Post Launch Assessment Review Report
2014-2015 NASA Student Launch

Florida International University
American Society of Mechanical Engineers (FIU-ASME)

Florida International University Engineering Center
College of Engineering and Computing
10555 West Flagler Street
Miami, Florida 33174

Mini-MAV

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1. SUMMARY OF FRR REPORT

1.1. TEAM SUMMARY

1.1.1. Summary

The student section of the American Society of American Engineers (ASME) at Florida International University (FIU) participated in the 2014-2015 NASA Student Launch competition as part of the Mini-MAV portion of the competition. As this was the first year in which FIU participated in the competition, the goal was to establish a rocketry group and foster interest in the field of rocketry among the FIU student community. As will be communicated in this review, those goals were exceeded beyond expectations. The goal is now to increase student membership and improve performance at next year's competition.

1.1.2. Faculty Adviser

Dr. Benjamin Boesl
Assistant Professor, Mechanical Eng., PhD
bboesl@fiu.edu
(305) 348-3028

Florida International University
MME Department
10555 West Flagler Street
Miami, Florida 33174

1.1.3. Team Participants

Team Leader
Giancarlo Lombardi
BS Mechanical Engineering – Senior
NAR Member – Level 1 Certified
glomb002@fiu.edu
(305)632-8584

Safety Officer
Maryel Gonzalez
BS Mechanical Engineering – Senior
NAR Member – Level 1 Certified
mgonz219@gmail.com
(786)712-3155

Chief Engineer
Christopher Hayes
BS Mechanical Engineering – Senior
NAR Member – Level 1 Certified
chaye001@fiu.edu
(305)905-4301

Team Mentor
Joseph Coverston
BS Mechanical Engineering – Junior
TRA Member (#12413) – Level 2 Certified
jcove010@fiu.edu
(407)754-6572

Members

Name	Major	Standing
Juan T.	Mechanical Eng.	Junior
Shane C.	Mechanical Eng.	Junior
Jonathan P.	Mechanical Eng.	Junior
Jorge D.	Mechanical Eng.	Sophomore
Daniella B.	Mechanical Eng.	Sophomore
Jorge L.	Mechanical Eng.	Freshman

1.2. Launch Vehicle Summary

Size:	Total length = 9.4 feet Outer diameter = 4 inches
Mass:	Total mass of rocket = 276.8 oz (with motor)
Motor Choice:	Cesaroni K2045 Vmax reload kit with a 4 grain Cesaroni case.
Recovery System	The recovery system consists of two PerfectFlite StratologgerCF altimeters for parachute ejection, 2 GPS units, and 3 parachutes. The GPS units are located in two separate electronics bays, forward and rear, which each contain only a GPS unit and its power source. The two flight computers are located in a central electronics bay along with their power sources. Both flight computers are programmed to deploy the drogue parachute at apogee, located in the lower parachute bay. The upper parachute bay consists of two untethered parachutes. One is attached to the lower airframe and the other to the payload bay and nosecone with a piston in-between them to ensure separation. One altimeter is set to eject both parachutes at 1000 ft. The second altimeter is set for ejection at 900 feet for redundancy.
Rail Size	The rocket uses Acme conformal rail guides on a 1.5 inch 80/20 aluminum rail.

1.3. AGSE/Payload Summary

Payload:	PVC Payload Provided by NASA
AGSE:	After placement of payload on the ground, the AGSE Arduino Mega will be powered on by the master power switch. An electronic pause switch will then be activated, pausing all AGSE equipment. Once the rocket is cleared to begin, AGSE movement and all nonessential personnel have cleared the area, the pause switch will be deactivated, and the AGSE arm will grab the payload and then move to a position above the rocket. The payload will then be deposited into the rocket payload bay, and the Arduino Mega controller will close the payload door after an internal contact switch in the payload bay is closed, indicating successful payload insertion, or after 10 seconds, in the event that the payload does not trigger the sensor. The Arduino Mega will then close the payload bay door using the extending rod. Once the motor has reached the end of its travel as designated in the programming of the Arduino (thus closing the payload bay door), the Arduino will then activate the Linear motor to raise the rocket into the flight ready position. Once in the flight ready position, a team member will arm the flight computers and insert the motor igniter manually into the rocket. The Launch Control Officer (LCO) will then launch the rocket.

