Plantation High School Team #2

2015 – 2016

Post Launch Assessment Review

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Contents

Launch Summary

- Team Name: Plantation High School Team 2
- Motor: Aerotech K1050WL
- Vehicle Length: 110”
- Vehicle Diameter: 5.5”
- Vehicle Mass: 22 lbs.
- Apogee: 4590’

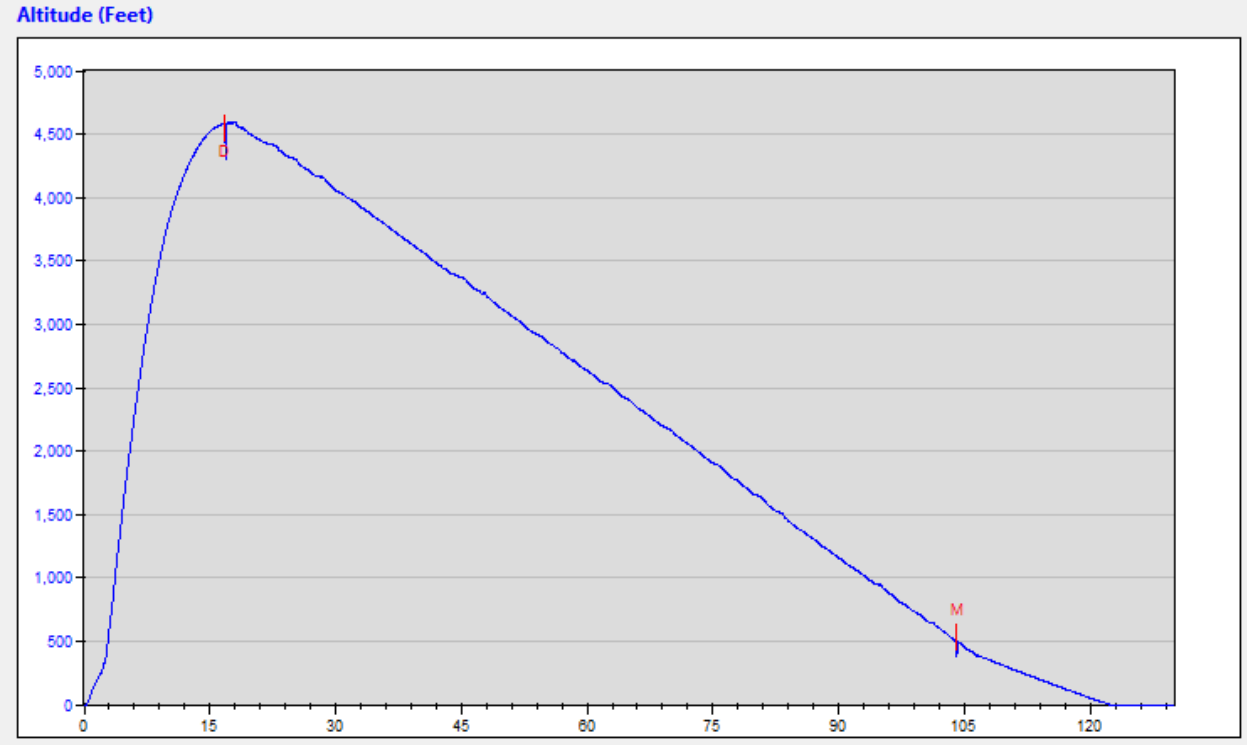
Payload Description

The team’s payload was an Electromagnetic Field Detector, reading residual interference from the atmosphere, using an antenna. The payload used an Arduino Mega microprocessor. A second payload was constructed and stayed on the ground, in order to compare ground and flight values.

