BaDSTAR II

Critical Design Review

MITCHELL COMMUNITY COLLEGE
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Mission Overview
Mission Overview

- **Electronics Team**
  - To build a control system for communication, data acquisition/collection on telemetry systems, on-demand image transfer, Hybrid boom deployment sensor, vibration dampener sensors

- **Boom Team**
  - To successfully employ a Hybrid gravity gradient boom system. The intent is to reduce overall size and weight.

- **Vibration Dampening Team**
  - We will design a test system to analyze viscous fluid for vibration damping abilities for a future CubeSat.
Gravity Gradient Boom Theory and Concepts

\[ F_g = \frac{GM_1 M_2}{r^2} \]

- We know from this formula that the gravitational pull of the earth is proportional to the distance between the center of the earth and the mass on which it acts.
- Furthermore a mass with an extension of itself (ie: GGB) will tend to have the end of greater mass remain directed at the earth as opposed to the end with less mass.
- Boom has the future CubeSat act as a gravitational dipole in the gravitational field.
  - The lowest energy state with the most stability is the pole of the CubeSat with the most mass closer to the Earth than the pole of the CubeSat with the less mass.
- This acts to damp out vibrations of the future CubeSat in pitch and yaw.
Vibration Damping System Theory and Concepts

- Passive Vibration Dampening System
  - Viscous Fluid Dampening System
    - Use a viscous oil to dampen a roll vibration that the future CubeSat will experience
    - Use very small ball bearings to track fluid flow

- No previous research has been conducted from MCC rocket team
  - Brand new addition to the Rocket Team, so we are starting from scratch.

- We will use characteristics of a subwoofer to bench test our vibration dampening system
  - The use of the capacitive or ultrasonic sensors will monitor the movement of the ball bearings within the fluid (current design)
Theory & Concepts - Electrical

- Line of sight attenuation in free space
  - Path Loss in free space (Dbi) = 32.5 + 20 x Log10(Distance Km) + 20 x Log10(Frequency MHz)

- Ionosphere, Moisture, Rain Attenuation
  - Rain Attenuation (α) = coefficient of vertical polarization (a) * Rate of Rain(R)^coefficient of vertical polarization (b)

- Dbi Loss due to cable and connectors
  - Pre matched cabling

- Antenna Gain
  - \( G = \sum R \cdot D \)

- Antenna Polarization
  - Linear (Vertical / Horizontal)
Con Ops

**Altitude**

- Establish Connection with Ground Station
- Apogee
  - Boom Deploys
  - Take Photo
  - Begin Data Packet Transmission
- Continue data packet transmission till splash down
- Boom System data turn off
- Chute Deploys
- Splash Down, turn off system. End all Data Acq

**Timeline**

- t - 2 min
  - Turn on System
  - Start dampening
  - Data Acq

- t ≈ 15 min
  - Splash Down, turn off system. End all Data Acq
Expected Results

- **Electronics Team**
  - Establish communication/control of on-board systems, collection and transmission of telemetric data from sensors monitoring on-board systems

- **Boom Team**
  - To achieve a better quantitative understanding of the deployable boom system. Also to prove this design is RockSat-X ready

- **Vibration Team**
  - Expect that data received during the experiment should correspond to predicted results
  - Expect to collect enough data from the sensors to determine how effective our vibration dampening system is likely to perform
Design Description
System Design

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PART NUMBER</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cylindrical Payload Body</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Canister Lower Endcap</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>Canister Upper Endcap</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Nyk's Toy Payload Assembly</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Part 1</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Part 2</td>
<td>1</td>
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<tr>
<td>7</td>
<td>Part 3</td>
<td>1</td>
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<tr>
<td>8</td>
<td>Part 4</td>
<td>1</td>
</tr>
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</table>
Changes Since PDR -GGB

- Changes have been made to the gearing system that drives the cams. The updated design implements a worm gear driving two opposing helical gears.
- We have found that using a servo motor will best suit our need for precise rotation of our cams while eliminating the need for an encoder to drive a DC motor.
- In an effort to streamline the prototyping process we are using 3D rapid prototyping.
- These changes were necessary to overcome undesired power consumption in using a DC motor with an attached gear box to supply our stall torque and to simplify the design.
- This change in design does not effect GGB major mission requirements.
We expect positive results from our updated design and plan to move forward with prototyping and testing.

