Small Satellite Research Laboratory
Franklin College of Arts and Sciences
UNIVERSITY OF GEORGIA

Mission Overview

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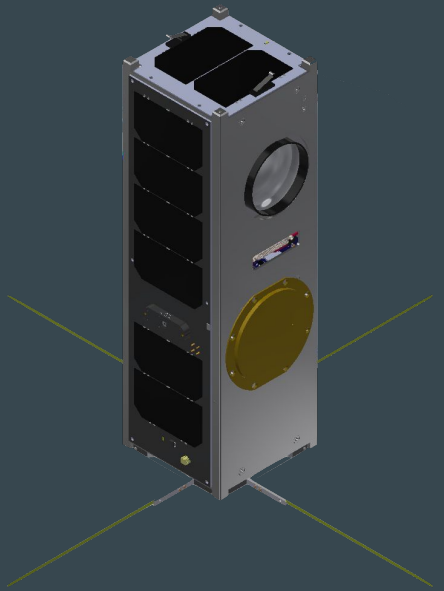
Our Mission


MULTI-VIEW ONBOARD COMPUTATIONAL IMAGER
SMALL SATELLITE RESEARCH LAB
UNIV. OF GEORGIA

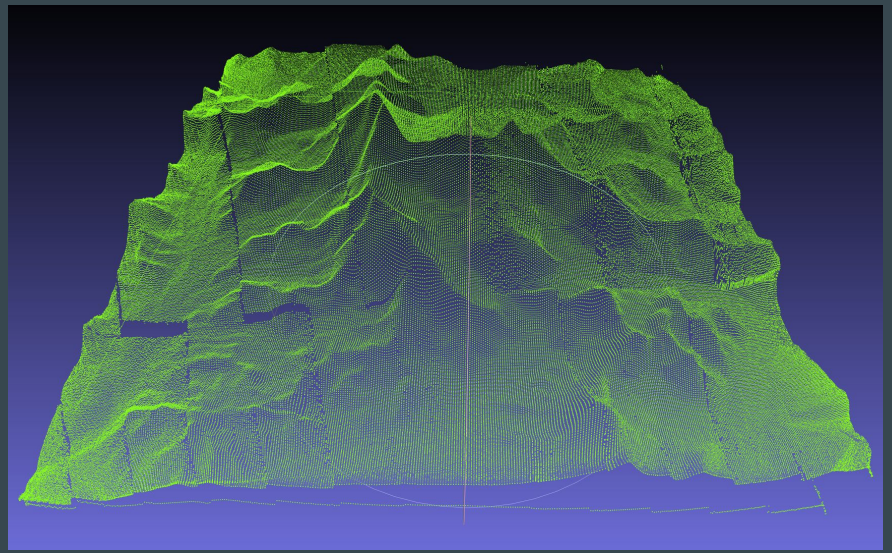
Mission Statement

The Multi-view Onboard Computation Imager (MOCI) mission will acquire imagery of the Earth's surface from LEO and perform real time Structure from Motion (SfM) at a landscape scale custom algorithms and off the shelf, high performance computational units. The MOCI mission will also identify and map coastal phenomena such as sediment plumes and algal blooms while training students in STEM related fields. Efficient data compression, feature detection, feature matching, and SfM processing techniques of space based imagery will be performed on board the spacecraft.



Mission Objectives

- MOCI shall run on-board SfM of target areas and transmit the processed data using customized compression techniques.
  - Full: MOCI shall generate a DSM, demonstrated on orbit, within 1.281 sigma (80%) of existing DSM's
  - Min: MOCI shall generate a Digital Surface Model (DSM) within 1 sigma of existing DSM's