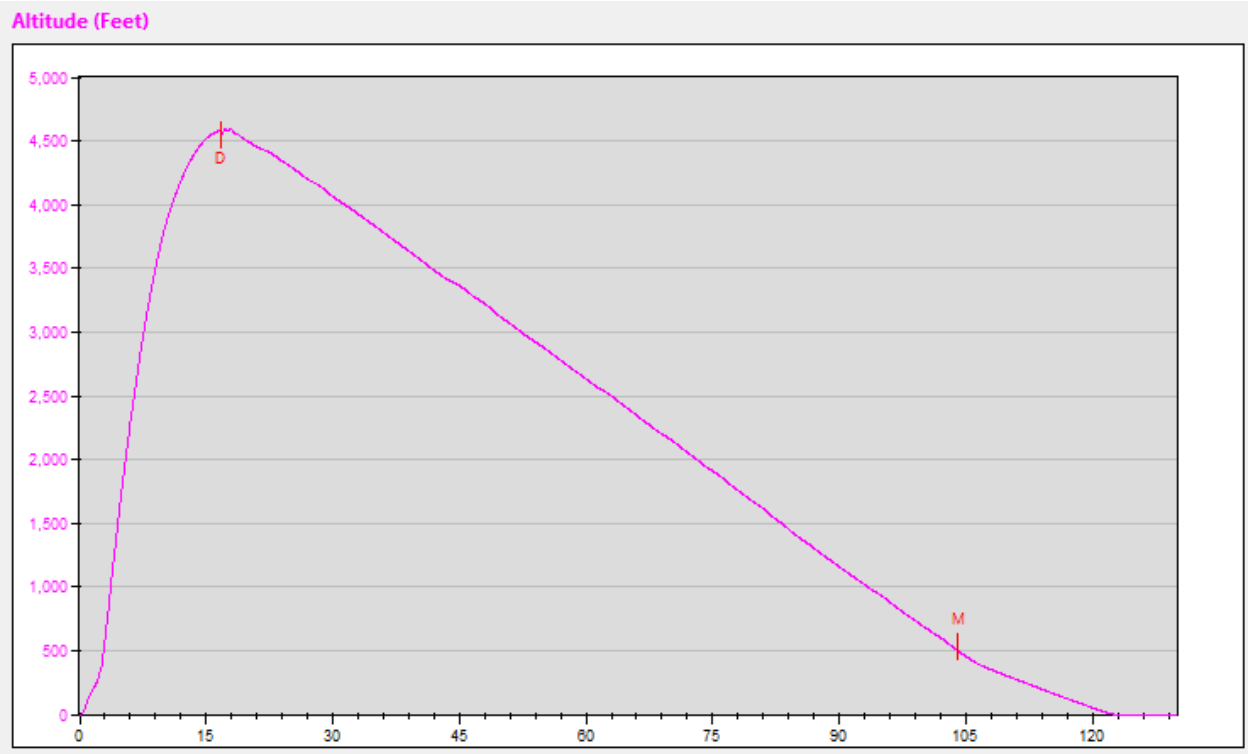
Vehicle Summary

The launch vehicle was constructed from 5.5” Bluetube body tubes. It was made up of a 48” upper airframe, a 46” lower airframe and a 2” coupler band. Its nosecone was a 13” plastic ogive cone, with a 4” shoulder. The vehicle’s fins were in the shape of quarter ellipses, with a root chord of 8” and semi span of 4”. These were constructed from 3/32” G10 fiberglass. The vehicle used a 54mm Bluetube motor mount in its propulsion system. This was integrated into the lower body tube with a ¼” G10 fiberglass centering ring and thrust plate, as well as a Slimline engine retainer. The coupler contained 2 Perfectflite Stratologger altimeters, integrated onto a wooden altimeter bay. 2 ½” G10 fiberglass bulkheads were used to seal the coupler. A ¼” G10 fiberglass bulkhead was also used in the upper body tube to separate the main parachute from the payload. The vehicle recovered on a 24” drogue and 84” main parachute, placed on 40’ and 20’ pieces of ½” tubular Kevlar recovery harnesses.