- At this time we do not foresee any compromise to our objectives.

Back feeding of the boom tape is our area of high risk and is a major mechanical component of our subsystem design. The alternative would be to use last years boom design and retrofit to accommodate new testing environments.
GGB Cage & Spool Assembly

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PART NUMBER</th>
<th>QTY.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cage Assembly</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Tape Spiral</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>TEST Platform</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Tape Spool</td>
<td>1</td>
</tr>
</tbody>
</table>
Changes Since PDR - VDS

- What major changes have you made since PDR?
- Structural changes to the Primary Fluid Compartment
  - The hole in the middle of the Primary Fluid Compartment design has been removed due to no need for it.
  - Increase the diameter of through holes and increase thickness to increase structural integrity
  - Raised baffles inside of the primary fluid compartment to increase dampening effect
  - Addition of a secondary layer to act as a backup if the Primary Fluid Compartment does not perform as expected

- The following changes do not change any of the mission requirements or objectives
De-Scopes and Off-Ramps - VDS

- There are currently no de-scopes at the moment

- Off-Ramps
  - Capacitive Sensor Array
  - Secondary Fluid Compartment
  - Fluid Compartment design with separate axis free to spin. One accelerometer located on the fluid compartment and one accelerometer located on the payload. Data of the two accelerometers will be compared to conclude the effectiveness of the system
  - Fluid Compartment design with propeller in the middle connected to a rotary encoded to monitor the movement of the fluid
Vibration Dampening System Design Elements

Primary Fluid Compartment
Primary Fluid Compartment
Vibration Dampening System Design Elements

Secondary Fluid Compartment
Changes Since PDR

- Capacitance Sensor Array & Gyroscope
  - Capacitance Sensor Array - unable to design, Gyroscope - Open up pins for different Vibration Sensors

- This can potentially change the requirements for the Vibration Dampening Subsystem
De-Scopes and Off-Ramps- electrical

- Development of custom Arduino PCB boards
  - High risk if etched
  - Lower risk if routed

- De-scope if boards not functional or does poorly in testing
  - De-scope, Use pre-fab Arduino boards
The Communications System utilizes an Atmega328p microcontroller that controls the Boom Servo, reads for change in IR sensor, reads and transfers images from the Camera module VC0706 to transceiver and a TTL bidirectional RS232 converter.

- Atmega328p sends a PWM signal to the Boom Servo that opens the Boom Gates.
- IR Sensor circuit is designed to work as state change monitor, and record status of Boom deployment.
- Camera Module takes image buffers and transfers data over serial.
- TTL to RS232 Converter conditions signal levels to ensure safe logical levels between MCU and Transceiver.
- Atmega328p communicates with Data acquisition system using TW(I2C).
Communications Design Elements

- Major Components
  - MCU- Atmega328p
  - MAX3232
  - Camera- VC0706
  - Servo
  - IR LED- SFH482
  - IR Receiver- TSOP1730TB1
  - Transceiver- Microhard Nano 2420

Communications Schematic A
Communications Design Elements

- Major Components
  - MAX3232
  - Sub-D 9 pin connector
  - Polarized Capacitors
Communications Design Elements

2.4 GHz Yagi antenna design 1.1

All Dimensions in Inches

<table>
<thead>
<tr>
<th>ITEM NO.</th>
<th>PART NUMBER</th>
<th>DIMENSIONS</th>
<th>QTY.</th>
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<tbody>
<tr>
<td>1</td>
<td>Yagi antenna 1.1</td>
<td>.25in Ø x 3in</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Yagi director 1.1</td>
<td>.125in Ø x 2.18in</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Yagi Driven element 1.1</td>
<td>.125in Ø x 2.26in</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>Yagi reflector 1.1</td>
<td>.125in Ø x 2.43in</td>
<td>1</td>
</tr>
</tbody>
</table>
Data Acquisition Design Elements

The Data Acquisition system utilizes an Atmega328p microcontroller that reads data from 3 analog outputs on the Accelerometer, writes data from analog digital converters to MicroSD card using defined SPI. After Data read write loop finishes data is then transmitted through TWI to Communications system.

