Team Whoosh Generator
Post-Flight Performance Report

2013 Regional Rocket Competition

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FLIGHT OVERVIEW

The rocket designed and built by Team Whoosh Generator for the 2013 Wisconsin Space Grant Consortium (WSGC) Collegiate Rocket Competition had a successful competition launch on April 6th, 2013. Due to this successful launch the team advanced to the regional launch. At the regional launch the pre-motor weight was 6.2 pounds. The rocket obtained an apogee of 1558 feet and a maximum acceleration of 882 ft/s^2. Upon descent all ejection charges deployed, the drogue chute did not eject, but the main chute ejected successfully at 600 ft. The rocket was recovered but was not in a flyable condition. The reasoning for these results will be explained further.

ROCKET OPERATION

There are a number of factors that affected the launch of the rocket on April 27th, 2013. The weather on the day of the launch was clear with wind speeds varying from 1 mph to 5 mph. From analysis of video taken of the flight and data received from the Raven 3, the flight pattern of the rocket was determined. The Cesaroni I-540 motor used in the launch did not burn correctly causing major damage to the rocket. The engine burned in 0.56 seconds with an acceleration of 882 ft/sec^2. This was half of the expected time for burn out and nearly double the expected acceleration. The motor is believed to have broken its thrust ring and have flown up into the rocket hitting the U-bolt used to attach the recovery harness. The U-bolt smashed into the side of the rocket creating a large hole in the lower body tube. When the black powder charges deployed at apogee there was no separation because pressure could not build up. The rocket accelerated towards the ground until it reached 600 feet where the main parachuted deployed. This jerk caused the upper body tube to zipper and the lower body tube to separate from the rest of the rocket due to the U-bolt's detachment. This also caused the motor to fall out the aft end of the rocket having destroyed its positive retention system on motor burn out.

ROCKET FLIGHT PERFORMANCE COMPARISONS

Computer simulations were run to design and estimate the flight performance of the rocket. The two methods used were OpenRocket and a MATLAB simulation written in previous years and revised by the team this year. At the launch, the flight data of the rocket was recorded using a Raven III flight data recorder, provided by WSGC. A comparison between the predicted and actual flight results is shown in Table 1.

Table 1: Flight Comparisons

Flight Performance Comparisons		
	Apogee (ft)	Maximum Acceleration (ft/s^2)
MATLAB	3011	575
OpenRocket	3005	567
Actual	1558	882
	Percent Error from Actual (%)	
MATLAB	93	35
OpenRocket	93	36

Also, predicted and actual altitude and acceleration data to apogee are plotted in Figures 1 and 2, respectively.

