

Team 4: Avionics

Week 1, Spacecraft Design Lab 2019-2020



Fig. 1. Satellite with solar cells

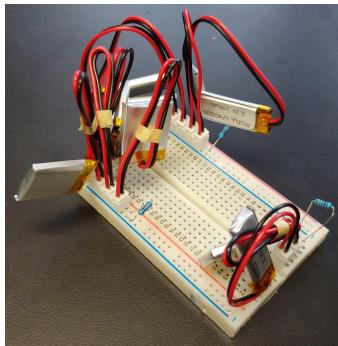


Fig. 2. Passive battery balancing

Updated Key Milestones (past + present)

- External PCBs arrived! 10/19
- Energy harvesting board sunlight testing 10/19
- Assembled external PCBs (version 1) 11/06
- X board testing 11/20
- Flex cable design finished → Max 11/28

Interfaces

Structures

Avionics

- Testing antenna functionality on external PCBs
- Flex cable new location on -Y

Requirements

Weekly Results

- Still setting up the in-door sunlight generation station. Current light provide 12.26 mA working current on X board.
- IV Swinger is functional, but needs inside set up or direct outside sun to work on solar panels
- Obtained camera boards and reviewed current state of code and documentation
- Battery vac testing with balanced cells is still uneventful

Upcoming Work

- Test solar panel working current under natural sunlight
- Test solar panel charging current under natural light and bulb light
- Test to make sure code to take images and send to main board works
- Assemble larger battery packs and verify capacity, lifespan at expected power draw (limit current + safety factor)

Team 4: Electrical and Avionics

Week 2, Spacecraft Design Lab 2019-2020



Fig. 1. Satellite with solar cells

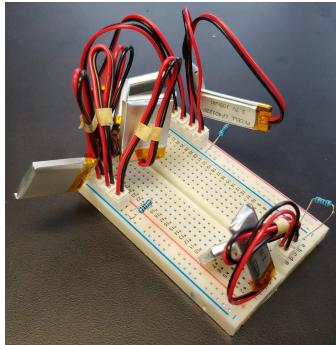


Fig. 2. Passive battery balancing

Updated Key Milestones (past + present)

- External PCBs arrived! 10/19
- Energy harvesting board sunlight testing 10/19
- Assembled external PCBs (version 1) 11/06
- X board testing 11/20
- Flex cable design finished → Max 11/28

Interfaces

Structures

Communication

- The way to download image(.jpg data).

Requirements

- SD Cards
- Heat filter

Weekly Results

- Setting up IV Curve test circuit using potentiometer
- Obtained camera boards and reviewed current state of code and documentation
- Battery vac testing with balanced cells is still uneventful
- Modeling of magnetorquer coils
- Part selection for magnetorquer driver
- Set up hardware to test camera code

Upcoming Work

- Generate IV curves of solar cells
- Test individual solar cells for consistency
- Test to make sure code to take images and send to main board works
- Assemble larger battery packs and verify capacity, lifespan at expected power draw (limit current + safety factor)
- Magnetorquer driver test board
- Troubleshoot SD card error that is produced by main board code to communicate with camera board

Electrical and Avionics

Week 3, Spacecraft Design Lab 2019-2020

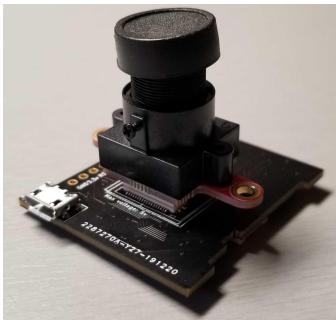


Fig. 1. Camera board

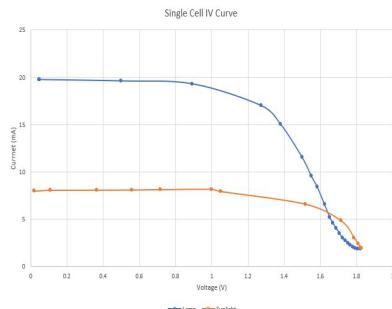


Fig. 2. IV curve for single solar cell

Updated Key Milestones (past + present)

- External PCBs arrived! 10/19
- Energy harvesting board sunlight testing 10/19
- Assembled external PCBs (version 1) 11/06
- X board testing 11/20
- Flex cable design finished → Max 11/28
- Generate IV plots 01/24

Interfaces

Structures

Communication

- The way to download image(.jpg data).