- Atmega328p reads sensor data and saves to MicroSD.
- ADXL377 Accelerometer sensor outputs analog data 3 axis (Z,X,Y)
- MicroSD on board data storage device

Communications Block Diagram
Data Acquisitions Design Elements

- Major Components
  - MCU- Atmega328p
  - MicroSD Socket
  - Accelerometer ADXL377

Data Acquisitions Schematic A
Data Acquisitions Design Elements

- **Major Components**
  - MCU- Atmega328p
  - MicroSD Socket
  - Accelerometer ADXL377

Data Acquisitions Schematic B
Electronics Design Elements

- Voltage Switching Regulating Circuit
- 11v to 5v 2A and 3.3v 2A out
- Unused voltage isn’t wasted in heat
  - IC NON-SYNCH BUCK CONV - TPS54283PWPR
  - Rectifiers- MBRS320

Power Supply Schematic
Communications Software Design Elements

Boom Flow Chart

- System on
- Begin read of ADXL
- Detect Change in ADXL
- Begin Mission Timer
- Begin Boom Routine
- Open Boom Gates
- Transmit Status
- Read IR Sensor
- Detect Change
- Transmit Status
- Close Boom Gates
- Transmit Status

Major Functions

- Detecting Launch
- Mission Timer0
- Servo open/close
- Detecting IR
- State Change
- Transmission of Status

Software Flow Chart
Communications Software Design Elements

Data Acquisition Flow Chart

- System on
- Begin read of ADXL
- Detect Change in ADXL
- Begin Mission Timer
- Begin Data Routine

- Reading Accelerometer X, Y, Z
- Writing data to MicroSD
- MissionTimer0
- Signaling Camera to capture image into Camera Buffer.
- Signaling Camera to transfer data to Transceiver.

Software Flow Chart
Prototyping/ Analysis
GGB Analysis Results

- Test Since PDR
  - Boom Deployment Testing

- Results
  - Boom has shown repeatable performance deploying and stopping using our Gear and Cam System.

- How do these results relate to the project requirements?
  - We require confirmation of a successful/unsuccessful deployment of our GGB system.
GGB Prototyping Results

- Designs Prototyped
  - GGB Subsystem

- Sub-assemblies
  - Cage Assembly
  - Tape Spool
  - Gearing for testing acquired

- We have found that our current 3D printing capabilities are not the best option for the final design due to lack of structural integrity, although it is the most efficient way to streamline our prototyping and testing.
  - We may utilize more precise 3D capabilities at UNCC using their FDM machine along with ULTEM(polyetherimide) for its strong mechanical abilities.

- Proving the gearing system for the cams as the best solution we believe is a success and plan to continue with this design.

- The back feeding solution component has been prototyped but not yet tested.
Analysis Results - VDS

Mock-up of the Capacitive Sensor Array has been tested and analyzed:
- The Capacitive Sensor Array was unresponsive to the metal ball bearings possibly because it needs to be in analog versus digital.
- The importance of a contingency plan for testing the Vibration Dampening System has been brought to attention.
Prototyping Results - VDS

- Primary Fluid Compartment
  - Result: Design revision were needed

- Cups for testing sealants
  - Two sealants have been tested and appear to be successful
  - This assures that we have at least two options for the first seal for the fluid compartments
## Detailed Mass Budget

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Total Mass (lbf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
<td>1.5 lb</td>
</tr>
<tr>
<td>GGB</td>
<td>3.00 lb</td>
</tr>
<tr>
<td>VDS</td>
<td>2.50 lb</td>
</tr>
<tr>
<td>Elec./Data Acq</td>
<td>3.5 lb</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>10.00 lb</strong></td>
</tr>
<tr>
<td><strong>Over/Under</strong></td>
<td><strong>0.00</strong></td>
</tr>
</tbody>
</table>
Analysis Results – Communications/Data Acq

- Analyzed code from last years payload
- Analyzed previous mission results Transmitting

Results:
- Data capture from Accelerometer was successful and a large amount of data was saved
- Transceiver code failed; incorrect internal settings.

