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AN INNOVATIVE PASSIVE SOLAR ARRAY DEPLOYMENT MECHANISM FOR CUBESATS

Abstract

The market of small satellites and especially CubeSats has been on an exponential rise for the past ten years. As CubeSats are steadily being launched and used for both scientific and commercial use, the miniaturization of the components, which allows to embed more and more sophisticated payloads onboard, is becoming increasingly highlighted. Consequently, their power requirements are skyrocketing despite the limited space and mass available. Typically, on a 3U CubeSat, the power generated by traditional triple junction cells rarely reaches over than 10 W which greatly limits the available on-board power and thus, their applications. This research sought to propose a simple passive deployment module of solar panels that can be implemented in most CubeSats structures to increase the surface of solar cells. Inspired from a system used for terrestrial multiple solar array, this mechanism is designed to be versatile, highly compact and modular. More ever, it can deploy several levels of solar arrays in the shape of a flower sequentially. This modular concept is particularly constructed to fit in the standard requirements of 3U CubeSats, but also making it adaptable for most applications of other Cube-satellites. This project has initially proposed to CNES from O'Sol, a young French start-up incubated at the ESA, which develops autonomous solar generators for terrestrial applications using innovative patent-based deployment mechanisms. The objective of this project was the feasibility study of a passive deployment mechanism for solar arrays on any 3U Nanosat, which accomplished through trilateral collaboration of CNES, O'Sol and TU berlin. This modular subsystem was innovatively devised to deploy solar panels in order to increase the number of cells and thus the on-board power generation. For that, two distinct architectures were designed which can deploy two levels of solar arrays in the shape of a flower by using only passive actuators. Furthermore, two different solar cell configurations were considered, high efficiency 3J solar cells and flexible thin film. Eventually, maximum amount of generated power in each solution compared to typical maximum delivered power of 3U CubeSats shows an increase in delivered power about two times (for thin flexible blanket) and about four times (for triple junction cells). Final designs were numerically validated through modal and thermal analyses.