Post Flight Report

NUSTARS

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Rocket Operation Assessment

The two flights of the Starpuppy experienced no flight anomalies. It is worth noting that the active drag system electronic systems were switched out from previous reports. The night preceding the launch, the arduino, specialized motor driver, accelerometer, and barometer all received too much current and fried. As a result, the Starpuppy flew with different components bought that morning from Microcenter, utilizing a fixed acceleration deployment method of deployment

The Starpuppy experienced expected propulsion. Although NUSTARS had Cato'd with a K1440 the previous week, we proceeded to launch again with the same motor. The burn times of the two motors lasted 1.51 seconds and 1.62 seconds respectively. The max acceleration provided varied extremely from the predicted 16Gs, topping out at 13.39Gs and 17.09Gs. Because the second motor provided much more acceleration, the Starpuppy was partly unable to reach the targeted 75% altitude.

Both launches flew straight with moderate arcing near apogee. The redundant system of Missleworks RRC3 and Raven 3 altimeters both worked correctly. Both sets of charges ignited at proper points, apogee and 700 feet. After parachute deployment, we experienced drifting of approximately 300 meters for our first launch and 100 meters for our second launch. Both recoveries were accomplished by both visual spotting and electronic tracking. The first launch landed in a group of trees, and climbing was necessary to retrieve the launch vehicle. Because the shock cord was 30 feet long, it was not necessary to climb far or to cut any point of attachment. The second launch landed in a nearby field, and was recover swiftly.

Pre launch procedure was efficient and properly completed. The pre launch checklist was followed, but additional items were added to integrate the new active drag deployment electronics. Post launch procedure was efficiently done, but the one-hour time preparation time limit could not be accomplished. All preparation, other than mounting the new electronics, was completed in less than 35 minutes, but the first launch showed a need to remount the electronics, which took more time than the allotted one-hour window.

Actual vs. Predicted Performance

Base Flight

The actual versus predicted flight apogee, peak velocity, and acceleration for the base flight can be seen below (Table 1). The base flight experienced a lower peak velocity than predicted. This is a direct result of the motor providing less Gs than participated

Table 1: Base flight performance

	Apogee (m)	Peak Velocity (m/s)	Acceleration (Gs)
Predicted	1225.8	176.44	16

Actual	1710.84	172.84	13.39

Active Drag System

The actual versus predicted flight apogee, peak velocity, and acceleration for the flight with active drag deployment can be seen below (Table 2). This flight experienced a peak velocity 5m/s higher than predicted, and 10m/s faster than the first flight.

Table 2: Active drag flight performance

	Apogee (m)	Peak Velocity (m/s)	Acceleration (Gs)
Predicted	919.35	176.44	16
Actual	1536.8	182.92	17.09

Data Collection

The data collection component functioned as designed during the flight of the rocket. It activated when the accelerometer registered a reading of 30 m/s^2 and recorded data through apogee. The data was stored on the off board EEPROM chip and downloaded onto a computer once the rocket was recovered. We then ran the MATLAB program to process the data, and were able to get a graph of the recorded drag coefficient over time for the rocket. The calculation was done by utilizing newton's second law and the drag equation to get the following equation:

$$Cd = \frac{Thrust - m(a-g)}{\varrho A(\frac{v^2}{2})}$$

Where m is the mass of the rocket over time, a is its acceleration, ρ is air density, A is frontal area and v is velocity. The following is a graph comparing our calculated value and the value from the OpenRocket simulation.

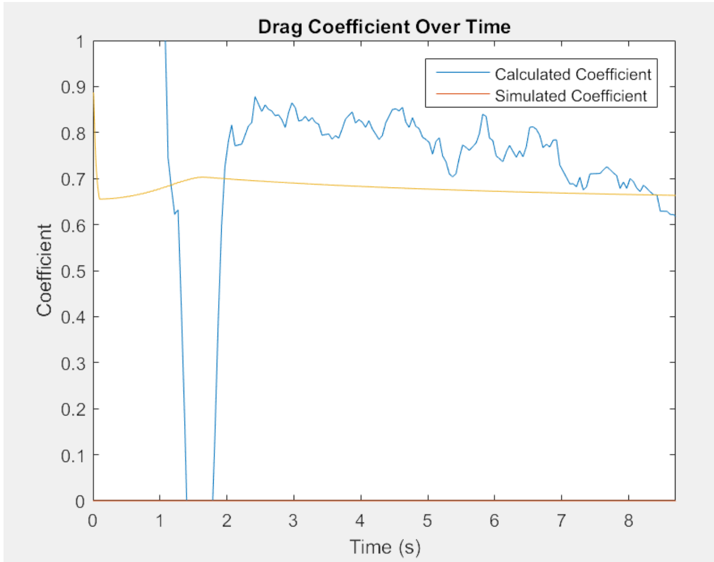

Figure 3: Graph of Drag Coefficient

The recorded data is erratic because of the large and erratic forces acting on the rocket throughout its flight. There is a large error in the data between 1 and 2 seconds, where the coefficient reaches a low of -1.5. This dip corresponds to motor burnout, which occurred at 1.7 seconds. At this time the accelerometer recorded an acceleration of -11.9 m/s^2. Because the calculation is based on acceleration, this brief but extreme deceleration caused this large dip in the coefficient.

Overall the calculated coefficient shows the same trends as the simulated. It starts at infinity because velocity is zero and comes down to settle at a value between 0.6 and 0.9. Our calculated coefficient is slightly higher than the one predicted by OpenRocket. This matches our expectations because our rocket design had many small parts sticking out (such as bolts, and the camera) that were not accounted for in the simulation.