How do these results relate to the project requirements?

- Using the analyzed code from previous payload helps create guidelines for working and code that needs to revised.
Prototyping Results-Communications/Data Acq

- Arduino Due connected to ADXL Breakout board used sample code to read analog outputs and displayed data through Arduino IDE serial monitor via USB.

- Connected Transceivers via serial to Laptops configured devices based on datasheet defaults.

- Paired Two transceivers wirelessly and received ACK via serial monitor.

- Schematics for each electrical systems rev1

- **How do these results relate to the project requirements?**
  - ADXL accelerometer is easy to interface with and response time is very fast. Will be able to poll values very quickly which will increase resolution of data.
  - Transceivers communicating with each other is mission critical and further testing is required with different antenna.
  - PCB schematics will determine final project size.
Power Discussion

Show an approximation of how much power each system will use vs. how much is available

Discuss your power supply, and how it will be sufficient

<table>
<thead>
<tr>
<th>Subsystem</th>
<th>Voltage (V)</th>
<th>Current (A)</th>
<th>Time On (min)</th>
<th>Amp-Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>com</td>
<td>21.3</td>
<td>.27</td>
<td>15</td>
<td>0.205</td>
</tr>
<tr>
<td>data</td>
<td>9.9</td>
<td>.1003</td>
<td>15</td>
<td>.025075</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Total (A*hr): 0.233</td>
</tr>
</tbody>
</table>
Manufacturing Plan
Currently we are assembling our first two subassemblies and have already manufactured the parts to do so. Until structural and back feeding isolation tests have been completed we will resume the use of ABS plastics.

We need to procure sensors for program testing of both the gearing actuation (open/close “cam gate”) and velocity readings.

- Recently acquired one sensor. Due to our desire for precise data to rate the velocity we will test and possibly implement the use of multiple sensors

First prototypes will be assembled and mechanically tested by mid-January.

First program simulation expected by mid-February
Manufacturing Plan - VDS

- The whole subsystem will be manufactured in-house
- Primary Fluid Compartment will be 3D printed
- Secondary Fluid Compartment will be machined out of Delrin at MCC facilities
Manufacturing Plan - Communications/ Data Acq

- Manually route each schematic, test if communications and data acquisition will fit on one side of PCB. Separate PCB for power supply.

- At least 5 revisions for each PCB

- What needs to be procured?
  - SUB-D 9 pin connectors
  - lipo battery 10-13v 4000mah
  - double sided copper clad PCB
Software Elements

❖ What discrete blocks of code need to be completed?
  o SoftwareSerial library
  o SD library
  o ADC Library
  o Servo Library
  o MissionTimer0
  o 2wire library
  o Serial library.

❖ They all depend on each other.
Testing Plan
# Gravity Gradient Boom System

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Verification Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boom will be capable of deploying in excess of 14 feet</td>
<td>Prototype testing</td>
<td>System will be deployed in excess of 10ft. to prove consistent deployment capabilities throughout deployment and 10 feet as a safety factor</td>
</tr>
<tr>
<td>GGB and Payload system will withstand dynamic forces</td>
<td>Dynamic Testing</td>
<td>Shake table, Flight Testing</td>
</tr>
<tr>
<td>Isolate Boom Tape back feeding</td>
<td>Prototype testing</td>
<td>Dual designs utilizing counter springs at multiple points of tangency along the circumference of the Boom Tape.</td>
</tr>
</tbody>
</table>
Testing Plan