Requirements

- Individual solar cells
- Heat filter

Weekly Results

- Generate IV plot for x,+y, z board and individual solar cell.
- Current in-door light set up is powerful than natural sunlight
- Battery vac testing with balanced cells is still uneventful
- Modeling of magnetorquer coils
- Part selection for magnetorquer driver
- New camera board can take and save images
- Image compression comparison
- Cloud detection algorithm literature survey

Upcoming Work

- Set up new in-door light station to simulate sunlight.
- Test individual solar cells for consistency
- Assemble larger battery packs and verify capacity, lifespan at expected power draw (limit current + safety factor)
- Magnetorquer driver test board
- How to split up an image via progressive compression
- Checksum for broken-up images
- Re-layout -Y board

Electrical and Avionics

Week 4, Spacecraft Design Lab 2019-2020



Fig. 1. Photo from telephoto lens

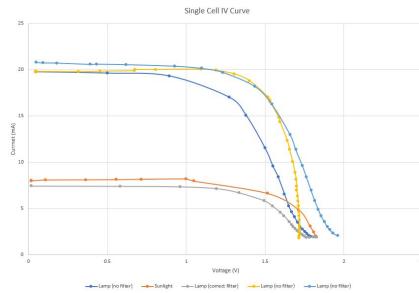


Fig. 2. IV curve for single solar cell

Interfaces

Structures

Communication

- The way to download image(.jpg data).

Requirements

- Individual solar cells
- Big lamp
- AA Battery

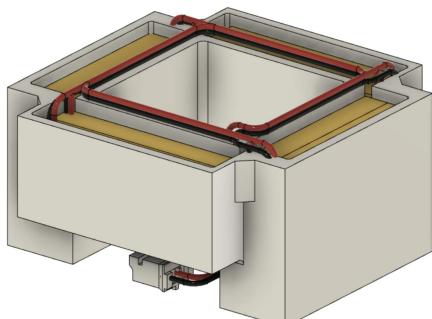


Fig. 3. Battery Donut with harness

Updated Key Milestones (past + present)

- External PCBs arrived! 10/19
- Energy harvesting board sunlight testing 10/19
- Assembled external PCBs (version 1) 11/06
- X board testing 11/20
- Flex cable design finished → Max 11/28
- Generate IV plots 01/24

Weekly Results

- Tested solar cell w/ filter & compared results to datasheet - generating ~85% of expected power output
- Current lamp with filter close to sunlight performance for single solar cell.
- -Y redesign in progress
- Battery harness designed, wire ordered
- Sent out test PCBs for magnetorquer drivers
- Sent out PCB for battery cycle board
- Image compression via SVD in Matlab
- Cloud detection algorithm literature survey

Upcoming Work

- Test individual solar cells for consistency
- Battery cycle test & low-resistance load test at freezer temps
- Magnetorquer driver test board
- Communicate between our main board and camera board
- Image compression via SVD on camera board
- Re-layout -Y board

Electrical and Avionics

Week 5, Spacecraft Design Lab 2019-2020



Fig. 1. Photo from telephoto lens

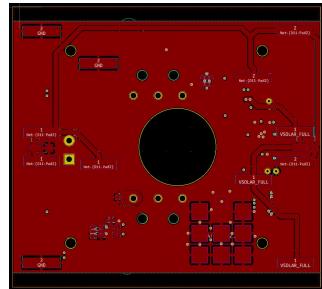


Fig. 2. New -Y board

Updated Key Milestones (past + present)

- External PCBs arrived! 10/19
- Energy harvesting board sunlight testing 10/19
- Assembled external PCBs (version 1) 11/06
- X board testing 11/20
- Flex cable design finished → Max 11/28
- Generate IV plots 01/24

Interfaces

Structures

Communication

- The way to download image(.jpg data).

Requirements

- Individual solar cells
- AA Batteries

Weekly Results

- Tested solar cells with halogen lamp - best set-up is still incandescent lamp
- Finished -Y redesign
- Battery harness wire received
- Assembled test PCBs for magnetorquer drivers
- Fixed Kicad schematics / PCBs
- Image compression by tiling then JPEG compressing
- GSD calculation for NOAA

Upcoming Work

- Test individual solar cells for consistency
- Build battery harness & fit check
- Battery internal resistance measurement at freezer temps
- Measure magnetorquer driver efficiency
- Make changes to PCB
- Communicate between our main board and camera board
- Image compression by JPEG compression then tiling
- Look into horizon-sensing image processing

Electrical and Avionics

Week 6, Spacecraft Design Lab 2019-2020



Fig. 1. Photo from telephoto lens

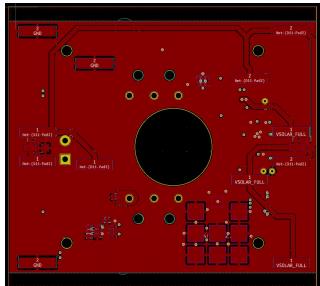


Fig. 2. New -Y board

Updated Key Milestones (past + present)

- External PCBs arrived! 10/19
- Energy harvesting board sunlight testing 10/19
- Assembled external PCBs (version 1) 11/06
- X board testing 11/20
- Flex cable design finished → Max 11/28
- Generate IV plots 01/24

Interfaces

Structures

Communication

- The way to download image(.jpg data).

