Post-Flight Performance Report

Prepared by:
The University of Iowa AIAA
Midwest High Power Rocketry Competition
Submitted on: May 26, 2016

Team Omega
University of Iowa
Chris Sosnowski – Team Lead
christopher-sosnowski@uiowa.edu
Albert Ratner - Faculty Advisor
albert-ratner@uiowa.edu

Member	Major	Project Responsibilities
Chris Sosnowski	Mechanical Engineering	project lead
Jake Keil	Chemical Engineering	presentation lead
Josh Larson	Electrical Engineering	circuitry
Naveen Ninan	Biomedical Engineering	manufacturing lead
Rohit Banda	Computer Engineering	software design
Roman Doyle	Mechanical Engineering	drag system lead
Seema Suthar	Biomedical Engineering	educational outreach
Thomas Niemeyer	Mechanical Engineering	budget
Zachary Luppen	Astronomy & Physics	technical reports

Executive Summary

During the test launch of our rocket, an ejection charge fired prematurely due to the high pressure gradient when the rocket launched. Instead of launching out of the ends of the rocket, it exploded horizontally and destroyed the adhesive joining the two rocket halves together. The electronics bay was destroyed, but most of the rocket was salvageable. The electronics remained functional.

One day prior to the competition, the Arduino Micro was tested for the competition. The device was fully functional, and appeared successful. However, on secondary startup, the device did not work at all, and without it, the recovery system couldn't be deployed and our rocket would have become a projectile. This did not fit within the safety parameters of the competition, and we were not able to launch the rocket.

Analysis of Anticipated Performance

The flight analysis of the rocket was calculated using Open Rocket software. The software allowed input of the dimensions and weights of the rocket components along with the impulse of the competition motor, and returned a graph with specific flight data. A total of seven variables were calculated to produce the resulting graph including time (s), altitude (m), total velocity (m/s), CP location (cm), CG location (cm) and drag force (N). The rocket motor burns for about 2.3 seconds, getting the rocket to a maximum acceleration of about 530 m/s^2 and a maximum velocity of 189 m/s. At about 13.5 seconds after launch, the rocket will reach maximum altitude, at about 1,007 m (3303.8 ft). This simulation does not include use of the active drag system, as it cannot be simulated using Open Rocket.