- **Mechanical Components of Vibration**
  - Verify mass allowance of shell by placing on scale.
  - Test structural integrity of the shell under extreme circumstances.
    - Placing on shake table or subwoofer
    - Successful if no cracks, weak joints, and leaking fluid is observed upon removal. If not choose a strong sealant material.
  - Determine critical dampening point with various fluids at our expedient disposal.
  - Compare seismograph app data in the x, y, z directions

- **Electrical Components of Vibration**
  - Testing the sensitivity of capacitive sensors.
  - Place on shake table or subwoofer
  - Successful if data is observed on the SD card. If not, bigger ball bearings, more capacitive sensors, or a different sensor altogether will resolve the issue.

- **Software Components of Vibration**
  - No syntax errors in code
  - Check the code logic and revise as necessary
Testing Plan - Communications/ Data Acq

- Line of sight attenuation communications test (Dec. 2014)
  - Testing RF attenuation/signal on ground, line of sight at 1 watt power

- High altitude balloon communications testing (Jan. 2015)
  - Testing RF attenuation/signal on high altitude balloon while spinning (3-5 Hz)

- Data bus system table top test (Dec. 2014)
  - Acquire sensor data and save to SD then verify data

- Data bus stress test/ vibration test (Jan. 2015)
  - Acquire sensor data and save to SD, while in vibration testing system

- Image data acquisition test (Dec. 2014)
  - Capture image and verify on SD card (software/hardware test)

- Image date RF communication test (Jan. 2015)
  - Capture image and send data via RF transceiver

- Basic software elements testing (ongoing)
  - Verify program is working correctly
System Level Testing

<table>
<thead>
<tr>
<th>Test</th>
<th>Explanation</th>
<th>Test Metric</th>
<th>When</th>
<th>Location</th>
<th>Execution (Who? What?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fit Test</td>
<td>Full System integration</td>
<td>All three subsystems are able to integrate into one whole system structural and electrically</td>
<td>First week of April</td>
<td>@ MCC</td>
<td>-All systems -All teams</td>
</tr>
<tr>
<td>Simulated System Benchtop Test</td>
<td>Run full system simulation</td>
<td>All mission objectives are met</td>
<td>Second/Third week of April</td>
<td>@ MCC</td>
<td>-All systems -All teams</td>
</tr>
<tr>
<td>Flight</td>
<td>Payload Test Flight in hobby rocket, maximum apogee &lt; 1 mi</td>
<td>To see if Payload can withstand flight conditions and meet mission objectives</td>
<td>End of April/Beginning of May</td>
<td>Midland, NC</td>
<td>Dr. Doug Knight -All systems -All teams</td>
</tr>
</tbody>
</table>
Risks
Risk Walk-Down

- What were your biggest risks at PDR? (based of PDR Risks Matrix)
  - Mechanical device seizes/ binds
    - Extensive ground testing and flight testing
  - Damage to external wiring harness
    - Review previous year’s design
  - Damage to electronic components due to G-forces
    - Extensive testing and robust design
  - Fluid Containment Leakage
    - Extensive testing of sealing design for capability
  - Capacitive Sensor Matrix Failure
    - Creating contingency plans that do not include using a Capacitive Sensor Matrix
Risk Walk-Down

Accepted Risks
- Rocket Failure
- Payload Recovery
- Weather affecting Communications

<table>
<thead>
<tr>
<th>Consequence</th>
<th>Possibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSK.2 – Electronics not functioning as designed</td>
<td>RSK.1 - Capacitive Sensor Array</td>
</tr>
<tr>
<td>RSK. 3 – Boom Design Scalability</td>
<td></td>
</tr>
</tbody>
</table>
Risks- GGB & VDS

**GGB**
- Back-feeding of Boom Tape around the Spool
  - Primary design developed to overcome this problem
- Seizing of tape inside raceway
  - Will create adequate spacing of raceway and appropriate Radii to reduce friction
- Gears Binding
  - Precision machining/rapid prototyping will be used to ensure proper mesh
  - Servo motor program will rotate gears clock and counter-clock-wise to assist with any unforeseen back-feeding and/or improper meshing instances

