OpenOrbiter I &2

In Space 3D Printing and Low-Cost Framework Demonstration

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Brief Overview

- OpenOrbiter I is, first and foremost, a mission to demonstrate the capabilities of the Open Framework for Educational Nanosats
- Basically we've designed a number of subsystems and a structure and we've put together a lot of documentation
- To-date, we've sent parts of the designs to people that wanted to use a particular subsystem
- We are also working with a number of high schools and colleges that are in various stages of making CubeSats based on the OPEN designs

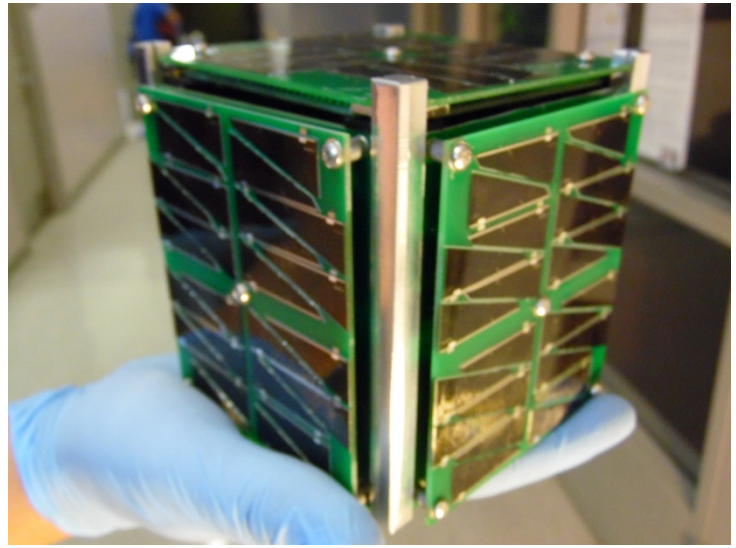


Image from: OpenOrbiter website

Initial Payload Mission

- Test 3D printing in space
- We designed a printer to test various properties of 3d printing under orbital conditions (microgravity, temperature, vacuum, radiation)
- This unit was designed to fit in the spacecraft's payload bay.

