Great Midwestern Regional Rocket Competition 2014 Post Flight Report

University of Illinois at Urbana-Champaign

Celestial Chiefs

This document describes in detail the launch of 4/26/2013 and compares flight performance data from the rocket launch to the predicted performance. The differences between the actual and predicted values will be discussed and explained.

Dishanth Swaminath| Kyle Pieper | Jess Gonzalez | Garrett Stoddard | Shoham Das

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1	**Operation**	
	Launch	Successful
	Drogue Deployment	Successful
	Main Deployment	Failed
	Recovery	Successful
	Flyable Condition	Successful
2	**Maximum Altitude (ft)**	2730
3	**Peak Acceleration (ft/s^2)**	530.7
4	**Time to Apogee (s)**	12.25
5	**Descent on Impact (ft/s)**	71.42

Table 1: Performance Characteristics

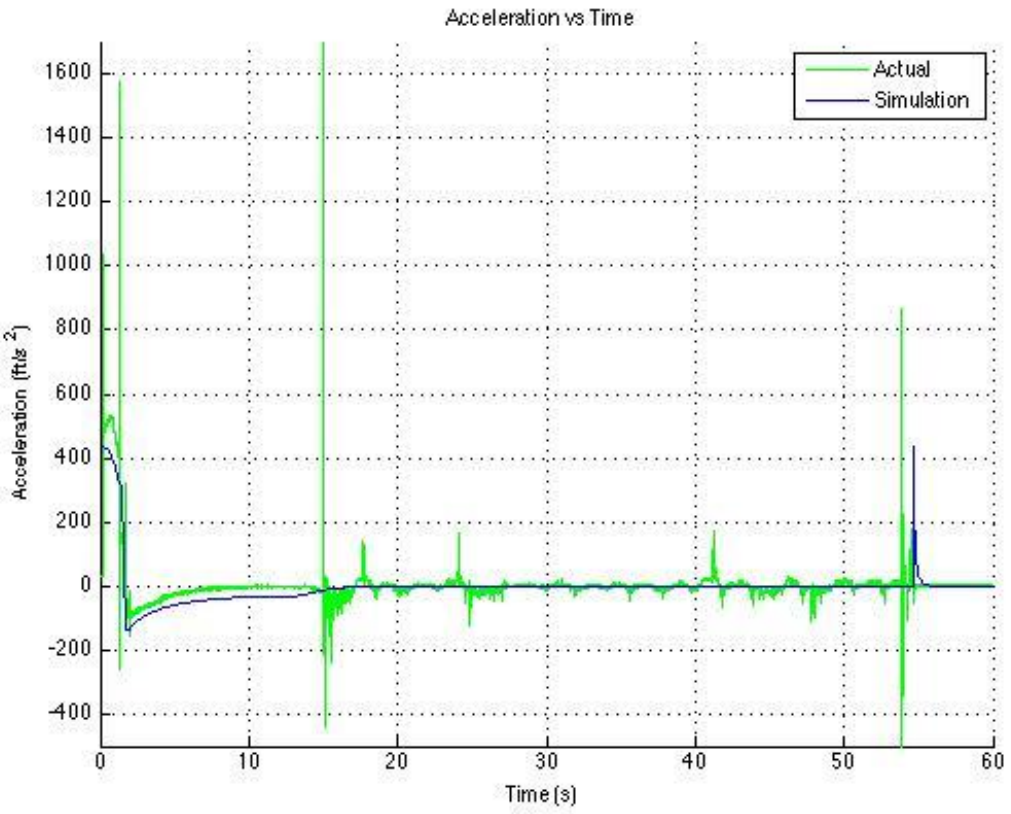

Figure 1: Acceleration vs Time

Launch and Flight Characteristics

The launch took place at North Branch, Minnesota on April 26th, 2014. The high temperature was 53° F, with an average wind speed of 14 mph at launch. The atmospheric pressure was 30.0 inches of mercury and the visibility was good at 10 miles. There was no precipitation.