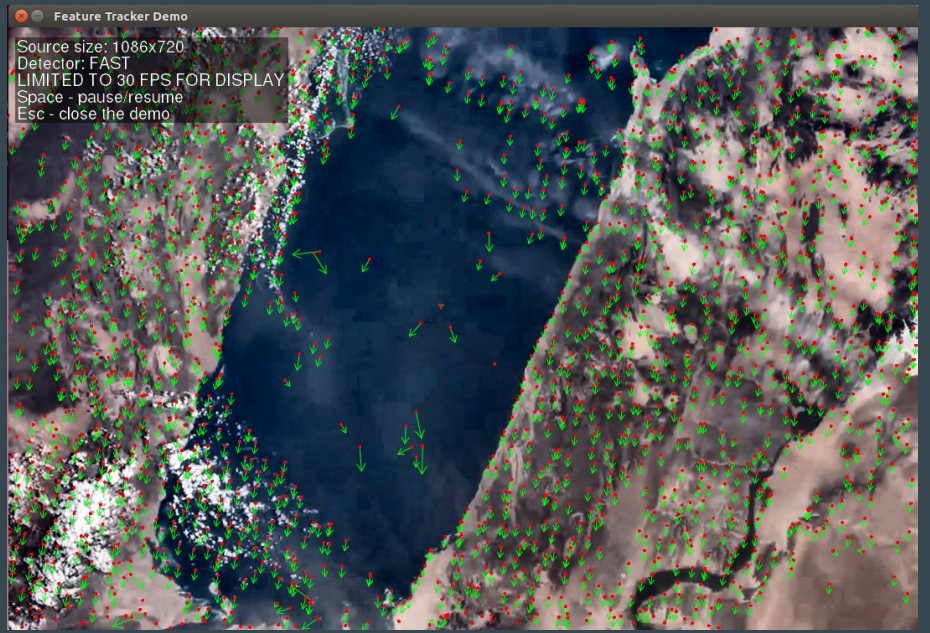


Mission Objectives

- MOCI shall image the coastal regions of the Eastern United States for marsh phenology, land use, and off-coast water quality.
  - Full: MOCI shall acquire 15 images, at least three days apart, of one coastal target or the Sapelo Island test area over the lifetime of the mission.
  - Min: MOCI shall acquire 3 images, at least one month apart, of one coastal target.

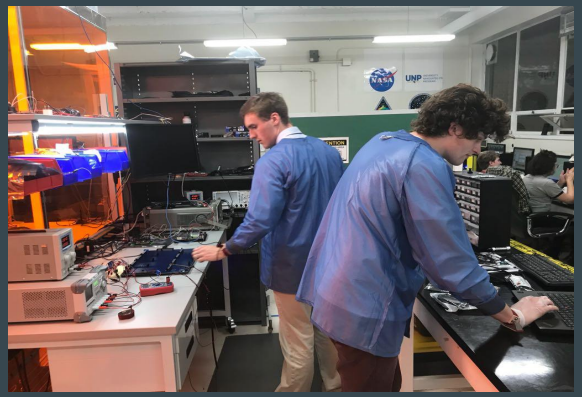
Mission Objectives

- MOCI shall identify algal blooms or sediment plumes in order to track their growth, size, and location.
  - Full: MOCI shall identify an algal bloom or sediment plume, with 60% predictive accuracy
  - Min: MOCI shall identify an algal bloom or sediment plume, with 60% predictive accuracy, while tracking its size and location over a the lifetime of the bloom/plume, 5 usable images at least 1 day apart.



Mission Objectives

MOCI shall train students in STEM related fields by having them investigate optimal data transmission techniques, georeference imagery for mapping, conduct photogrammetric processing of images acquired from the satellite, develop community outreach programs, and learn general aerospace manufacturing/testing/ designing skills.



Outreach & Research

Outreach

- Just yesterday we were talking to high schoolers about space!
- Women in technology workshop
- STEM student workshops
- Local high school outreach

Research

- Paper on computation in space is coming soon...
- Small Sat
- CubeSat Developers Workshop
- Numerous smaller conferences
- Not much research exists for our type of space computation