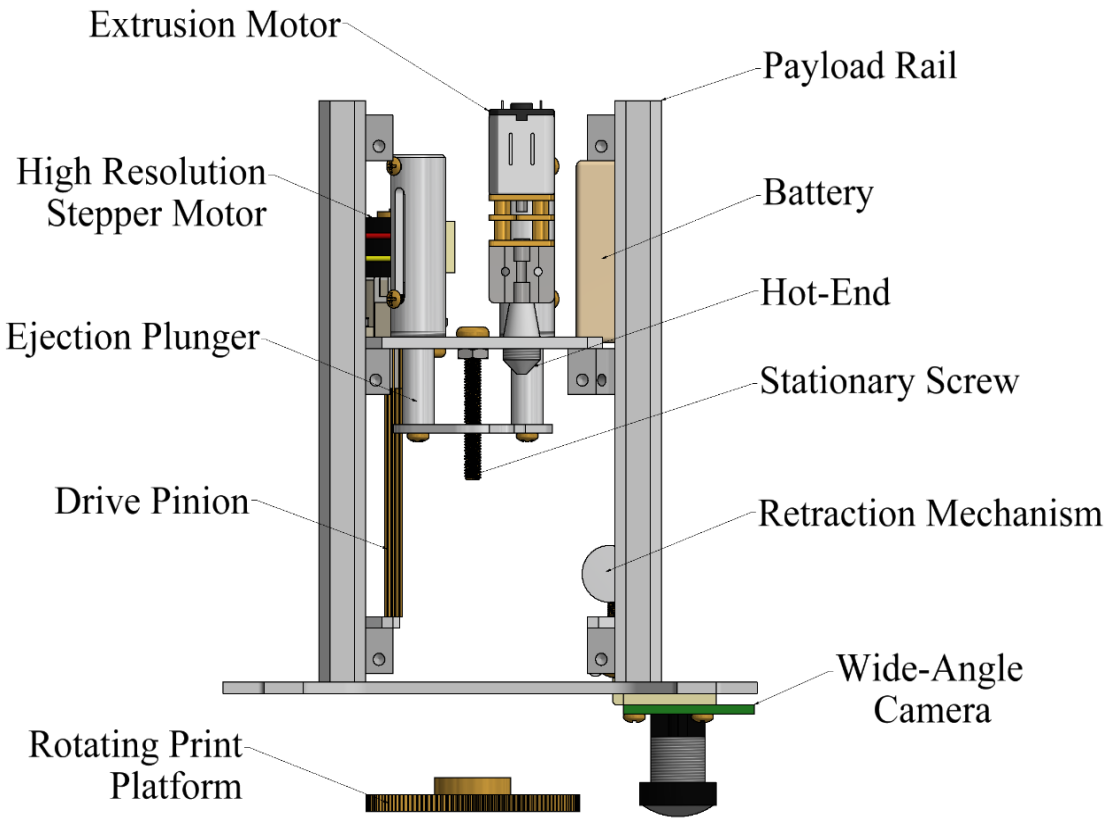


Image from: Leake & Straub, "A CubeSat Test Mission to Advance In-Space 3D-Printing"

