NASA Student Launch 2017

Post Launch Assessment Review Report

4/24/2017

SOCIETY OF AERONAUTICS AND ROCKETRY

14247 Les Palms Circle, Apt. 102
Tampa, Florida 33613

Table of Contents

Table of Tables

1 Team Name And Vehicle Summary

1.1 Team Name

Society of Aeronautics and Rocketry (SOAR) at University of South Florida (USF)

14247 Les Palms Circle, Apt. 102
Tampa, Florida 33613

1.2 Motor Used

L1115 from Cesaroni Technology:

Total Impulse: 5015 N·s

Length: 621 mm

Burn Time: 4.5 s

Propellant Weight: 2394 g

Diameter: 75 mm

1.3 Payload Summary

A landing module was intended to be deployed from the main body of the rocket upon separation at an altitude of 1200 feet upon descent. This landing module housed an electronics bay with a camera which was used to attempt to autonomously locate, identify, and differentiate between the multicolored tarps. At the bottom of the landing module were four cylindrical spring-loaded legs designed to ensure that the module landed vertically.

2 Vehicle Experiment Criteria

2.1 Vehicle Dimensions

The rocket was a total of 145 inches tall and had a six-inch outer diameter. The loaded weight of the launch vehicle was 47.5 lbs.

2.2 Altitude Reached

The apogee reached for the final flight in Huntsville was 4,629 feet.

2.3 Vehicle Summary

Our vehicle had four points of separation, ultimately splitting it into four parts: the nose cone, the main body tube, the altimeter bay, and the fin can. The fin can housed just the motor and the drogue parachute. The altimeter bay was bolted to the main body tube so that they would remain attached upon descent. The main body tube then held the main parachute, landing module, and two large parachutes for the landing module and the nose cone. The nose cone was secured with 4 small shear pins.

2.4 Data Analysis & Results of Vehicle

The vehicle was designed to eject a drogue parachute at apogee and then eject the main parachute along with the payload and nose cone at a lower altitude which we chose to be 1,200 ft. However, when we packed the rocket before launch, everything fit tightly and the nose cone only barely fit on top holding everything in. Because of this, when launched, the first charge at apogee transferred enough force forward to break the shear pins at the front end of the rocket, causing the nose cone and payload to eject at a higher altitude than planned. This premature ejection allowed the both objects to drift much farther than expected. The solution to this problem would have been simply to repack the rocket when we realized things weren't fitting correctly.

3 Payload Experiment Criteria

3.1 Payload Summary

A landing module was designed with the intended goal of VTVL and target identification. The vision system was composed of a Raspberry Pi 3b and an oCam USB camera that was responsible for identifying and differentiating between the three different colored targets on the ground near the launch pads. A custom Arduino-based system was designed to interface with a GPS and various sensors to determine its location and orientation. Based off these readings it would calculate the position two servos should be adjusted to aim the camera downwards towards the targets.

3.2 Data Analysis & Results of Payload

Due to communication issues via I2C between the Raspberry Pi and Arduino system, the vision system was unable to record any images of the targets. The Raspberry Pi code used some of the values recorded from the sensors to calculate tarp size in pixels. However, it could not successfully request this data from the Arduino system. The Raspberry Pi was also designed to log all of the data from the sensors for analysis after landing but there were no log files saved due to the communication issue. We have no way of determining if the landing module originally landed upright or not

3.4 Visual Data Observed

When we approached the landing module upon recovery, it was laying on its side and there were clear feet indentation marks on the ground where it at first touched down. Because there was no data logged we are not able to verify if it first landed upright and then the parachute pulled it over or not.

4 Experience Summary

4.1 Lessons Learned

We quickly learned upon arrival in Huntsville that if we want to get something done and done right, we needed to be prepared and flexible. We made sure to be one of the first in line to get our LRR done and receive our punch list since it was on a first-come first-serve basis, and we made sure to get all of our last-minute work done before launch day. For launch day, we had our altimeter bay ready, out motor assembled, and our rocket cleaned out and ready to be packed. All we had to do was finish programming our landing module, pack the rocket, and then load it onto the launch pad. We realized that this would save us a lot of time and get us one the launch pad sooner. However, due to the overall disorganization of the launch event, we and another team were given conflicting information about our launch pad assignment order which was ultimately corrected but also forced us to have our rocket in launch-ready mode for over three hours. During this time, the battery powering our landing module's electronics and camera died which left us with no recorded data from the launch. Not only did this ruin any chances we had of meeting the requirements of the competition, but it also denied us the knowledge of whether or not our electronics even worked the way they were programmed to do so. From this, we learned for next time not to turn on the electronics until we have our launch pad assignment and to notify someone sooner if too much time has passed. We must also remember to take into consideration that other teams aren't going to be as prepared as we are so launch pad setup of all the rockets in the lineup may take longer than expected.

4.2 Summary of Overall Experience

Our team had a great time learning, researching, building, and testing our rocket and landing module this year. The entire project gave us more knowledge of rocketry and hands-on experience than any of our classes would have and for that, we are very grateful. We walked away from the competition with great ideas and plans for what we're going to change for next year. Being able to see at the rocket fair what other teams came up with in their designs and then seeing how those design decisions worked out for them during launch was a great learning opportunity for all of us. Even though our launch and landing didn't go exactly as planned, we were able to get a good idea of what needs to be modified, fixed, or replaced completely for next year. We were honored to have had the opportunity to compete for a second time this year and we are excited to return in 2018.

3.3 Educational Engagement Summary

Unfortunately, at our university we do not have a degree program dedicated to aerospace or aeronautical engineering, so for us, this project was a unique learning experience that we could not have acquired anywhere else. On our own outside of classes, we researched different aspects of design, fabrication, and components, we talked to Tripoli members and asked a ton of questions, we ran simulations tests, ground tests, and launch tests to see what worked and what didn't and we made modifications along the way. In school, classes are taught in such a way that students will remember information only to pass tests but won't truly understand it for actual real-world applications. This project allowed for an dynamic and effective way of learning and we will be able to take the knowledge we gained and the skills we obtained into our future careers.

For the educational outreach requirement of the competition, we used a pre-existing engineering outreach event at our school (USF Engineering Expo) to showcase our rockets and explain the design, fabrication, and launch process to elementary, middle, and high school students from our community. The students seemed to enjoy being able to look at and touch our rockets and were actually engaged in talking about what it takes to build one. We were even able to speak to some high school seniors who were interested in going into STEM majors and getting involved in projects like this one when they started college in the fall. Overall, we had fun engaging in conversation with the students and showing them our work, but for next year, we'd definitely like to have a more hands-on demonstration for them or to have a separate outreach event entirely. We still have a lot of brainstorming to do for this.

3.4 Budget Summary

For our budget, we have a very detailed system of how purchase are ordered and recorded. This information is made available to all leaders in the organization who have the authority to submit purchase orders so that there is less of a chance of too much money being spent or someone not knowing how much is left. Of the funds our organization was granted by our student government, we set aside a certain amount specifically for the completion of this project and then further distributions were made to the subsections of the project as needed. Overall, we were able to make our money last throughout the course of the project. Our expenses and remaining budget are shown below.

Table 1: Budget overview for project duration.

Budget Item	**Projected Cost** ($)	**Amount Spent** ($)	**Remaining Budget** ($)
Rocket	3,000.00	1,207.40	1,792.60
Payload	2,000.00	1,486.40	513.63
Travel	2,857.08	N/A	N/A