**VDS**
- The structure of the fluid compartment is not durable enough
- Sealing mechanisms are not adequate
- Capacitive sensors fail to detect vibration
- Capacitive sensors fail to store data to SD card
User Guide Compliance
User Guide Compliance

- Weight: The weight of the payload will be 10 lb ± 0.1 lb
- Center of Gravity: Will be within 1”x1”x1” envelope
- Batteries: Rechargeable LiPo battery 10-13v 4000mah
- Activation: T- 2 minutes
- No high voltage
- Optical and Antenna Port requested
- Liquids for VDS will be contained and triple sealed
Shared Canister Logistics

- Who are you sharing with?
  - Unknown at this time

- Plan for collaboration
  - Electronic – e-mail and/or teleconference
  - Sharing of designs will be digital transfer of SolidWorks and Text files

- Structural interface – To be determined with partner

- An Optical and Antenna port will be needed by Mitchell Team
Project Management Plan
<table>
<thead>
<tr>
<th>Date</th>
<th>Action</th>
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<tbody>
<tr>
<td>30 Jan 2015</td>
<td>Update Teleconference</td>
</tr>
<tr>
<td>13 Feb 2015</td>
<td>Update Teleconference</td>
</tr>
<tr>
<td>16 Feb 2015</td>
<td>First Payment Due</td>
</tr>
<tr>
<td>26 Feb 2015</td>
<td>STR Presentation Due</td>
</tr>
<tr>
<td>27 Feb 2015</td>
<td>STR Presentation Teleconference</td>
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<td>13 March 2015</td>
<td>Update Teleconference</td>
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<td>27 March 2015</td>
<td>Update Teleconference</td>
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<td>6 April 2015</td>
<td>Final Payment Due</td>
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<td>9 April 2015</td>
<td>ISTR Presentation Due</td>
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<td>10 April 2015</td>
<td>ISTR Presentation Teleconference</td>
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<td>24 April 2015</td>
<td>Update Teleconference</td>
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<td>8 May 2015</td>
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<td>21 May 2015</td>
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<td>22 May 2015</td>
<td>FMSR Presentation Teleconference</td>
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<td>9 June 2015</td>
<td>LRR Presentation Due</td>
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<td>10 June 2015</td>
<td>LRR Presentation Teleconference</td>
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<tr>
<td>17 June 2015</td>
<td>Depart for Wallops</td>
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<tr>
<td>18-25 June 2015</td>
<td>Wallops Trip and Rocket Launch</td>
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## ROCK SAT-C 2015

### Expenses

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<tr>
<th>Canister</th>
<th>Oct. Earnest Payment</th>
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<tbody>
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<td>Jan. First Payment</td>
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<td>Apr. Final Payment</td>
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<td><strong>Total</strong></td>
<td><strong>$7,000.00</strong></td>
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<table>
<thead>
<tr>
<th>Wallop Travel Cost</th>
<th>June</th>
<th>$7,000.00</th>
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</thead>
<tbody>
<tr>
<td>Hotel</td>
<td>$7,000.00</td>
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</tr>
<tr>
<td>Vehicle Cost Including Gas</td>
<td>$1,000.00</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$8,000.00</strong></td>
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<table>
<thead>
<tr>
<th>Orangeburg/Midland/Launch/Trip BALLOON LAUNCH</th>
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</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
</tr>
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<table>
<thead>
<tr>
<th>Balloon Launch</th>
<th>December</th>
<th>$200.00</th>
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<tbody>
<tr>
<td>Travel</td>
<td>$200.00</td>
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<tr>
<td>Rocket/Motors</td>
<td>$400.00</td>
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<tr>
<td>Travel</td>
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<tr>
<td>Rocket/Motors</td>
<td>$400.00</td>
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<td><strong>Total</strong></td>
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<table>
<thead>
<tr>
<th>Food &amp; Registration Cost for Students @ Wallops</th>
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<tr>
<td><strong>Total</strong></td>
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<table>
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<tr>
<th>Wallop</th>
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<tbody>
<tr>
<td>Price Per Student $250</td>
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<tr>
<td>Telephone</td>
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<td>Transportation</td>
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<tr>
<td>Stationery supplies</td>
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<tr>
<td>Fax services</td>
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<td><strong>Total</strong></td>
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Project Summary