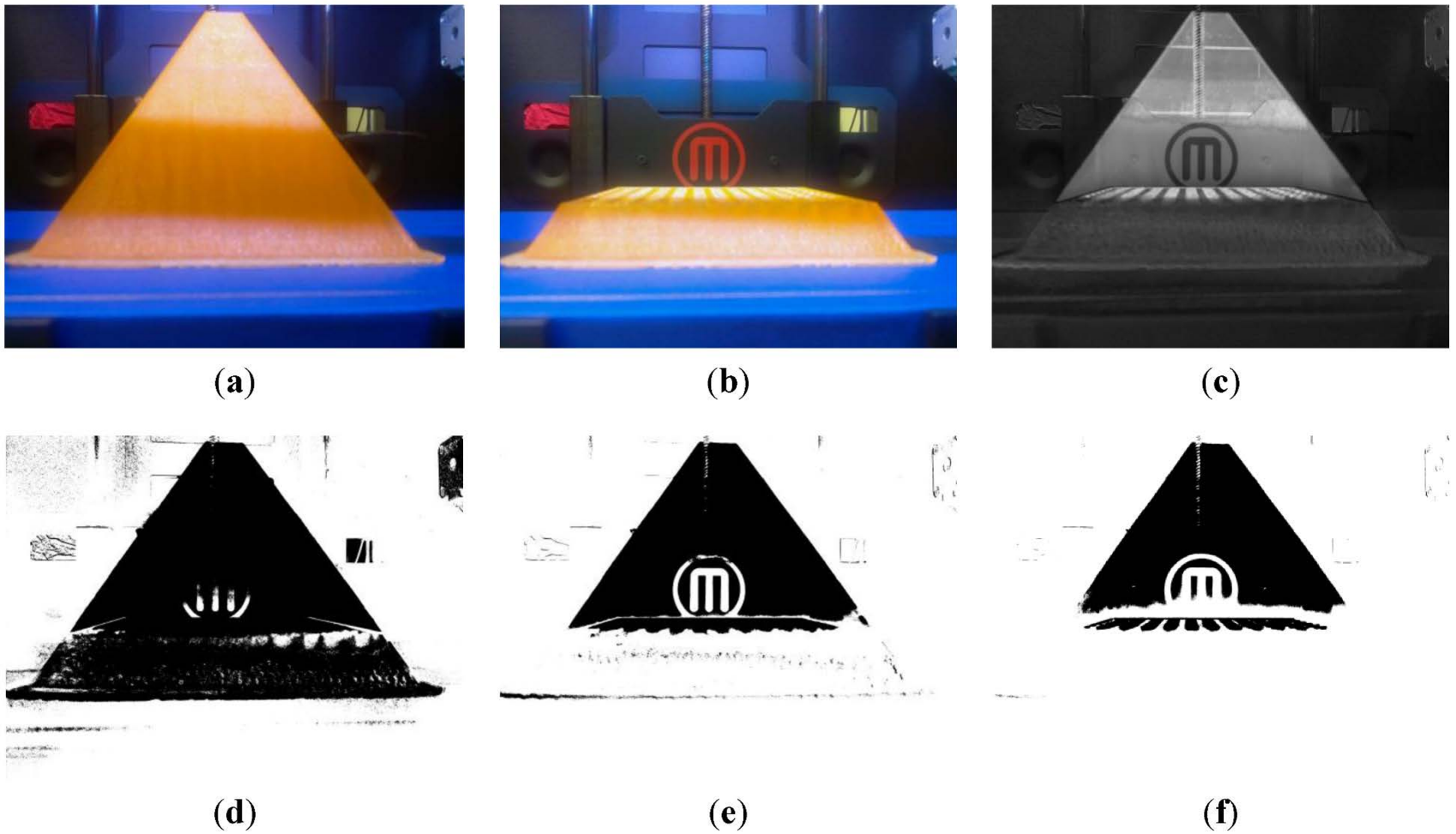
The Big Data Connection

- The challenge here was that we had far more data than we had any reasonable hope of transmitting to the ground
- The choices were, thus, to make do with less data or figure out how to determine if the printing succeeded onboard …

- In a laboratory far, far away … or at least across the hall … work was ongoing on a system to validate 3D printing quality
- Combining the two would allow us to:
  - Get a simple yes/no answer about whether what expected happened
  - Identify deviation data to send down to analyze

Using 3D printing QA software onboard

- Visible light data is collected
- Compared to expected imagery (including alignment correction), etc.
- Deviations are detected
- Deviations are identified as significant (or not)



PATENT PENDING

Image from: J. Straub, "Initial Work on the Characterization of Additive Manufacturing (3D Printing) Using Software Image Analysis"

Mission changes

- Mission Comms grew to require all of the payload space plus some
  - We were initially flying a smaller radio and are now flying two radios to meet FCC licensure requirements
  - We're doing some interesting tests with the radios:
    - Smallest satellite to fly the GlobalStar Duplex
    - Flying both GlobalStar simplex and Duplex in same satellite
    - Performing some testing / analysis related to the Comms payload
    - Sending back data on the performance of the subsystems and structure
- We've had to defer the printing payload to a second mission