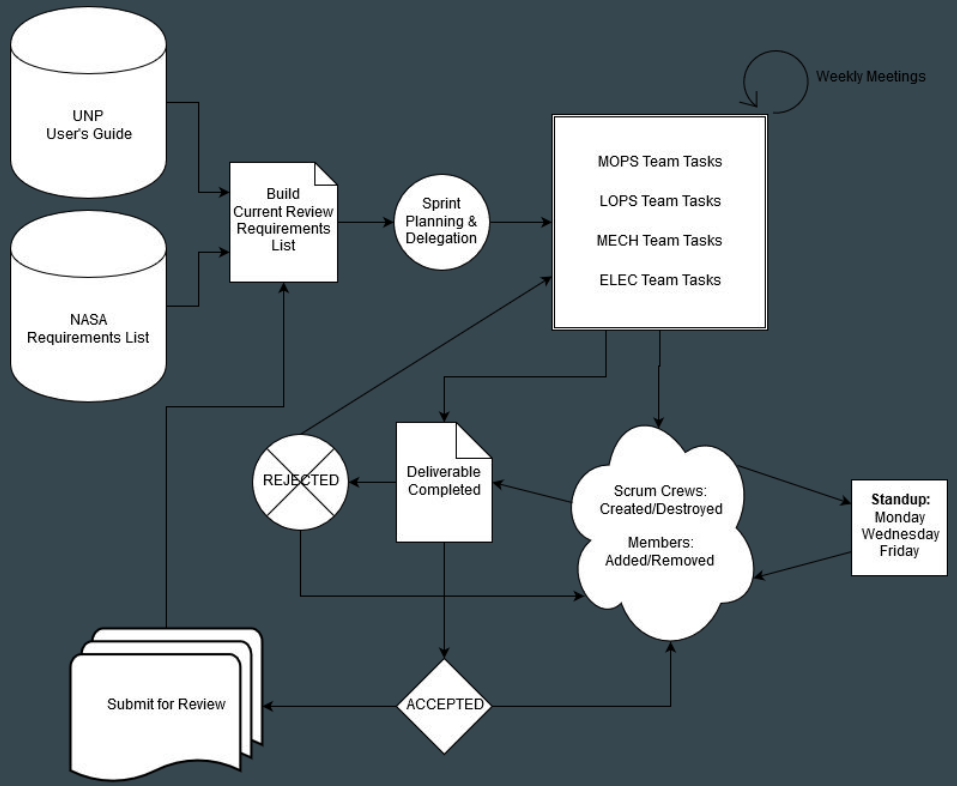
Project Structure

The UGA SSRL

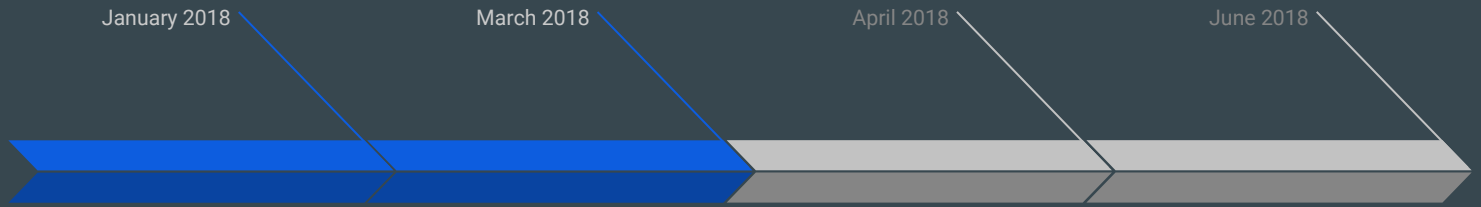
- Maintaining Undergraduate Leadership
- MOCI & SPOC & Another?
- We love UNP!

Project Workflow

- Weekly Team Meetings
- Weekly Standups
- Trello
- Deliverable Based
- Leadership Meets Weekly
- Entire Team Meets bi-weekly



Immediate Schedule



FSR

January 13-14, In ABQ NM. SSRL's MOCI was selected for Phase B.

CDR

March 9-10, Happening now! At the SSRL. This is an official AFRL/UNP review.

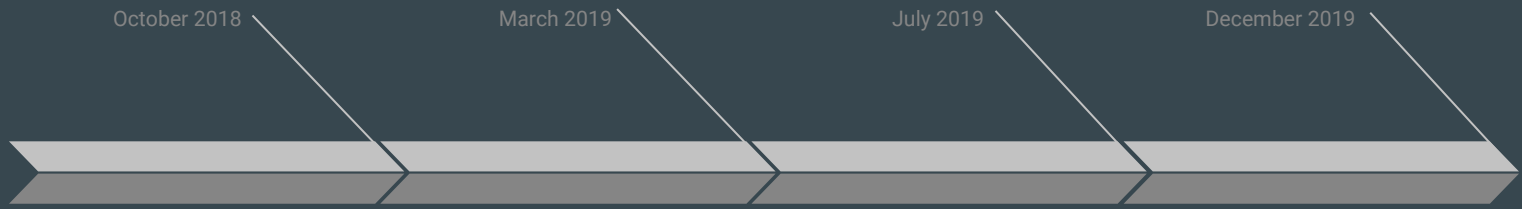
Delta CDR

April 30, an internal design review. We expect significant progress at this review.

