InterSTELLAS

Full Mission Simulation Report

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Presentation Outline

• Section 1: Mission Overview
• Section 2: Integrated Subsystem Testing Status
• Section 3: Full Mission Simulation Results
• Section 4: Project Management Update
1.0 Mission Overview

*Name of Presenter(s)*
Mission Overview

• Measure radiation levels and atmospheric ionization levels at different altitudes
• Data can provide insight on how solar/cosmic radiation changes in the ionosphere
ConOps

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

**UV: 121.5 nm**
- X-ray/Gamma

**Start of Ionosphere**
- 60 km

**t = 0 min**
- All systems on
- Begin data collection

**t = -2 min**
- Udoo Board Start Up

**t = 5.5 min**
- Chute Deploys

**t = 15 min**
- Splash Down
Changes since ISTR

• Udoo board was changed for Arduino Mega
  – Udoo board has many bugs
  – Complication in integrating subsystems
  – Arduino is 5V logic which allows for removal of logic level shifters

• Pro Trinket replaced for 5V version
  – Microcontroller was changed so it could easily be integrated with Arduino Mega
2.0 Integrated Subsystem Testing Status

Name of Presenter(s)
Integrated Subsystem Testing Status

• Software integration
  Air cutoff
  UV system
  Flow Meter
  Pressure Sensor

• Still to be integrated
  Gerdien condenser
  Radiation Sensor
  IMU (communication)
  Data Collection System/Power Shield
Integrated Subsystem Testing Status

Air cutoffs

Verify proper operation and timing for opening and closing on a GPIO control pin and TIP120 transistors

Test was completed on May 5th with great success. Timing was accomplished for opening for a period of 13 minutes.

Software will be integrated with the IMU data in order close the values after the parachute is deployed.

The final software integration with the IMU data should be complete and tested by May 17. This is one of the last integration tasks.

Mechanical Integration by May 12.
UV System

PCB tested and operational after some modifications. Still need to add component for 2.5V reference for ADC.

Data received was accurate and mathematically correct but communication is not true SPI so it was taken off the SPI bus. Will need to bitbang the SCLK for data retrieval.

Mechanical integration and fit completed on April 25. DB9 cable from MP port to canister needs to be assembled.

Final completion and testing of PCB and data communication will be completed by May 15.
Integrated Subsystem Testing Status

UV System

```
[[135, 255, 135, 255],
 [135, 255, 135, 255],
 [135, 255, 135, 255],
 [135, 255, 135, 255],
 [135, 255, 135, 255],
 [135, 255, 135, 255],
 [135, 255, 135, 255],
 [135, 255, 135, 255],
 [128, 0, 128, 0],
 [128, 0, 128, 0],
 [128, 0, 128, 0]]
```

CTraceback (most recent call last):
  File "spi.py", line 20, in <module>
  main()
  File "spi.py", line 17, in main
  sleep(0.1)
KeyboardInterrupt

udoor@udooneo:~$
Flow Meter

RS232 connection is not working as incorrect flowmeter was sent.

Analog conversion using ADC in UDOO is working properly until RS232 flowmeter arrives.

Flow meter reading are the correct range from 0 to 50 spfm as tested using an air compressor and regulator.

Mechanical Integration will be completed when the RS232 capable model comes in.
Pressure Sensor

Pressure sensor is software integrated. The reading are correct as evaluated by an air compressor.

I2C interfacing is complete and data successfully returned along the bus.

Mechanical integration will occur with the perf power board shield which connects to the microcontroller board. This system is currently being built.
Integrated Subsystem Testing Status

Gerdien Condenser

No testing or integration has been completed due to a resistor sizing issue with the PCB.

The correct resistors arrived on 5/8/2017 and the PCB assembly will be completed on 5/9/2017 and tested immediately for correct operation.

Testing and necessary modifications should be completed by 5/12/2017.

Mechanically, the final Gerdien Condenser Tubes are almost completed but a holdup on machine shop time is expected as it will be closed until 5/16/2017. Currently sourcing another machine shop on campus for completion of machining teflon (the last needed piece).
Integrated Subsystem Testing Status

Radiation Sensor

Radiation output and power was tested but software has not been created yet. Software design poses issues as it requires a timer and an interrupt count which must be created as a driver in the Linux Kernel.