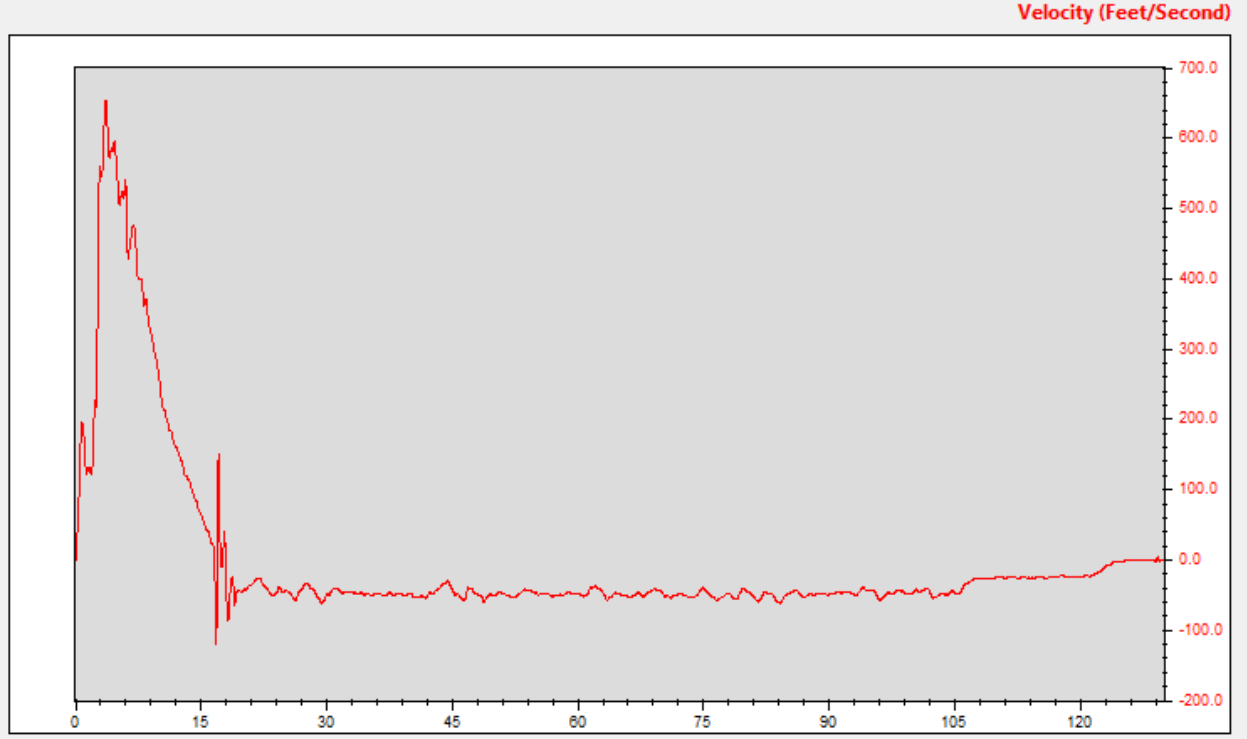
Vehicle Data Analysis



Raw altitude data from altimeter 1



Smooth altitude data from altimeter 1



Raw velocity data from altimeter 1

The launch vehicle reached an altitude of 4590 feet, below the target altitude of 5280 feet. The team believes that this is due to a combination of factors, including mass added to the nosecone to increase stability and wind speeds. The vehicle also reached a maximum velocity of under 700 f/s, less than the predicted maximum of 714 f/s. Finally, the descent rates for the main and drogue parachutes were more similar than expected, consistent with data from the test flight, but not with recovery simulations from Rocksim.

Other than these discrepancies from predictions, the vehicle performed as expected. Most importantly, both the drogue and main ejection charges deployed successfully, at the correct altitudes of apogee and 500'. The rocket was safely recovered approximately 2100 ft. from the launch site. Upon inspection, no damage was found. The vehicle's ascent was also safe, as the vehicle was stable and experienced no fin flutter or other catastrophic events during flight.

The vehicle's altimeters did not beep correctly, listing only 3 numbers for altitude instead of 4. Because of this, the team was unable to report altimeter data on the field, and had to wait until they could use a laptop to analyze the data on the PerfectFlite Data Cap.

Payload Summary

The team's payload consisted of an Arduino Mega that detected electromagnetic fields through the use of an antenna that read residual voltage in the atmosphere. A ground payload was also constructed to compare ground values to those gathered during flight. Both payloads logged data onto an SD card, along with time and location, to allow for easy comparison of the data sets. Both payloads were integrated onto 3D printed base plates. The flight payload was screwed onto 2 t-rails and flown in the upper airframe. The ground payload was attached to 2 metal rails as well, and placed in a spare airframe during the flight.