Interim Review 1

June 25, an AFRL/UNP review. Significant progress on the payload and FlatSat is expected at this time.

Schedule



Interim Review 2

October 19, a functional payload and FlatSat are expected at this time.

Pre-Integration Review

March 25, a fully functional FlatSat and Payload are expected at this time.

Interim Review 3

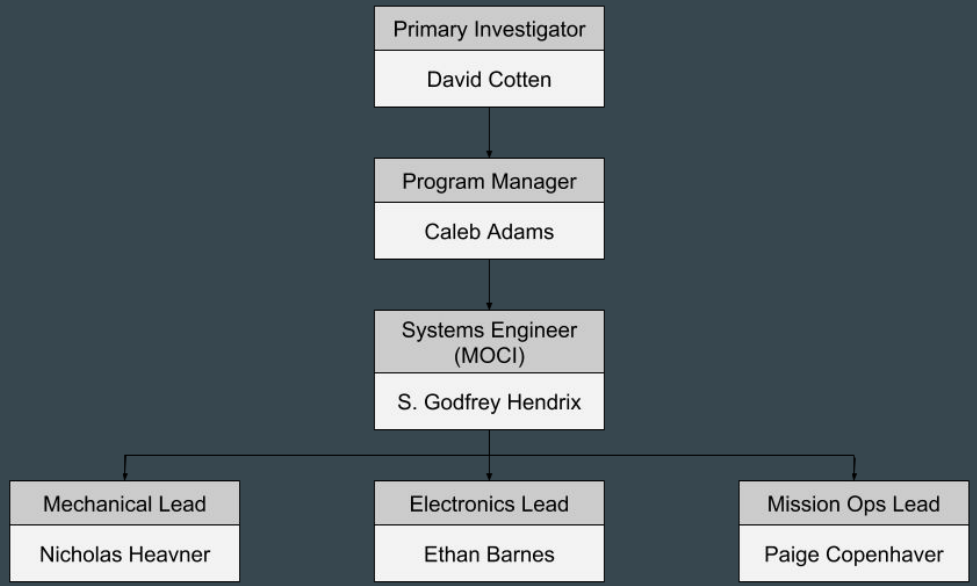
July 22, MOCI is expected to be mostly, if not completely, integrated. Tests and development continue.

Pre-Shipment Review

December 29, MOCI is evaluated before it is sent to the AFRL for final tests.

Structure

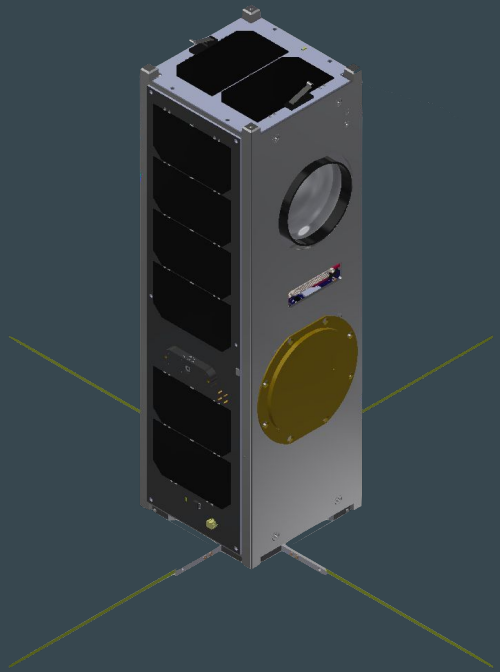
- Each Mission at the SSRL has a Systems Engineer as lead
- Each Mission has a Mechanical, Electronics, and Mission Operations team.