2. Competition Flight Performance

2.1. Altimeter Flight Data

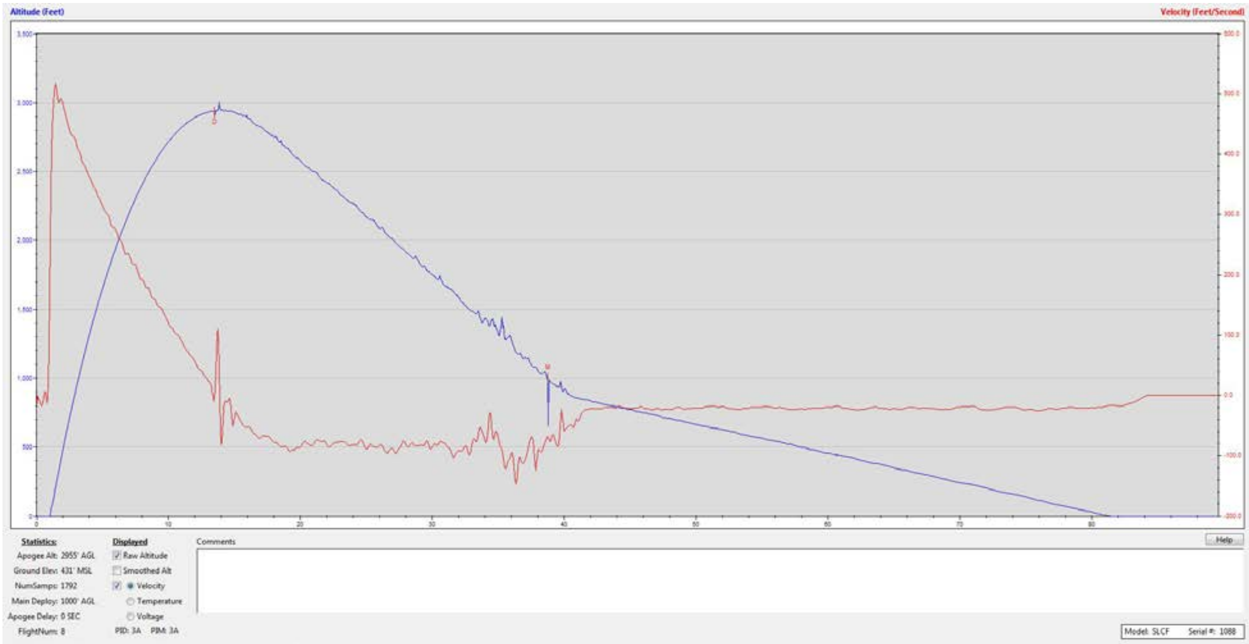

Figure 1: Competition Flight Data

2.2. Altitude Reached

As can be seen in Figure 1, the vehicle attained an apogee altitude of 2955 ft.

2.3. Visual Data Observed

The flight of the vehicle at competition was nominal. Everything performed as desired at the appropriate events. There were no anomalies that compromised mission success or the integrity of the launch vehicle.

3. Discussion

3.1. Vehicle Results

The flight performance of the launch vehicle during competition is testament to the emphasis on detail and accuracy given during the design process. During the Launch Readiness Review, the rocket received praise from the NAR officials for the uniqueness and structural integrity of the design. To reflect this, the ascent of the rocket was smooth and nearly vertical with no anomalies. The recovery of the rocket was safe and successful: a drogue parachute ejection at apogee, and main parachute and payload ejection at 1000 ft. was achieved. The team is very satisfied with the results.

Additionally, the altitude goal for this competition was closest to 3000 ft. At an apogee altitude of 2955 ft., the team came as close as 45 ft. to the intended altitude goal. Comparing this result with other competing teams, FIU was able to outperform some of the top schools in the nation since they attained apogee altitudes much farther than our results. Although, FIU was not the top performer in this category, the team is very satisfied that, as a first year team, the team was able to place itself among the top teams in the nation.

