SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Small Satellites Potential for Future Integrated Applications and Services (4)

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DESIGN AND DEVELOPMENT OF THE 1ST GREEK SATELLITE AT THE UNIVERSITY OF PATRAS (UPSAT)

Abstract

As major improvements in technology increase the availability of smaller, lighter and more power efficient components for space missions, a significant market is emerging from the universities to develop space missions based on small, low complexity and low cost satellites, offering in that way a shorter route to flying new technology. The current project describes the design, development, manufacturing and testing of the first Greek satellite developed at the University of Patras (UPsat), which is a cube-shaped picosatellite (Cubesat) with basic dimensions 10x10x10 cm, weighting max of 1kg. The key innovative approach includes the replacement of the aluminum structural frame with structural composite components as well as the use of Shape Memory Alloys (SMAs) for the deployment of the solar arrays. The UPsat program, now in its first year, is a large project undertaken by a multidisciplinary group of engineering students and professors under the framework of final year thesis. Principles of Concurrent Design along with respective sessions took place for the development of the designs. The preliminary structural analyses have been completed by the mechanical engineering team together with thermal design evaluations. The attitude, electrical, power and communication subsystems have been designed by the electrical engineering teams. The material that is chosen to make up the structural composite material is Carbon Fiber Reinforced Plastic (CFRP). CFRP offers a great range of attractive possibilities for designing a basic material with outstanding mechanical properties. A CFRP laminate can be designed to have a very low coefficient of thermal expansion and a very high stiffness, which combined with a very low density, results in smaller deformations and higher eigenfrequencies than equivalent aluminum structures, therefore offering new potential for custom made designs. SMAs are novel materials which have the ability to return to a predetermined shape when heated. This unique ability has been used to develop a huge number of aerospace applications since SMAs simplify the functional parts of a mechanism and reduce the energy consumed for the function. For the present project NiTiCu Shape Memory Alloys are chosen since their transformation temperatures satisfy the temperature boundaries of the design. Two deployments concepts have been proposed using different SMA geometries. The result of this study is the activation of the mechanism using as less power as was possible and the maximization the solar energy obtained by the maximization of the solar array surface through design. The results of this procedure are the starting point for further designs the tools developed for simulating the mechanical design will be used for the design of other concepts for surface and structure deployment (e.g. Antenna radome) utilizing SMA technology.

Other Session: B4.6