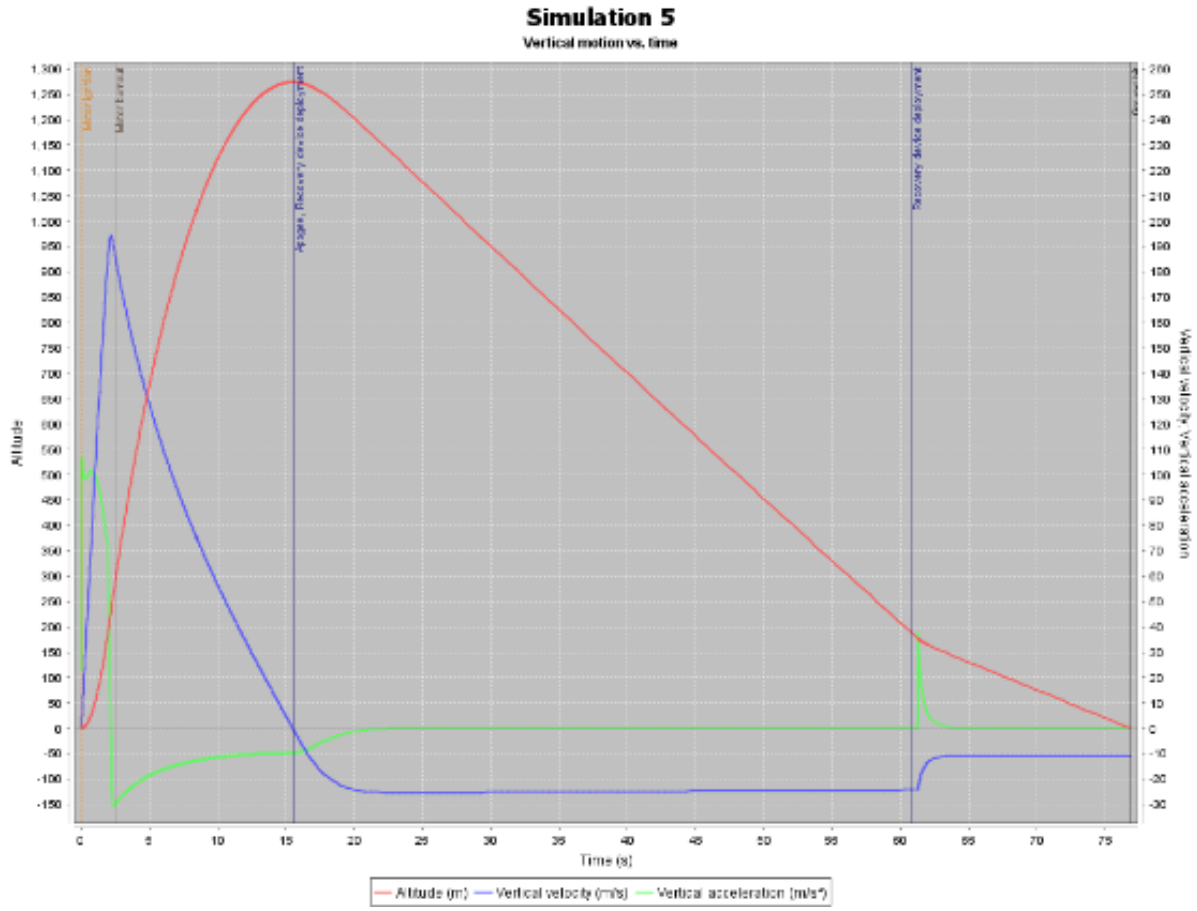

Figure 1: Diagram showing the projected altitude, vertical velocity and vertical acceleration of our rocket, produced using OpenRocket Simulator.

The estimated flight time is about 78 seconds, without the active drag system, which will raise this time, but only slightly. With average wind speeds of 5 and 10m/s, there is a horizontal distance less than 800m.

The calculated velocity at impact for the rocket is 10m/s. This will be slow enough to prevent damage to the fins and electronic components.

Test Flight

Overall performance during the test flight was not desirable. The launch of the rocket was successful, but due to a malfunction of an ejection charge due to too much black powder, the flight was failed. This caused the rocket to explode just after launch, and split it in two. While the body of the rocket was damaged, the rest of the rocket remained intact and salvageable.

Because of the unexpected failure, we do not have any data to show, and the analysis of the anticipated performance is the best summary of the expected performance during the competition launch.

Competition Flight

Flight for competition was not possible for our rocket. One day before the competition, the Arduino Micro malfunctioned, and wouldn't work afterwards. This device controls the recovery system, communicating to the ejection charges when to explode and deploy the recovery system. Without this system activating, the streamer and parachute cannot be deployed and the rocket becomes a projectile. This is, of course, not acceptable for launching, and so the competition flight was not possible. We were offered a replacement Arduino Micro with at the launch site, but with two hours remaining to fix the recovery system, among other problems, we deemed the launch an impossibility.

Discussion of Results

Due to the failed test flight, we cannot compare actual data to the expected values and simulations. The anticipated performance is the best representation of what our flight may have been if the malfunctions had been fixable in the remaining time.

Lessons Learned and Plan for Improvement

This section is meant to discuss the problems faced during this year's competition, in no specific order, and how the University of Iowa AIAA plans to compete in next year's competition.

One of the largest problems facing this year's competition was the amount of participation by each of the members. At the beginning of the year, the club received so many new members that the administration board decided to form two teams for the competition. This was a completely reasonable decision, as having approximately 24 people working on a single rocket would lead to frustration and confusion as members tried to figure out their roles in the project. In February, we received the funding for our rocket, and by that time, membership to the club began to dissipate and the number of people working on the rocket approached a dozen people. Both teams had lost an half their members, so each was struggling to make significant progress in the remaining time. In an attempt to resolve this problem, we asked for permission to combine our teams, which was approved. This decision turned out to be really helpful, and we were able to produce a testable rocket within a couple weeks. Further success would have been achieved had the rocket not exploded on after launch.

Due to the explosion of our rocket it was very difficult to rebuild with minimal funding. As a new team, we do not have any sponsors yet so all our funding came from space grant or was fundraised by us. With two weeks left before the competition it was necessary for us so salvage what we could, forcing us to assume our electronics were fully functionable, which they were not. The issue with the electronics could have possibly been prevented if we had one of our electrical engineers with us during the competition. A group of electrical engineers had previously programmed all our electronics, however none were able to make it to the competition. In order to prevent this in the future we would like to make sure we have at least one member from each group that contributed to the rocket who fully understands their part. We believe this will be helpful because any issues that would arise could be solved by the members at the competition.

Our funding was received in February and we did not begin building until after, this prevented us from scheduling early test launches for our rocket and caused us to work under a time crunch. We believe it would be beneficial to begin designing and building the rocket as early as we possibly can next year, and scheduling several test launches as well. This would allow us to be better prepared for any issues that could arise during the competition and could allow us to construct a better rocket.

This competition was very challenging for us as a new team, even though we were not able to launch our rocket we believe that we have learned many valuable skills and lessons that will allow us to perform better in future competitions. We are all very excited for next year's competition because we believe we have learned what we need to change from this year's competition in order to succeed in future competitions.