Known Issues

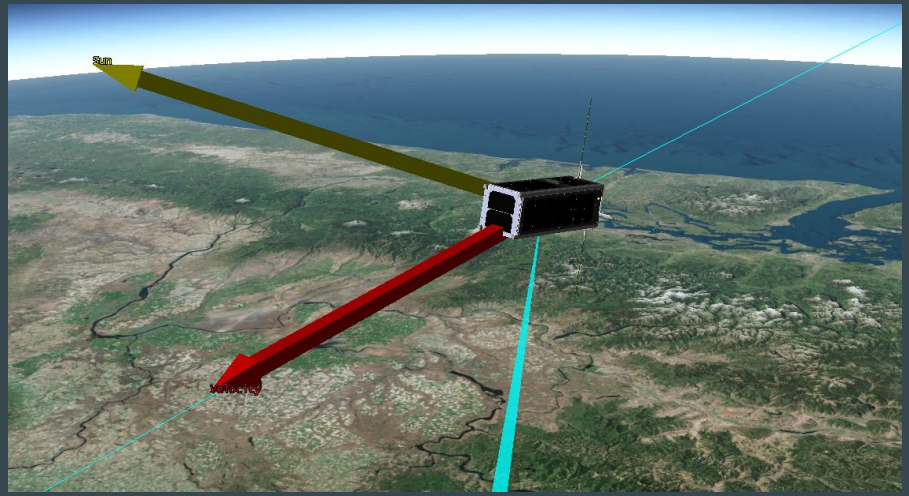
Post-FSR System Redesign

- System was redesigned in very little time
  - We believe improvements were made
- All requirements still met
- Have a good base design to make edits to and improve upon
- Still requiring CAD from ADCS and Ruda-Cardinal Lens



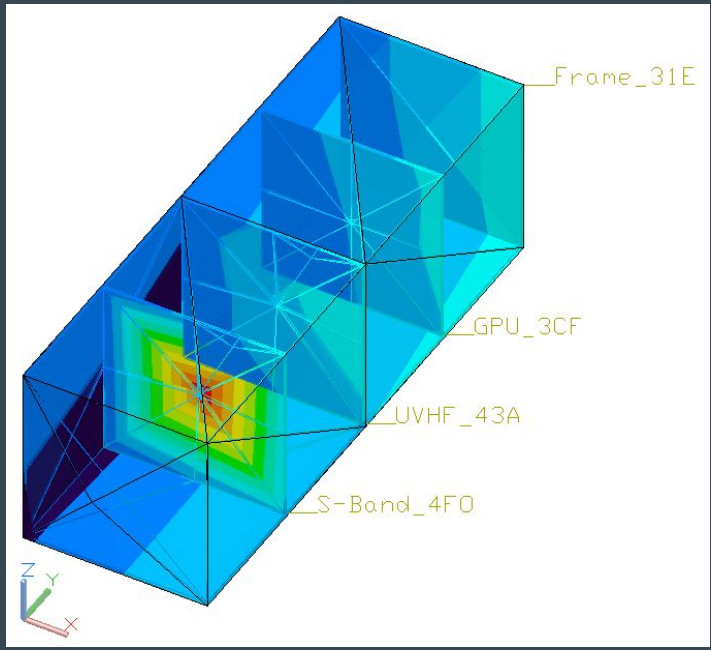
Pointing & Position Needs

- Algorithmic unknowns relating to position and orientation knowledge needs.
  - possible to compute with no knowledge, just becomes more complicated.
- ADCS modifications have been made to address this



