Investigation on the use of Composite Material for CubeSat Primary Structure

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Abstract

This study presents feasibility of the use of composite material, as an alternative to aluminum for the primary structure on a 2U CubeSat frame. Composite materials have been extensively used in various space applications, their main advantage being superior stiffness and strength to weight along with their ability to be tailor made with respect to mechanical properties.

The NUTS (NTNU Test Satellite) is a satellite being built in a student CubeSat project at the Norwegian University of Science and Technology (NTNU). The project was started in September 2010 and is a part of the Norwegian student satellite program run by NAROM (Norwegian Centre for Space-related Education). The main contributors in the project are final year master students from several departments. The NUTS project goals are to design, manufacture and launch a double CubeSat by 2014. As payload, an IR camera observing waves in the air-glow layer is planned, as well as a short-range RF experiment. The satellite will fly two transceivers in the amateur radio bands.

In the previous CubeSat-projects, the structural subsystem seems to have been lacking in development, as almost every project has used the standard aluminum. Some of the reasons might be limited funding, lack of knowledge of composites, or simply the risk of not getting approved. Many of the projects have themselves pointed out the possibility of using composites, but have settled upon aluminum in the end, without really investigating the possibility.

Using static and dynamic finite element analysis in addition to thermo-mechanical analyses, the effect of using composite materials instead of aluminum have been evaluated. When applicable, requirements from CubeSat standards were implemented in the solutions. Applied material properties were found from currently approved space materials. The investigation clearly indicates that the use of composite material generally gives a stiffer structure with respect to weight and that composite material is a feasible alternative to using aluminum for CubeSat applications.

Preference for presentation: oral
Most suitable sessions:
Session 4 - "Technology demonstration on CubeSats"
Session 11 - "Future technologies on CubeSats, further reduction in the size of CubeSats"

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