ORCA

NATIONAL HIGH POWER ROCKETRY COMPETITION

PROJECT PROPOSAL

2015-2016

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§1 Introduction

The goal of this project is to compete in the NASA Midwest High Powered Rocket Competition, which includes teams from throughout the nation. This competition entails designing a high-powered rocket with an active braking system to be launched twice, once with and once without the activation of the brake system. Along with the physical rocket launches themselves, two written reports are to be submitted and two presentations are required for the competition. Especially with the dawn of private commercial space flight, the research done for this competition is highly applicable to real world situations pertaining to controlling the aerodynamics of a rocket once it has been launched.

§2 Significance

Rocketry is a constantly growing field, with many companies, such as SpaceX, Boeing, and Virgin Galactic, pioneering the private sector approach to space travel. The field of rocket science is generally acknowledged to be complicated, with many different approaches applied to all aspects ranging from launch orientation, propulsion system, booster configuration, flight trajectory, payload deployment, recovery, etc. Specifically, this research is focused on demonstrating control of a rocket to decrease its final altitude once it has been launched from the launch pad, engaging a mid-flight braking system after motor burnout and disengaging the braking system before parachute deployment.

This study will be done on a much smaller scale than the rockets developed by the aforementioned companies, but the conclusions drawn from it will be applicable on a larger scale. The competition not only requires that the rocket be stable and have an active drag system to control the velocity, but also that there be systems in place for video monitoring of the system and for the safe recovery of the rocket, i.e. parachutes to slow the descent to ensure that the rocket lands softly in near perfect condition, but does not drift too far away, enabling quick recovery and re-launch within one hour.

Most similar concepts are applied strictly to the recovery of the vessel, be it during regular flight or in emergency. With the ability to control the velocity, therefore compensating for irregularities in a launch, this technology could allow flight corrects to avoid possible abort scenarios and in turn reduce the budget risks of those missions. This project will not be covering such situations, further study could be done based on the conclusions of this project to test the applications of a drag system in the event of any failures upon launch.

§3 Objectives

The objectives of this project are fairly straightforward and meet the requirements of the Midwest High Powered Rocket Competition in which we intend to compete:

1. Build and test a high-powered rocket with built-in drag system
2. Write required reports (Preliminary Design, Flight Readiness, Flight Performance)
3. Present oral Flight Readiness Presentation
4. Launch Competition Flights

§4 Methods

As the rocket motor requires a refill for every launch, it is most economical to do the majority of the research in a theoretical sense beforehand. This mostly involves simulations using software available either as downloadable open source or provided by the Physics Department. The simulation results will be qualitative as well as quantitative, indicating the effectiveness of a given method of drag via the ratio of peak altitude with vs. without the braking system engaged along with detailed position, speed, and acceleration vs. time from launch to landing. The results of these tests will be vital to the development of the rocket and its associated drag system.

After simulations and construction, there must be at least one test launch, preferably two, to verify the stability of the overall design and capability of the active drag system. These test launches will also serve to train the team to be able to prepare the rocket for launch in a timely manner (since a key aspect of the competition requires the second launch to occur within the span of a single hour).

The final test of the system will be the launch as part of the competition. This will show the effectiveness of our approach compared to that of other teams throughout the country (note: while the competition is called the “Midwest High Powered Rocket Competition,” teams are invited from across the country, with contestants in 2015 from from as far as TX, OH, VA, KS). This competetive system of research promotes creative perspectives for solving a problem. In a sense, our team’s design and performance research will contribute to the research goals of NASA that are to efficiently determine the most effective approach to building an active drag system.

Jan. 21, 2016	International Telecom Repeat 7-8pm CST
Jan. 29, 2016	Formal Team Registration
Feb. 12, 2016	Declaration of Attendance
Mar. 18, 2016	Preliminary Design Report due
Apr. 2016	Test Flights
May 6, 2016	Flight Readiness Report and Educational Outreach Form due
May 15, 2016	Flight Readiness Presentations and Safety Checks
May 16, 2016	Competition Launch
May 17, 2016	Alternative Launch (Rain Day)
May 27, 2016	Post-Flight Performance Evaluation and Data Collection Report due
Jun. 10, 2016	Final Competition results reported

§5 Dissemination

As the competition launch is not until May, our work would not yet be ready for presentation at any of the spring conferences. This means that we will not be presenting at any large-scale events until the Fall Gala the following academic year. The launch is after finals for the spring semester as well, and so we will also need to wait until the following fall to present our work at the regular Society of Physics Students meetings, which we intend to do. The competition also requires an educational outreach presentation, which we plan to give at Meyer Middle School and/or Hudson Senior High School.

§6 Detailed Budget

Equipment Budget	**Dim.**	**Ppu**	**Quant.**	**Total**
G12 Fiberglass	5.5” x 48”	$175.10	2	$350.20
G12 Coupler	5.5” x 12”	$60.67	2	$121.34
Blue Tube - Motor Mount Tube	75mm	$29.95	1	$29.95
Fiberglass Nosecone	5.5”	$110.20	2	$220.40
G10 Centering Rings	75mm/5.5”	$17.10	4	$68.40
808 Keychain Camera		$41.35	2	$82.70
Thrust Plate	75mm/5.5”	$59.21	1	$59.21
Bulkhead Disk	5.5”	$7.25	2	$14.50
Angel Parachute	60”	$105.00	2	$210.00
Fruity Chute Drogue	24”	$63.70	1	$63.70
Shock Chord U-Bolt	1/4”	$4.29	1	$4.29
Sunward Black Parachute Protector	18”	$9.99	1	$9.99
Madcow Parachute Protector	12”	$8.51	1	$8.51
Kevlar Cord 1500#	1’	$0.92	10	$9.20
Airfoiled Rail Buttons		$7.00	1	$7.00
Large Capacity Ejection Canister	5pk	$12.50	1	$12.50
Blue E-Bay	5.5”	$56.95	1	$56.95
Fiberglass Fin Stock	1/4” x 1sq.ft.	$51.43	2	$102.86
Tracking Powder		$6.25	1	$6.25
Ace Premium Spray Paint	12oz	$23.94	3	$71.82
Tube Cutting Guides		$12.83	1	$12.83
Large Guillotine Fin Jig		$195.00	1	$195.00
Arduino Mega 2560 Rev3		$51.07	1	$51.07
Sparkfun Mpu6050 Triple Axis Accelerometer And Gyro		$39.95	1	$39.95
Raven III Altimeter		$155.00	1	$155.00
G5000 Rocket Epoxy	2pint	$38.25	1	$38.25
Total Equipment Budget				**$2,001.87**

Stipend Budget	**Rate**	**~Hrs.**	**Total**
Mitchell Ahlswede	$5.00	60	$300.00
Roman Alvarado	$5.00	60	$300.00
Mark Christenson	$5.00	60	$300.00

Brian Miller	$5.00	60	$300.00
Adam Hendel	$5.00	60	$300.00
Trevor Hoglund	$5.00	60	$300.00
Riandro Vogt	$5.00	60	$300.00
Total Stipend Budget			**$2,100.00**

§7 Total Request

Main Budget	
Equipment	$2,001.87
Registration	$400.00
Poster Printing	$75.00
Stipend	$2,100.00
Total	**$4,576.87**