Mechanical integration is complete as it is mounted on the PCB.

Integration into the Arduino side of the UDOO board is inefficient with significant coding analysis. Currently discussing porting project into Arduino Mega Platform.

Port cover design is completed in Solidworks and will be exported to a CNC mill for machining. This is not time critical as a delay of the optics has occurred.
Integrated Subsystem Testing Status

IMU

Software for Pro Trinket and Sensors is complete but integration into the microcontroller system is not complete. This is a SPI bus system and should integrate quickly and easily as all of our subsystems (except the Pressure sensor and UV) are SPI.

Calibration and testing is complete.

Mechanical mounting on the payload will occur this week.
Data Collection/Power Shield

Data collection system in Python is complete but issues with the radiation sensor and Linux issues with the UDOO board have led us to moving to an Arduino platform.

Porting to Arduino will be faster than writing kernels and device trees and debugging on the UDOO board and will allow the development of the Power Shield which powers all the subsystems and contains the pressure sensor to accelerate quickly.

This will be a shield for the Arduino Mega which we readily have access to. SD card for data collection will remain the same and will be on the SPI bus.
3.0 Full Mission Simulation Results

Name of Presenter(s)
Full Mission Simulation Results

- Air cutoff, UV system, flow meter, and pressure sensor were all integrated together with successful results
- Gerdien condenser, radiation sensor and IMU still need to be integrated into the full system
  - Gerdien condenser circuit still being assembled due to issues with resistor size, ordered new resistors which just came in
  - Code needs to be written to integrate radiation sensor
  - Connection between IMU and Udoo board was established but no data has been transmitted yet

- Significant issues with UDOO board, switching to Arduino Mega
Full Mission Simulation Results

- What action items do you have left between now and the LRR?
  - Finish assembling and testing Gerdien Condenser
  - Fully complete UV testing and code for retrieving data
  - Integrate and test IMU
  - Integrate and successfully test all subsystems in payload
4.0 Project Management Update

Name of Presenter(s)
Action Item Summary

- May 9 - Gerdien Condenser PCB assembly will be completed
- May 12 - Air cutoff mechanical integration and Gerdien Condenser modifications and testing
- May 15 - Fully test PCB for UV system and achieve data communication
- May 17 - Software integration of IMU data collection to be completed and tested
- June 2 - Fully integrate all subsystems into the payload and successfully test together
## User Guide Compliance

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Status/Reason (if needed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center of gravity in 1&quot; mid-can?</td>
<td>Collaborating with team we are sharing canister with</td>
</tr>
<tr>
<td>Contained in can</td>
<td></td>
</tr>
<tr>
<td>Connected to can by 4/5 bulkheads on top and bottom only</td>
<td></td>
</tr>
<tr>
<td>Mass at 6±0.2lbs</td>
<td>5.15lbs</td>
</tr>
<tr>
<td>Shared canister clearance</td>
<td>1” separation between payloads</td>
</tr>
<tr>
<td>No voltage on the can</td>
<td>No opportunity to check yet</td>
</tr>
<tr>
<td>No voltage on multipurpose port</td>
<td>No opportunity to check yet</td>
</tr>
<tr>
<td>Activation wires at least 4 ft</td>
<td></td>
</tr>
<tr>
<td>Activation wire at least 24 gauge</td>
<td>22 gauge</td>
</tr>
<tr>
<td>Early Activation: current &lt; 1 A</td>
<td>1.1 (working on reducing)</td>
</tr>
<tr>
<td>T-0 Activation: current &lt; .1 A</td>
<td>Not using</td>
</tr>
<tr>
<td>Battery Type</td>
<td>Lithium Polymer (will not charge at Wallops)</td>
</tr>
</tbody>
</table>
Biggest Worries

• Issues with Gerdien Condenser Operation
  Have to rely on design and troubleshooting skills if issues occurs
• Photodiode failure
  Can’t afford another one so vibration testing will be minimal
• Time Constraints
  Finals over so free to work on projects until internships and work starts
Conclusions

• Due to unforeseen setbacks we have had to pushback our dates for the deliverables.
  – Problems with the Udoo board caused us to switch to Arduino Mega
  – Manufacturer issues with the PCBs caused a delay in building the circuit boards