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DEVELOPMENT OF A FUNCTIONAL ELECTROPLATED THERMOPLASTIC SATELLITE STRUCTURE FOR CUBESATS

Abstract

Satellite structures are conventionally constructed of aerospace-grade metallic and composite materials which can be costly to manufacture and operate. Recent advances in rapid manufacture capabilities allow the application to satellite structures. Satellite structures made using rapid manufacture techniques may be made more cost effectively, be able to incorporate structural complexity previously impossible, allow optimised structures to be developed that reduce mass, reduce component count and increase functionality. There has been a steady progression of increased resolution, increased speed of production, reduction of unit costs and a widening of material choices. By utilising 3-D printing techniques, load optimised structures with fewer joints and parts can be manufactured allowing the production of low mass geometries currently not feasible.

There have been some successes in developing satellite and rocket components using additive manufacturing, particularly with engineering metals. This process remains relatively expensive, and produces components with a similar structure density as traditionally manufactured components. This study focussed on developing structural components from thermoplastics that could be functional in the space environment. The production of thermoplastic components is significantly cheaper and accessible, allowing for more design iterations and also opening up the use of the process to the growing nano satellite market.

This study developed, tested and launched a satellite structure primarily constructed with nylon using selective laser sintering. The manufactured structure was electroplated with a 50micron layer of nickel, which served to increase the strength, rigidity and space environmental compatibility. This paper presents: the design process; the manufacturing process; and the structural and environmental testing used to qualify the structure for flight. The results from the simulations and testing are presented and used to highlight the benefits and limitations of the approach used. Lessons learned from the production of flight model structures are also presented. Lastly, areas of application and future developments are summarised.