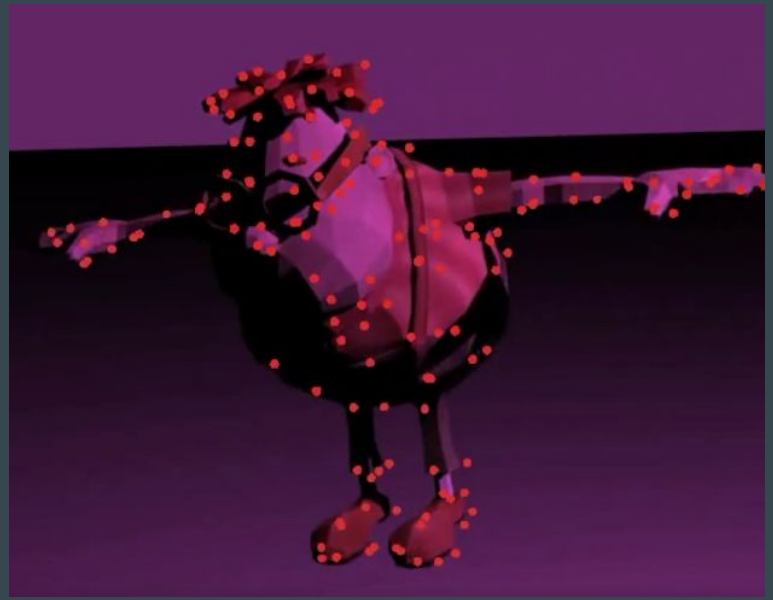
Thermal & Structural Assumptions

- Frame Redesign
- Payload Housing Redesign
- PCB wire traces
- limited testing and analysis has been done on new systems
- Significant Thermal and Structural analysis needed



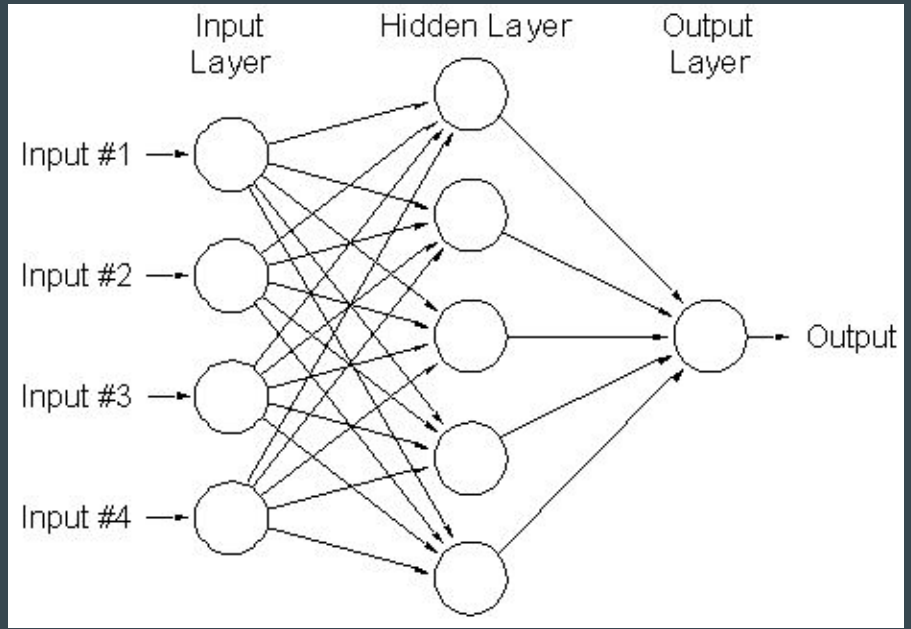
Feature Detection & FPGA Development

- FPGA is only significant portion of the payload with little convergence
- Feature Detection can be redundantly implemented on the GPU
- FPGA is a candidate for downscoping



Neural Network Data Sets

- Difficult to find test sets for what we need
  - High resolution
  - Ideally thousands of images
    - positive and negative
- Ambiguity on the Neural Network solution

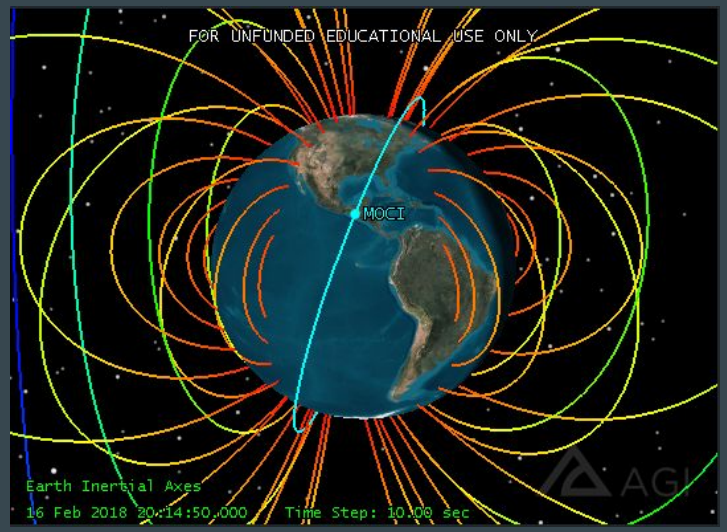


CAN Bus implementation

- Needed by clyde space
- OBC CAN bus needed to control S-Band
- Payload powered for hours
- Significant cost to ConOps