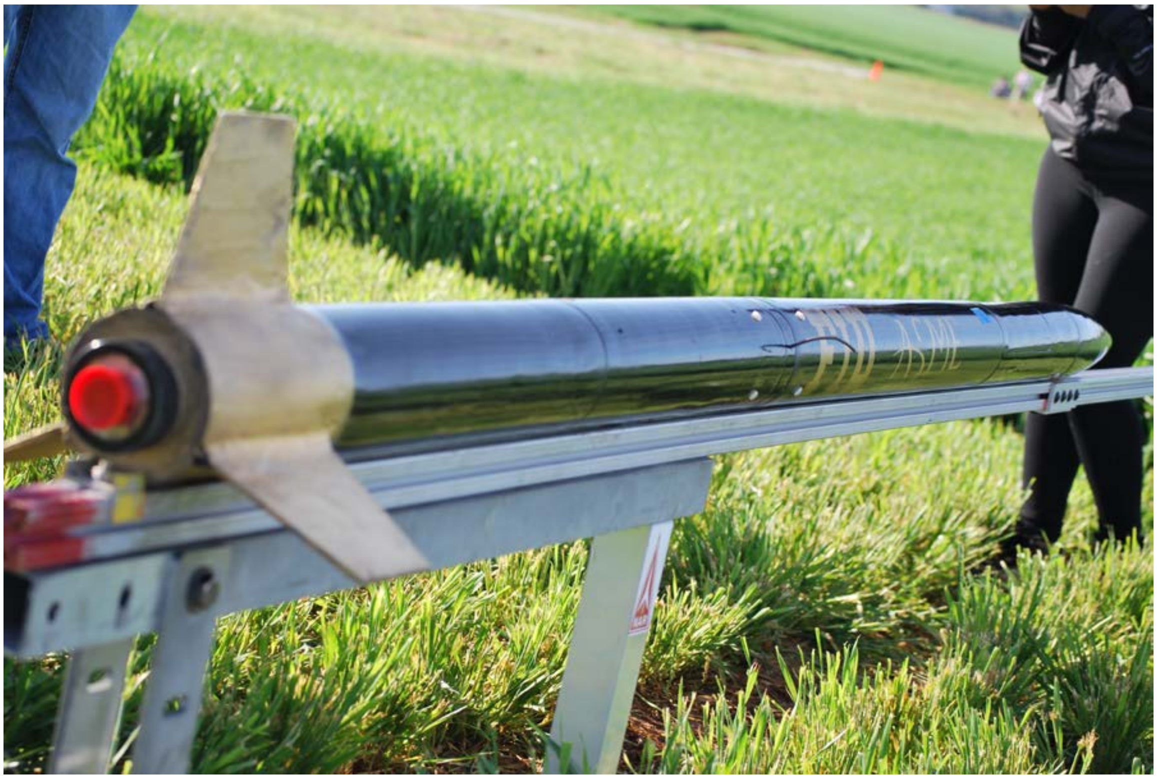

Figure 2: FIU rocket on the pad ready to launch

Figure 3: Successful Flight Recovery

3.2. AGSE RESULTS

The competition requirements called for the design and development of an autonomous ground equipment system that was capable of capturing a payload and containing it within the launch vehicle and lifting the launch vehicle to a vertical position to prepare it for launch. The team was able to prepare the required components and satisfy all the competition requirements.

The team presented their AGSE to the competition judges at the Launch Readiness Review. The AGSE passed their inspection and was allowed to perform its intended automated routine. The following figure is of the team undergoing the AGSE judging. The team received positive feedback on the successful capturing and containing of the payload as well as the vertical lift of the launch rail. Additionally, the AGSE successfully completed its routine within the allotted ten minute time frame.

