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Open Prototype for Educational NanoSats CubeSat Structural Design

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Introduction
CubeSats are a class of small satellites that have recently gained significant interest and are being developed and used for engineering test missions, bona fide research and various other applications. A 1-U CubeSat (the original form factor) has nominal dimensions of 10 cm x 10 cm x 10 cm and a mass of no more than 1.33 kg [1] (however, some integrators are now consistently allowing higher mass levels). Due to their small size and the demonstrated ability to successfully use consumer-grade electronics in low-Earth orbit, CubeSats cost significantly less than larger sized satellites [2]. These reduced costs, however, are still beyond the means of many companies and educational institutions. To increase access, a complete set of designs and fabrication instructions for a 1-U CubeSat is being created that will have a parts cost of less than $5,000. [3]

Side-Slotted Design
OpenOrbiter uses a side-slotted design (discussed in [5]), as compared to traditional CubeSat designs which are based on board-stacking. This means that the primary electronic systems are placed along the sides of the CubeSat. The spacecraft payload is allocated one of the four side panels and a 5 cm x 5 cm x 10 cm area in the center of the satellite.

With the side-slotted design, rails connected to the top and bottom structural members (shown in Figure 3) are used to support the side panels, which are comprised of three connected printed circuit boards (PCBs). The center PCB connects electrically to a receiver on the base (shown in Figure 1). These parts have been designed to facilitate low cost structure. They are made from 6061 aluminum (conforming to the CubeSat standards [1]) and will be produced using a student-assembled Computer Numerical Controlled (CNC) mill (see Figure 5).

Twenty-four solar cells (in groups of two) are attached to a dedicated board, which is on the outside of the 3-PCB cluster for each of the four sides (shown in Figure 2). The center and interior boards will hold the CubeSat’s core (power, attitude determination and control, radio, flight computer) and payload electronics.

The complete OpenOrbiter spacecraft (shown in Figure 4) has solar panels on five of its six sides and a payload opening on the sixth.

Conclusions & Future Work
Future work will include expansion of the OPEN design to include additional and larger CubeSat form factors such as 3-U. Deployable solar panels are in development as well as a robust payload area structure.

References

Acknowledgement
This poster has been updated from [4].