- Doubts about the Capacitive Sensor Array feasibility and manufacture ability
- Areas of concern
  - Communication from distance effects (apogee)
  - Manufacturing electronics in-house (will they work as expected)
  - Determining whether test method validates functionality of VDS
  - Boom design scalability to a CubeSat
  - GGB Gate design robustness
<table>
<thead>
<tr>
<th>Name</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adam Hartley</td>
<td><a href="mailto:achartley97@gmail.com">achartley97@gmail.com</a></td>
</tr>
<tr>
<td>Amelia Zwiener</td>
<td><a href="mailto:ajzwiener@gmail.com">ajzwiener@gmail.com</a></td>
</tr>
<tr>
<td>Brandon Duley</td>
<td><a href="mailto:bduley7703@gmail.com">bduley7703@gmail.com</a></td>
</tr>
<tr>
<td>Clarence West</td>
<td><a href="mailto:cgwest@mitchellccmail.com">cgwest@mitchellccmail.com</a></td>
</tr>
<tr>
<td>Corey Adams</td>
<td><a href="mailto:cpadams29528@mitchellccmail.com">cpadams29528@mitchellccmail.com</a></td>
</tr>
<tr>
<td>Grover Jarvis</td>
<td><a href="mailto:gfjarvis@mitchellccmail.com">gfjarvis@mitchellccmail.com</a></td>
</tr>
<tr>
<td>Kris White</td>
<td><a href="mailto:kwhite_2012@yahoo.com">kwhite_2012@yahoo.com</a></td>
</tr>
<tr>
<td>Lewis LaBrie</td>
<td><a href="mailto:ljlabrie@mitchellccmail.com">ljlabrie@mitchellccmail.com</a></td>
</tr>
<tr>
<td>Lucas Parker</td>
<td><a href="mailto:lbparker30558@mitchellccmail.com">lbparker30558@mitchellccmail.com</a></td>
</tr>
<tr>
<td>Max Daubin</td>
<td><a href="mailto:1biolego@gmail.com">1biolego@gmail.com</a></td>
</tr>
<tr>
<td>Noah Weiss</td>
<td><a href="mailto:naweiss@mitchellccmail.com">naweiss@mitchellccmail.com</a></td>
</tr>
<tr>
<td>Nyk Bray</td>
<td><a href="mailto:nykryanbray@yahoo.com">nykryanbray@yahoo.com</a></td>
</tr>
<tr>
<td>Raleigh Puskas</td>
<td><a href="mailto:rspuskas@mitchellccmail.com">rspuskas@mitchellccmail.com</a></td>
</tr>
<tr>
<td>S. Ray Kongvongxay</td>
<td><a href="mailto:srkongvongxay@mitchellccmail.com">srkongvongxay@mitchellccmail.com</a></td>
</tr>
<tr>
<td>Taylor Parker</td>
<td><a href="mailto:wakeboard147@gmail.com">wakeboard147@gmail.com</a></td>
</tr>
<tr>
<td>Tim Painter</td>
<td><a href="mailto:twpainter6239@gmail.com">twpainter6239@gmail.com</a></td>
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# Team Availability Matrix

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**Availability**

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**Rocksat-C**

12/5/14
Conclusion

- **Plan of Action:**
  - Continue development and begin testing of each subsystem.
  - Handle off ramps as necessary

- **To Complete before Winter Break**
  - Testing of GGB system
  - Continue sensor and test development for VDS system
  - Perform one long distance test of communication system
  - Finalize Circuit diagrams