Figure 4: Demonstrating AGSE performance to SL judges

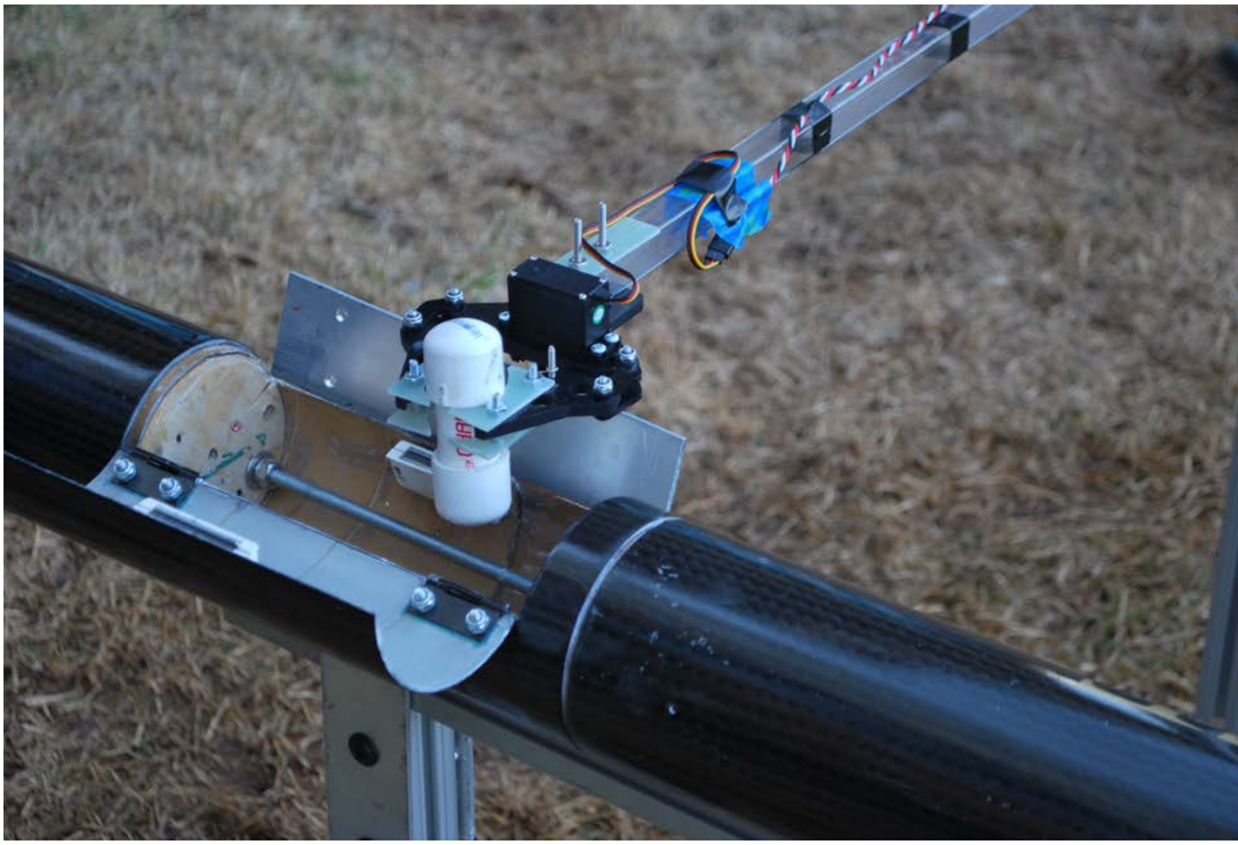

Figure 5: Payload Capture and Containment

Figure 6: Lifting the Vehicle autonomously

4. Project Data

4.1. Budget Summary

Component Costs

Part	Units	Unit Price ($)	Price ($)
Phenolic Tubing, Couplers, bulkheads	X	X	546.44
Parachutes	3	X	160
Flight computers (altimeters, data cable, standoffs)	X	X	138.30
GPS Units + SIM Cards + Activation	X	X	66.98
Carbon Fiber	20	30/ft	600
Heat Shrink and resin	X	X	198.82
80/20 supplies - Launchpad	X	X	504.77
Servo motors	X	X	162.11
Linear Actuator for rail lift	1	96.27	96.27
Electronics	X	X	432.64
Aerotech J270W Reload kit (x1)	1	60	60.00
Cesaroni K2045 reload kit (x2)	1	110	220.00
Misc. Hardware (adhesives, nuts/bolts, brackets)	X	X	298.91
Total			**3385.24**

