EM-CoRP
RockSat-C 2015
Community College of Denver
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Preliminary Design Review

[Logos for NASA, Community College of Denver, and another]
Mentors

- Steffanie Peterson
- Rick Glesner
- Stephen Hevert
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Mission Overview

[Logos of NASA, Community College of Denver, and WFF]
Mission Overview

- **Mission Statement:** To Successfully develop, test, and implement a computer controlled, electromagnetic spin stabilization platform in the payload housing portion of the rocket.

- **Mission Requirements:** To achieve successful programming and spin control of our platform during the launch and flight of the rocket using an Arduino Mega microcontroller. Any indication that we achieved a stable spin platform with less an error margin of than 0.5 Hz or 30 rotations per minute would constitute a success. We will also be utilizing an Electromagnetic Shielding to protect other experiments that will be measuring the Earth’s Electromagnetism.  
  We will not need access to any special ports on the rocket.
Mission Overview

● **Expectations:** We believe that we can take the previous experiment by Frostburg University in 2012, remove some of the gears and motors to reduce power consumption and make a lighter, less power draining spin platform system.

● **Benefits:** Biomedical and Pharmaceutical companies are developing and experimenting with new compounds and want to test their chemical reactions as well as see how the compound holds up in a near zero gravity environment. Our platform would allow them to do so without any centrifugal forces acting upon them in near zero gravity.
- Rocket is spinning up to 240RPM

- Should see low centrifugal forces on the spin gyro

End of Orion Burn
- $t \approx 0.6$ min
- Altitude: 52 km
- Measurements of both gyroscopic sensors adjusting spin till splash down

- G switch triggered
- All systems on
- Begin data collection
- Begin stabilization

Apogee
- $t \approx 2.8$ min
- Altitude: $\approx 115$ km

- Altitude: 95 km

- Splash Down

- Altitude: 75 km

- Altitude: 75 km

- Altitude: 52 km

- Altitude: 52 km

- Altitude: 95 km
Theory and Concepts

- Stators are the electromotive parts used in electric motors as well as car starters.
- They use electric current running through a coiled copper wire to generate a rotating electromagnetic field that will spin a rotor.
- In our configuration we will build a platform attached to the rotor that will act as our despun platform.
- The voltage applied to the stator controls the rotational speed of the platform and the direction of the current pattern will determine if it spins clockwise or counter-clockwise.
Theory and Concepts

- Previous RockSat-C experiments have focused on doing the same thing, but using an electric motor (similar) to power a gear box (not similar) to cause the plate to spin.
- They learned close to their LRR that they had power issues which has led us to be very considerate of our experiments power consumption.
- The concept of Centrifugal Force and Torque
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System Overview
Flow of Data

Angular Velocity → Fixed Gyroscope → Computer → Convert to RPMs

- Platform Gyro sends data to computer
- V.R Sends power to stator
- Relay to Voltage Regulator
Mission Requirements: Computer

- Triggered by a G-Switch
- Program the flight computer to read gyroscopic measurements from multiple sensors and adjust electric current to the stator to adjust the angular velocity of the despun platform
- To have the flight computer read gyroscopic data off of a fixed gyroscope measuring the rocket's angular velocity
- To have the flight computer read gyroscopic data off of a gyroscope located on the despun platform
- Successfully run a current through the Stator to spin up, or spin down, the despun platform depending on rocket rotation - in real time
Mission Requirements:
Sensors

- Still in discussion with manufacturers about sensor capabilities to ensure sensor fit requirements adequately
- Sensor are expected to deal with vibrations and temperature changes
Mission Requirements:
Structure

- 10 Lbs +/- .1lb
- Must be able to withstand 45 +/- 5 G’s
- Electromagnetic Field MUST be completely insulated from the rest of the rocket
- Spin plate must be able to rotate under the G-force’s of launch and acceleration
We have a running Google Spreadsheet of our parts, dimensions, source, and cost.

https://docs.google.com/spreadsheets/d/1oV7dsxmabfLumch6-YBTkMRVU_4kriQa7Eh5YpgTWY/pubhtml
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Subsystem Design: Stator Motor
Functional Block Diagram

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- Solid Gyro
- Flight Computer
- Power Supply
- DC Voltage Regulator
- Stator
- Spin Plate Gyro

Denotes Power
Denotes Data
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Subsystem Design: Arduino Mega
Functional Block Diagram

- Low G Accelerometer
- High G Accelerometer
- Temp Sensor
- Rocket Gyro
- Platform Gyro
- Pressure Sensor
- DC Voltage Regulator
- SD Card
- Stator

[Presenters Name]
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Prototype
Approx. Weight: 
~8 lbs

Preliminary 3D Design - Case
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• Computer system and pressure sensor will be tested in a belljar to insure accuracy
Temperature Test

- Cold test will be conducted using dry ice and a cooler
- Computer will be programmed to spin up and spin down the platform to make sure power consistency is the same at different temperatures
Vibration Test

- Once a prototype is built we plan on bringing the finished product to the Boulder facility to test mechanical components as well as sensor sensitivity
Centered Gravity Test

- Solidworks will be used to determine center of gravity as well as a physical test in the Boulder facility
Once final programming is complete a spinning stool will be used to test the success of the final product.
Rick Glesner’s 3D Engineering Design class:
Andrew Metsala
Michael McCarty
Felicia Hackney
Ryan Borah
Alexander Bender
Yemane Abraha
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Conclusion
Work to be done

- Finalize parts and sensor list
- Find an Electrical Engineer to assist in mentoring the electrical build of our experiment.
- Find a Programmer to assist in mentoring the programming of the experiment.
- Finalize our Gantt Sheet for the second semester of the build.
Once we get a model built, when would be able to schedule a time to bring a prototype up to Boulder to undergo the Pressure as well as Vibration tests?