Radiation

- Limited radiation testing has been performed on TX1 units
- Radiation testing of the TX2 is needed
- Radiation issues relating to the TX2 could make mission fail
- Partnership with Space Micro to rad test TX2
- Mechanical team is developing a solution that surrounds the TX2 in aluminized kapton and aluminum



Communications Knowledge

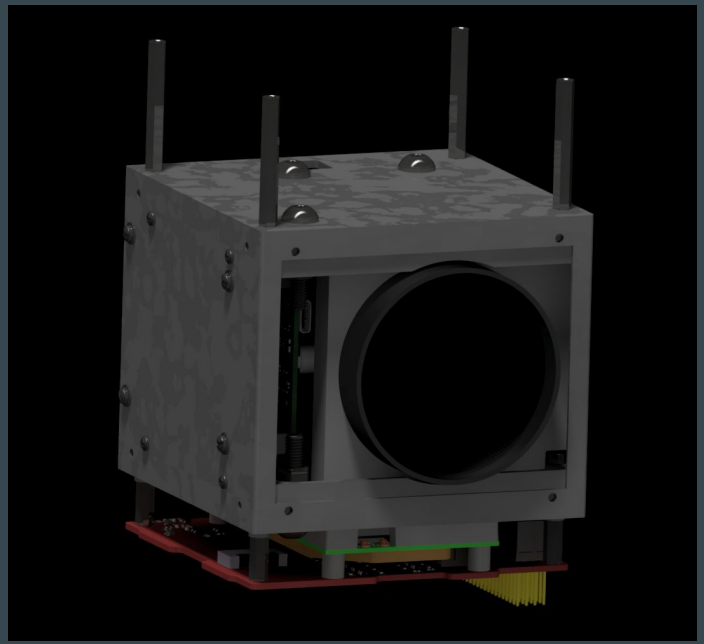
- Slow progress on UHF comms internally
- Recent progress with AX.25 on a linux system
- No “call and response” has been demonstrated between the FlatSat and a simple comm system

Potential Solar Panel Modifications

- The Z Plus solar panel needs cutouts to fit inhibit switches
  - In the worst case scenario this will cut about 1 W of power generation
- The Y Minus solar panel will be removed
  - Should not create any power generation problems since this solar panel never saw the sun in STK simulations
  - On this face there will be a roller inhibit as well as a cut out for the star tacker on the MAI-401

USB connection to PicoCam

- Poor choice of connection
- Significant risk on a single connection
- Possible alternative sensor / sensor board with the aid of Ruda Cardinal

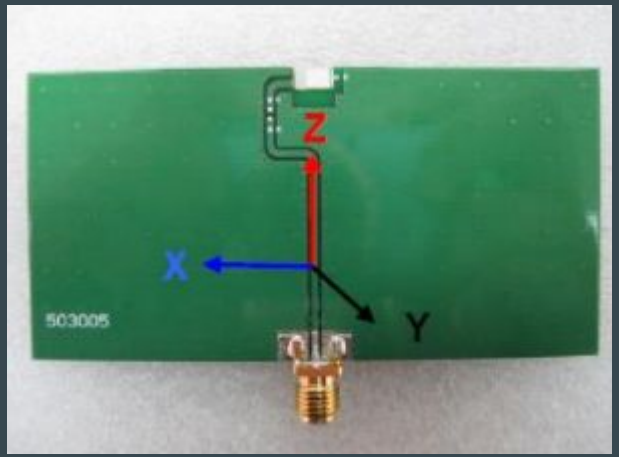


Fine Sun Sensor Integration

- Unknown communications between MAI-401 and Sun Sensors
- Unknown support of Solar Mems with MAI
- Can not be surface mounted on the solar panels due to size constraints

GPS Antenna

- Unknown mounting location
- Presumed to be embedded in the solar panel (says clyde)
- Unknown alternatives if we swap to GomSpace solar panels



Outgassing

- No way of measuring CVCM?
- We believe TML should be easy.
- How much time should we allow one board to be heated? We are thinking about 5 hours.

Vibrational Testing

- No way of doing this currently.
- Should we outsource it?

Questions?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