Fundraising

Benefactor	Amount
FIU ASME	$700
GoFundMe.com	$300
Platinum Fundraising	$740
Florida Space Grant	$2000
TOTAL	**$3740**

4.2. Educational Engagement

We have successfully conducted their educational engagement plans. On February 27, 2015, we participated in the annual 'Engineering Expo' at the FIU Engineering Center. As part of this event, 1500+ local K-12 students are invited on the campus to visit and tour the labs and see the cool projects engineering students at FIU are participating in. The motivation for this event is to inspire these young students to pursue a STEM career by showing them its various applications. Our group, the ASME student section, conducted two presentations for this event. The first presentation was titled 'Propulsion 101'. This presentation served as an introductory course in propulsion and how things move. The primary vehicle for the material was a PowerPoint presentation. At the end, a balloon experiment was conducted where a large and small balloon were set to "race" against each other; asking the students to predict which would go farther due to the pressure differences inside. Our second demonstration consisted of showing the composition of different propellant grains. Very small amounts of conventional rocket fuels were combusted in a confined environment in order to showcase the burn profiles of rocket motors. Also, different coloring agents were added to help explain some of the chemical interactions undergone in the combustion process. Overall, the event was a success with many supervisors and group supervisors verbally giving their approval of our demonstrations. A link to a news article of the event, where two of our members were quoted, can be found at:

http://news.fiu.edu/2015/03/engineering-expo-sparks-stem-interest-in-youngsters

5. PROJECT EXPERIENCES

5.1. OVERALL EXPERIENCES

The FIU Rocketry team was formed in May 2014 to compete in the most ambitious rocketry competition we could find, the NASA Student Launch competition. With just 3 starting members, our goal was simply to fulfil all the competition requirements, with the highest quality workmanship possible.

At first, with such a small team, we believe we fell slightly short of our goals, especially in terms of the report quality. At this point the team was just 4, and the massive amount of effort that this project required, along with our regular coursework, was extremely taxing on all of us. As the competition progressed, we slowly gained more members and started getting the hang of working as a team and therefore the quality of our work improved. Come competition day, we were extremely proud of our rocket and AGSE, both of which performed spectacularly.

Although we had a rough start we feel we progressed greatly and the experience gained along the way was invaluable. Not only do we have that experience under our belt now, but we have a solid base to compete in future competitions, and now we fully understand how this competition works and how we can improve our team for the future.

The overall experience of the team was that projects like this teach educations groups "what it takes" in order to build high powered, reliable rockets. While the team initially attempted to create a "Cadillac" of rocketry, features, and additional constraints on the launch vehicle caused the team to re-focus on the features that they believed to be valuable to either points for the SL competition, or safety related features. While at first the ASME FIU team believed that they had just barely succeeded in delivering both the AGSE and the rocket on time and on budget to the SL competition, watching other teams assemble and construct the entirety of their rockets and/or ground support while in Huntsville gave the team confidence that they had made proper choices when it came to the construction and design timelines for their vehicle. Some issues that occurred with the rocket involved control and modeling of robotic systems, an area that the ASME team was not formerly familiar with. While the results of the competition show that the ASME team has created competent, if not excellent, robotics and control systems, the initial testing of this system was fraught with difficulties. Servo motors to control the robot arm were either ordered in the wrong size, or did not arrive at all. Manufacturer specifications turned out to be mere "manufacturers wishful thinking", especially when it came down any kind of precise control of a servo motor. These experiences have proven to be extremely valuable to the ASME team, as supply side issues can be a persistent issue in manufacturing, and having team members exposed has only allowed the team to further develop their engineering management prowess. With that in mind, the ASME FIU team would like to do this project next year, because the challenges offered by the SL event are a welcome challenge to a developing group of engineers.

5.1.1. Lessons Learned

This project taught the ASME team many lessons about the proper way to design, build, and fly a semi-spacefaring vehicle. With the constraints of budget and time well documented in advance, one of the difficulties that the team encountered was availability of funds. While the space grant organization for Florida granted the team over $2000, accessing and using the funds was more difficult than the team anticipated, requiring the team to go through weeks of lengthy bureaucratic proceedings before any funds were made available to the team.