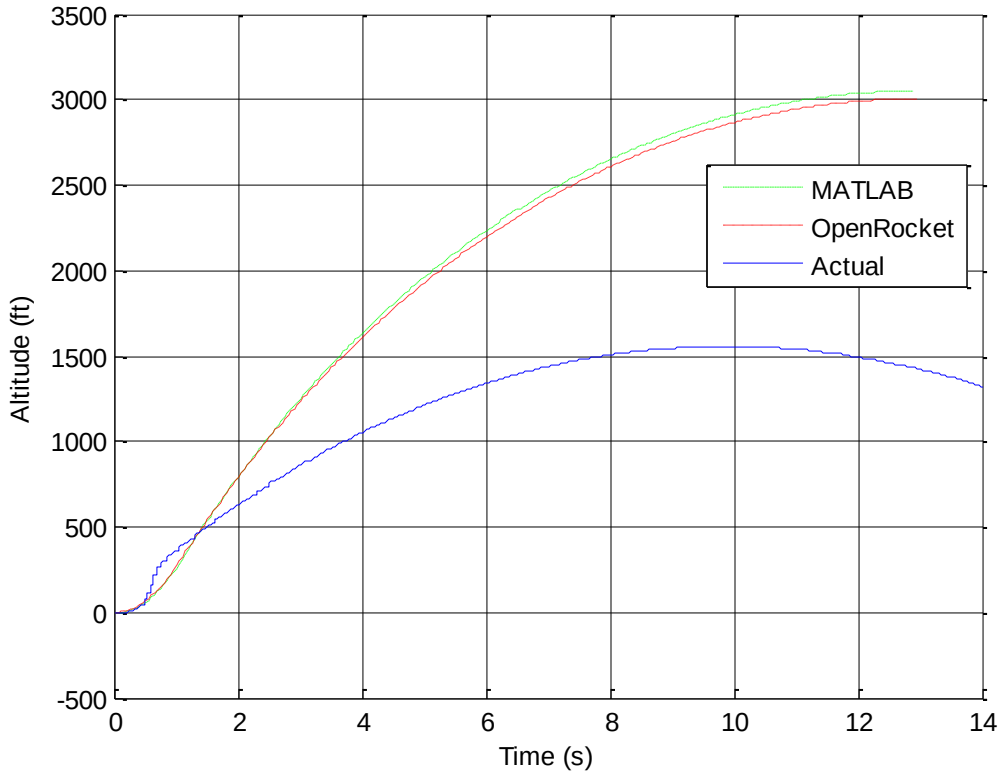

Figure 1: Comparison between Predicted and Actual Altitude

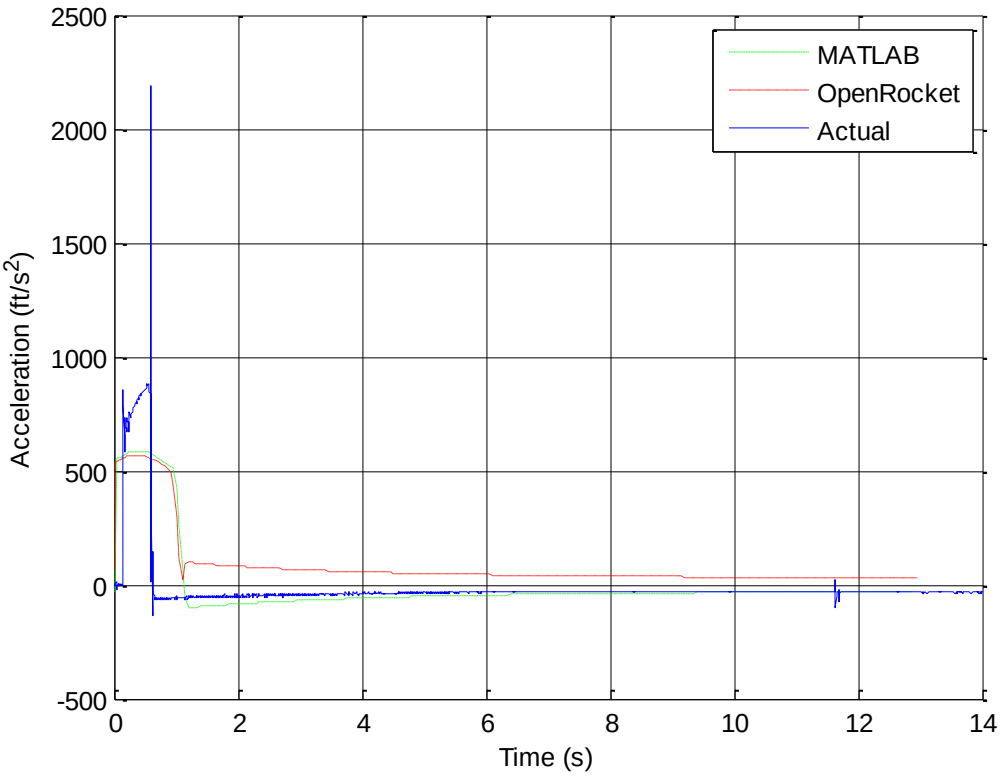

Figure 1: Comparison between Predicted and Actual Acceleration

The large discrepancies between the actual and predicted acceleration and altitude are due to the defective motor during flight. The motor created a huge acceleration for only half of the predicted time. This is also why the apogee is around half the predicted apogee. Considering the collegiate competition flight results (apogee of 3061 feet) and the predicted flight (apogee around 3005 feet), the predicted altitude and acceleration would very likely have been extremely close to the actual altitude and acceleration, had the motor not been defective.

PROPOSED DESIGN CHANGES

Due to the events of the regional launch, several design changes will be made. First of all an anti-zipper device will be used. This will be done by wrapping fiberglass around the top of the tubes at the ends so that it will be reinforced and may prevent the zippering. Epoxy was used before and so this is why the change will be made. It was not strong enough. Additionally, we will put terminal blocks on the inside of the altimeter bay to allow easier access to the electronics. This will reduce the lengths of wires and complication into the system.

CONCLUSION

On April 27th, 2013, Team Whoosh Generator flew and did not successfully recover the rocket due to a faulty motor. The rocket had a pre-motor weight of 6.2 pounds. The rocket flew to an apogee of 1,558 feet and had a maximum acceleration of 882 ft/s^2. Upon descent, all ejection

charges went off. The drogue chute did not successfully deploy due to the hole created upon decent when the motor shot up and hit the U-bolt. There was not an enough pressure to deploy the drogue chute. The main chute did deploy at 600ft, but due to the high velocity from the drogue chute not opening, the main chute cord zippered the upper tube. We found the rocket near the parking lot with the motor and motor retainer not to be found. It had come out of the back of the rocket at apogee. Data was able to be taken from the Raven 3 altimeter and this showed the actions of the motor and what happened during flight. Overall, it was disappointing to not see the rocket to be able to fly as intended. Our predictions for the flight were very close to 3,000 ft. It was a good experience overall and exciting to see all of the rockets lift off. All observations of the regional launch as well as the collegiate launch will be incorporated into future designs to optimize the rocket.