After prepping the rocket for launch by readying the electronics, packing the parachutes and protectors, loading the ejection charges and installing the motor, the rocket was taken to the launch pad. On the pad, all electronics were primed and the igniter inserted into the engine. With the range cleared, the rocket was launched. It jumped cleanly off the launch rod at a approximately 65.2 ft/s which was sufficient to maintain stable flight but due to the stronger winds, it immediately began to weather cock or turn towards the wind. At an apogee of 2721 ft, the altimeter controlled ejection charge successfully deployed the drogue parachute, which opened almost immediately. The rocket descended quickly and at around 600 ft, it failed to separate and deploy the main parachute. The rocket continued with only the drogue out and landed hard in the sod field, approximately 300 ft from the launch pad. Upon inspection, the rocket survived the landing, which inflicted only scratches on the outer surface and was approved for flying again.

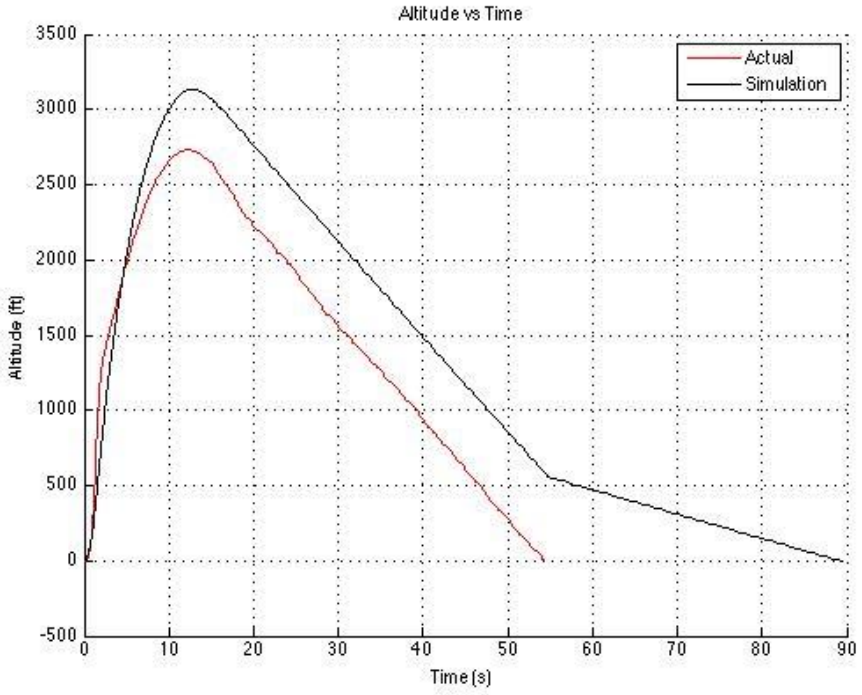

Figure 2: Altitude vs Time

As shown in the Figure 2 above, computed using MATLAB, there are two lines to take note of: (1) the black line shown depicts the predicted altitude versus time which was estimated using methods noted in the preflight report which included estimation of the wind during the day of the launch, coefficient of drag, and using data gathered from the test launch conducted, and (2) the red line shows the actual launch data. When analyzing the figures, it is clear that the main error occurred when the actual flight underwent a weather dependent flight trajectory change right after launch at around 1350 ft, indicated by the non-linear height increases. This 'weather cocking' affected the rest of the flight and its effects can clearly be noted. The actual flight was not able to achieve the predicted apogee, 3059 ft, due to the rocket trying to stabilize itself, thus using up optimal vertical thrust required to achieve the maximum altitude. Upon achieving the flight apogee of 2711 ft, it can be seen that the actual was able to mirror the predicted launch, horizontally shifted. Another error to note is the lack of a smaller negative slope on the actual launch data to indicate the deployment of the main parachute and thus slower decent rate at around 600 ft. It can be concluded based on the Figure 1 as well as Figure 2 that the main parachute did not deploy due to electrical leads becoming detached during flight, which lead to a loss of continuity in the ejection charge thereby resulting in no separation of the rocket.

In the Figure 1 above for the acceleration versus time, plotted using MatLab, the actual and simulated graphs can be seen. The simulated data, much like the altitude data, was obtained through the use of preflight analysis and methods in order to best meet and fit competition criteria and launch date conditions. The actual launch data is depicted in green. The graph shows constant noise as a result of the nature of motion, and data sensitivity but for the most part, provides accurate data. The events to note are the initial impulse due to the motor being ignited, the disturbance at apogee caused by the deployment of the drogue parachute, and the disturbance due to landing on the ground at the end of flight. The key characteristic missing is the disturbance due to the deployment of the main parachute, which, noted above, was a result of discontinuity in the main ejection charge resulting from the leads becoming detached during flight.