What we're doing now …

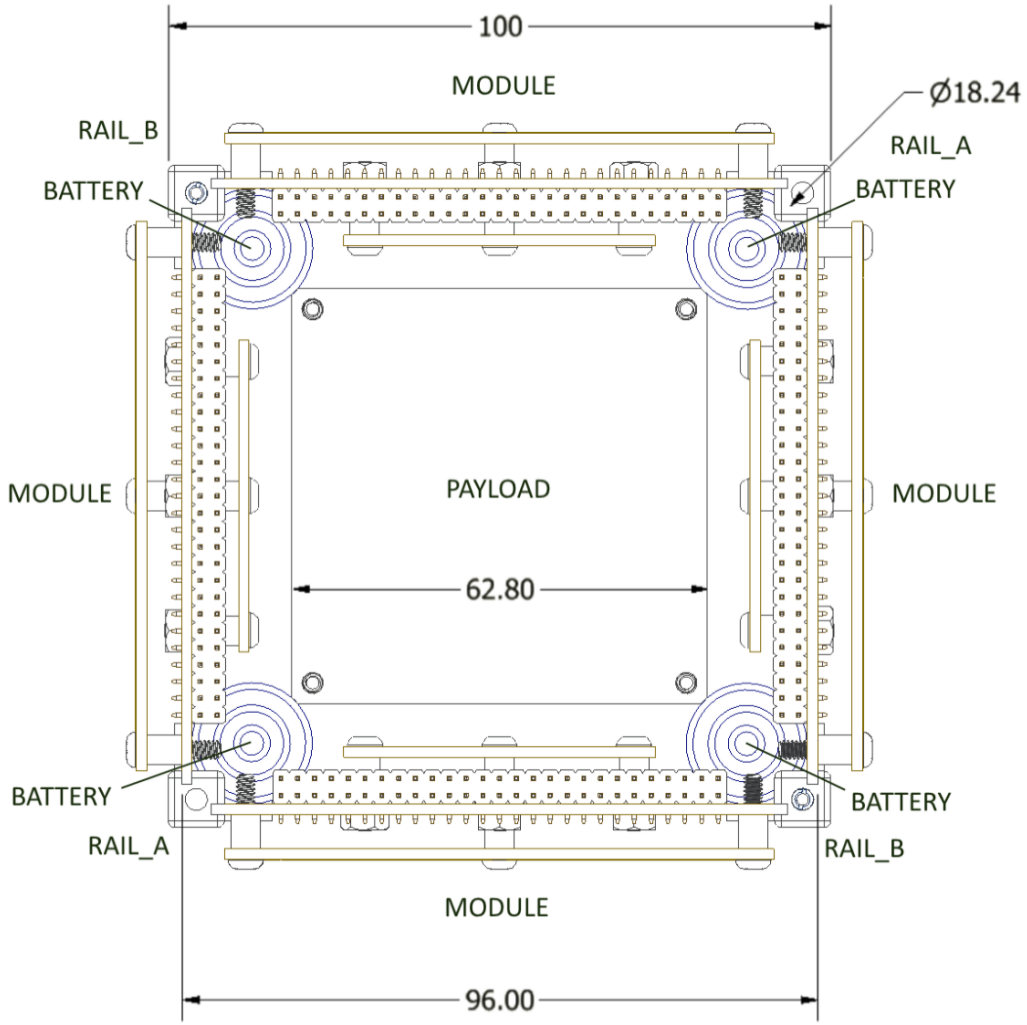
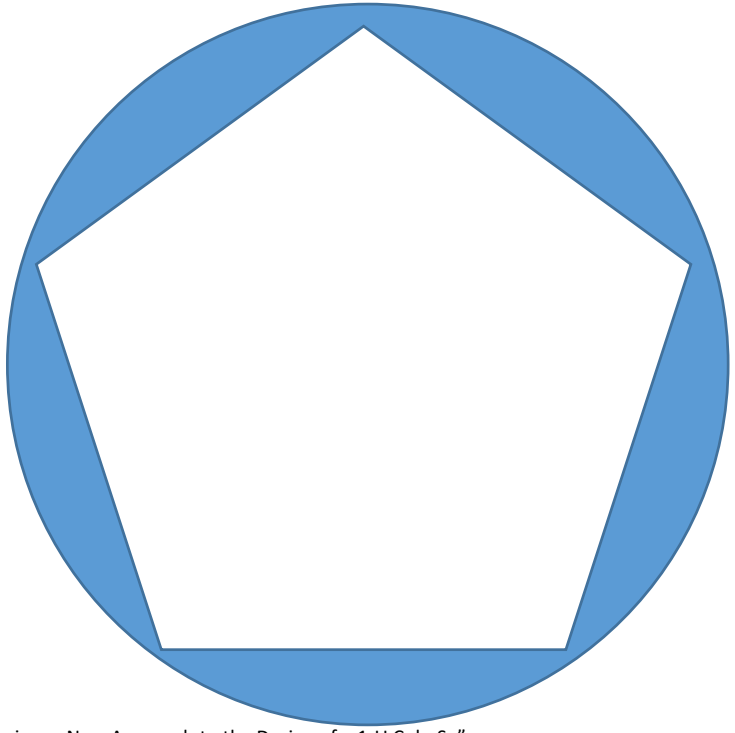


Figure 3. Diagram of the OPEN design (all units in mm).

- We're making a tubular satellite design based on our board designs
- We may fly the printing mission in a CubeSat or a tubular satellite



Left image from:
Kading, Straub & Marsh, "OpenOrbiter Mechanical Design: a New Approach to the Design of a 1-U CubeSa"

Thanks & Any Questions?

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