Payload Data Analysis

Both payloads successfully logged time and location data to the SD cards. However, the voltage read in was a constant 0 for the entire duration of the flight. The team believes that this is because the Mega Ohm resistor used in the antenna provided too much resistance, reducing the voltage read to 0 at all points during flight. However, this in itself is a result, showing that electromagnetic fields do not have a major impact on the launch vehicle.

```
Temperature:          24.80 C
Height:          129.27 m
          0.0 EMF
          0.0 EMF

Temperature:          24.80 C
Height:          129.86 m
          0.0 EMF
          0.0 EMF

Temperature:          24.80 C
Height:          129.43 m
          0.0 EMF
          0.0 EMF

Temperature:          24.80 C
Height:          129.94 m
          0.0 EMF
          0.0 EMF

Temperature:          24.80 C
Height:          129.60 m
          0.0 EMF
          0.0 EMF
```

Sample Payload Data

Scientific Value

The failure of the team's payload to read in any data above 0 greatly reduced its scientific value. The team flew an antenna of only one length, meaning that it read in interference of a certain frequency. It is possible that there are fields in other frequencies that the payload did not collect. The payload data shows that at this frequency, electromagnetic fields are not prevalent and are not likely to affect the vehicle and its electronic systems.

Visual Data

The team observed that its rocket carried out a stable flight, though it weather cocked slightly due to wind. The team observed the vehicle performing as expected, reaching a very high velocity without any problems, showing that it was structurally sound. The team heard the popping of some grains in the motor, and believes that this could have also affected altitude. At apogee, the team observed the setting off of the first ejection chare, followed by the deployment of the drogue parachute and the setting off the redundant ejection charge. After this, the vehicle descended somewhat quickly and drifted slightly to the right of the launch stand. At 500 ft., the team observed the setting off of the second ejection charge, again followed by the successful main parachute deployment and setting of the second redundant ejection charge. The team then observed a reduction in the vehicle's descent velocity, and an increase in drift. Finally, the team observed the vehicle landing safely in the field, about 2100 ft. from the launch site.

Lessons Learned

The team has learned a lot as a result of this project. First, it learned not to trust Rocksim's initial drag coefficient calculations, as they are arbitrary and almost always very wrong. It also learned that multiple test flights and a series of calculations are necessary to accurately estimate the drag coefficient. The team learned that when designing a vehicle, it is usually a good idea to minimize size and weight to allow for mass increase, changes in drag or wind speeds. The team failed to this because of the planned outreach payloads, but because these outreach payloads fell through, a lot of mass and space in the vehicle was wasted. The team learned that it is better to test the payload in flight than on the ground. The payload functioned properly on the ground because it was adjacent to sources of electromagnetic fields like radios and computers, but failed to function in flight because it was only reading residual fields. This failure was something that could have only been found through functional testing, not ground testing.

Educational Engagement Summary

The team engaged in various outreach events, from open lab nights, to presentations and show cases. In its open lab nights, the team worked with 3rd graders to construct rockets from an Estes kit. The team guided the students through all the steps, and explained the major features and functions of a rocket, from the motor mount to the parachute. The team also worked with 4th and 5th to help them design their own TARC style rockets. The team taught the students how to use OpenRocket, including the design of the rocket and tests and simulations. Students learned about the characteristics of different fin and nosecone styles, as well as methods for launching and protecting a payload. The team also attempted to partner with other schools, including one in Scotland, to design and fly a payload in its vehicle. However, these schools failed to meet the documentation and design requirements for their payloads, causing this outreach project to fall through.

Budget Summary

Section	Cost
Launch Vehicle	$1406.29
Payload	$51.21
Subscale	$427.21
Motor	$394.29
Travel	$3375.87
Outreach	$657.03
Total:	**$6311.90**

Overall Experience

The team found this experience incredibly valuable. It met all of its mission success criteria, from the successful flight to the completion of educational engagement events. Somethings the team attempted were unsuccessful, such as the payload outreach project, but the team believes that the overall results were good.

The team would like to thank everyone involved who played a part in the completion of the project. It would like to thank the NASA employees and volunteers, and NAR members who provided this opportunity to the team and organized an amazing launch week. It would also like to thank its mentor, educator, school principal, parents and chaperones who supported it during the completion of the project.