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THERMAL AND STRUCTURAL OPTIMIZATION OF SMALL SATELLITES USING COMPOSITE MATERIALS

Abstract

With the movement to use increasingly complex equipment in micro and nano satellites, the heat generated per unit area by those components has suffer an increase. Furthermore, during a typical orbital period there are situations where a satellite's face can be exposed to sunlight, receiving a high radiation flux, while others are turned to deep space, being at very low temperatures. This has lead to an active search for efficient heat dissipation and distribution systems, in particular with improved thermophysical properties, which would assure a proper operation of small satellites. At the same time, weight limitations drive the satellite developments as they might represent a cost increase and a comprise in mission capacity. As an attempt to address both problems, carbon fiber reinforced polymer composites can potentially offer a good solution, as they have a lower mass, when compared to conventional metal alloys with similar mechanical properties. This has surged a recent interest in these composites among the scientific and industrial space communities. The present work develops a numerical study conducted in NASTRAN to compute structural and thermal optimizations of the side panels for a micro satellite mission in development at CEiiA. Each optimization step is characterized by a change in one of the parameters which influences the thermal and structural performance of the composite. Among the solutions sough a metallic mesh is added for enhancing the panels' thermal properties. The structure is then subjected to launch and orbital environmental loads to access its performance. At the end of the work the solutions obtained are compared in terms of total mass, cost and production complexity. An assessment of the solutions obtained for future micro launcher vehicles and an experimental set up to validate the numerical results is currently under study.