Requirements

- Individual solar cells

Weekly Results

- Modeled magnetorquer coils in FEMM
- Updated PCB mechanicals
- Breaking up JPEG image into byte arrays for packets
- Reconstructing image from packets of byte arrays
- Telephoto lens focusing
- Earth horizon-detection algorithm in process
- Familiarize and implement current state machine code
- Battery harness dimensions measured & drawn

Upcoming Work

- Test individual solar cells for consistency
- Build battery harness & fit check
- Battery internal resistance measurement at freezer temps
- Relink PCB <> 3d models
- Communicate between our main board and camera board
- Finish horizon-detection algorithm and test
- Implement state machine code

Electrical and Avionics

Week 7, Spacecraft Design Lab 2019-2020



Fig. 1. Photo from telephoto lens



Fig. 2. Earth horizon sensor result

Updated Key Milestones (past + present)

- External PCBs arrived! 10/19
- Energy harvesting board sunlight testing 10/19
- Assembled external PCBs (version 1) 11/06
- X board testing 11/20
- Flex cable design finished → Max 11/28
- Generate IV plots 01/24

Interfaces

Structures

Communication

- The way to download image(.jpg data).

Requirements

- Individual solar cells

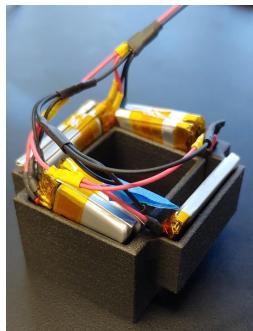


Fig. 3. Battery harness fit check

Weekly Results

- Created PCB parts library on Kicad
- Fixed PCB mechanical issues
- Telephoto lens focusing
- Earth horizon-detection algorithm in process
- Implemented idle state logic
- Battery harness built (thanks Max!) & fit checked
- Battery ESR test done for both cell types at freezer temp
- Started DCT for images

Upcoming Work

- Test individual solar cells for consistency
- Build battery harness design adjustments
- Battery internal resistance measurement at freezer temps
- Relink PCB <> 3d models
- Finish DCT for images
- Communicate between our main board and camera board
- Finish horizon-detection algorithm and test
- Implement state machine code

Electrical and Avionics

Week 7, Spacecraft Design Lab 2019-2020



Fig. 1. Photo from telephoto lens

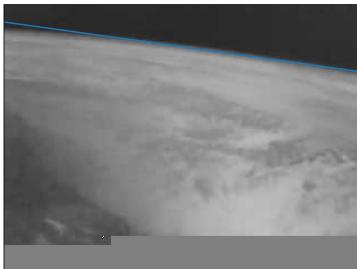


Fig. 2. Earth horizon sensor result

Updated Key Milestones (past + present)

- Energy harvesting board sunlight testing 10/19
- Assembled external PCBs (version 1) 11/06
- X board testing 11/20
- Flex cable design finished → Max 11/28
- Generate IV plots 01/24
- New PCBs sent out 03/02

Interfaces

Structures

Communication

- The way to download image(.jpg data).

Requirements

- Individual solar cells



Fig. 3. Melted 30g nichrome after freezer burn wire test

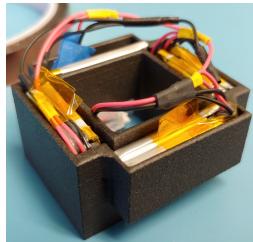


Fig. 4. Epoxied batt harness fit

Weekly Results

- Sent PCBs to fab
- Finished horizon-detection algorithm
- Implemented logic for 4 states
- Battery harness leads epoxied in place (Improvement)
- Burn wire test done with 1317 cells at freezer tempa (success)
- Soldered 2x XT60-JST PH adapters for batt pack charging
- Debugging reconstructing image from DCT

Upcoming Work

- Test individual solar cells for consistency
- Fix PCB edge clearance issue
- Place parts order / generate BOM
- Battery harness design adjustments (shorten leads)
- Relink PCB <> 3d models
- Finish DCT for images
- Communicate between our main board and camera board
- Integrate horizon-sensor algorithm with GNC
- Implement state machine functions

Electrical and Avionics

Week 9, Spacecraft Design Lab 2019-2020



Fig. 1. Photo from telephoto lens



Fig. 2. Earth horizon sensor result

Updated Key Milestones (past + present)

- Energy harvesting board sunlight testing 10/19
- Assembled external PCBs (version 1) 11/06
- X board testing 11/20
- Flex cable design finished → Max 11/28
- Generate IV plots 01/24
- New PCBs sent out 03/02

Interfaces

Structures

Communication

- The way to download image(.jpg data).

Requirements

- Individual solar cells



Fig. 3. Melted 30g nichrome after freezer burn wire test

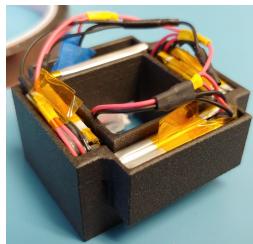


Fig. 4. Epoxied batt harness fit

Weekly Results

- Fixed PCB clearance issue and sent to fab
- Documenting work
- Documentation for state machine current set up
- Battery harness leads epoxied in place (Improvement)
- Burn wire test done with 1317 cells at freezer tempa (success)
- Soldered 2x XT60-JST PH adapters for batt pack charging
- DCT code finished

Upcoming Work

- Test individual solar cells for consistency
- Place parts order / generate BOM
- Battery harness design adjustments (shorten leads)
- Communicate between our main board and camera board
- Integrate horizon-sensor algorithm with GNC
- Implement state machine functions