Project title: OreSat Deployable Antennas

A 2017-2018 MME capstone project sponsored by the Portland State Aerospace Society

Sponsor contact information

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Project motivation

OreSat is Oregon's first satellite. OreSat is a 2U CubeSat that requires two antennas: a highly directional 2.4 GHz ("S-band") helical antenna, and an omnidirectional 430 MHz ("70 cm") canted turnstile antenna (see Figure 1).

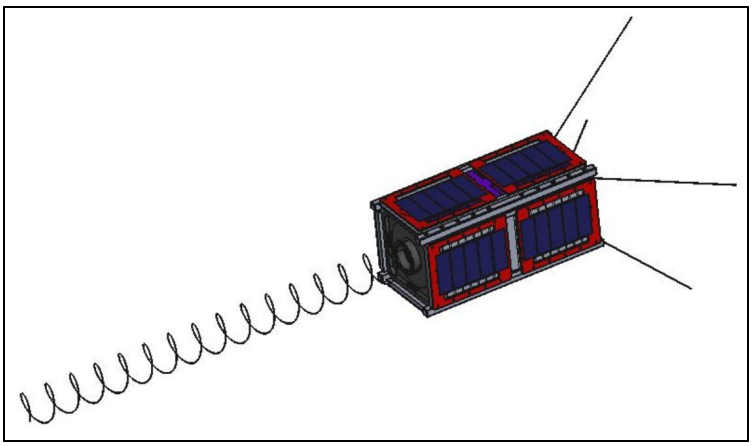

Figure 1: OreSat 2U CubeSat. Helical antenna on left, canted turnstile antenna on right

Both antennas must be stored within the satellite to keep the satellite's form factor within the 2U specification of the CubeSat Developer's Specification (CDS) rev 13. After OreSat is deployed into orbit, these two antennas must then be deployed into their very specific shapes in order to function correctly as antennas. While the antennas have been electrically designed, this capstone must design the mechanical implementation of the electrical design, including stowage, deployment mechanism, and any rigging or other structures necessary to keep the antennas properly deployed.

Customer needs

- Antennas must be manufactured out of a low electrical resistance wire.
- Antennas must be deployed into the correct shapes (helical and canted turnstile; exact dimensions are available upon request)
- The mechanism must:
    - operate from -40 to +125 deg C
    - survive CubeSat vibration testing.
    - be storable for up to 6 months
    - survive in space for 12 months
    - work in a hard vacuum.
    - not outgas (as specified by CubeSat standards).
- The deployment mechanism must be electrically actuated.
    - The mechanism must use a 3.3 - 4.2V power rail, at not more than 5A of current.

    - The mechanism must use under 100 Ws of energy to operate.
    - The antennas must terminate on one of OreSat's "end caps", which are printed circuit boards (PCBs).
- Deployment time must be < 1 hour for the canted turnstile antenna, and < 1 week for the helical antenna.

Typical operation or user interaction

Antennas are stowed in/on OreSat before delivering it for integration. Antennas will stay stowed for up to 6 months. 45 minutes after deployment, the system controller wakes up and actuates the deployment mechanism. The deployment mechanism deploys the two antennas, and then the antennas are used by the satellite for the 9 - 12 months the satellite is in orbit.

Financial and in-kind support

PSAS will supply materials and all electrical support for this project. Up to $1,000 for funds are allocated, but we hope the project uses much less than that.

Special requirements

- All intellectual property must be assigned an open source license, preferably GPL v2.
- Team members must use SolidWorks.
- All project design and documentation must be done using git on PSAS' Github pages.

Deliverables

- Working prototypes that have been:
    - Tested in a vacuum, at temperature extremes, and under vibration.
    - Some calculation of system reliability
- Complete documentation, including:
    - CAD models
    - Background, including research done and theory of operation
    - SOPs for antenna construction
    - SOPs for antenna prep for flight
    - Full reliability report