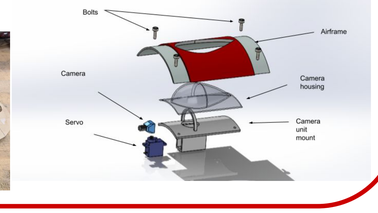




Payload Design

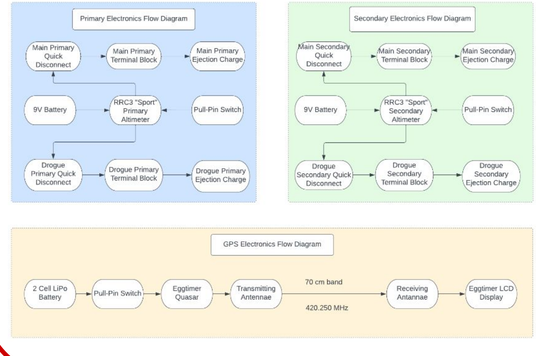
The goal of the payload is to take pictures of the landing site with specified orientations and effects based on Radio Frequency Commands sent on the launch field by NASA. It must be able to land and orient itself so it can capture both field and sky. This challenge was divided by payload structures, payload systems and software, and payload electronics.



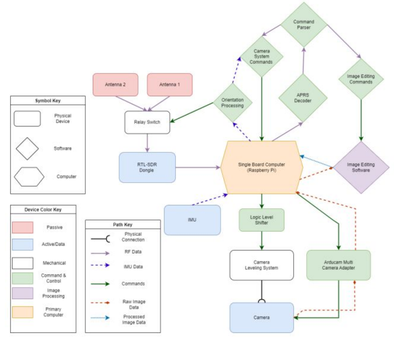


Functional Block Diagrams

RECOVERY AVIONICS DIAGRAM



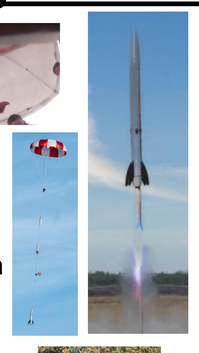
PAYLOAD FLOW DIAGRAM

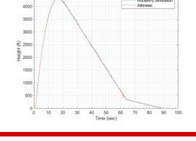


Test Flight Results

VDF & PDF

- Altitude: 4,313ft
- Ballast: 3.7lb
- SOCS powered throughout flight
- Retention system functioned normally
- Antennas lost connection
- Wearable components damaged





Secondary Test Flight

- Unsuccessful due to motor defect