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ADDITIVE MANUFACTURING FOR RAPID NON-CONVENTIONAL NANOSATELLITE STRUCTURES USING LASER SINTERED TITANIUM

Abstract

Using 3D printing has the capability to reduce the manufacturing time and cost for one-off products such as satellite structures. However, early 3D printers were only capable to manufacture structures using plastics. With the advancement of 3D printers and material science, today it is possible to print metal structures. However, limitations in the understanding of the mechanical and thermal properties of laser sintered titanium hinder the large scale adoption of the process for structural components. The paper describes the design and analysis of a nanosatellite structure, created using additive manufacturing, for T-SAT3 by the University of Manitoba Space Applications and Technology Society (UMSATS). In doing so, this paper furthers the understanding of additive manufacturing for space applications. The structure of the power control unit, for a 3U nanosatellite, was created using laser sintering, an additive manufacturing method which fuses successive layers of metal powder together using a high powered laser. The structure was analysed using finite element analysis, while the mechanical properties of the sintered titanium were verified using tensile tests and grain structure analysis. Afterwards, vibration tests were performed and the results of which were compared to FEA results validating the analysis. An additional finite element analysis for conventional titanium was performed, and these results were compared to the laser sintered titanium design. The use of additive manufacturing has several benefits in the production of singular nanosatellites. This practice allows for much more complex components including unconventional designs for specialized purposes. In contrast, conventional machining is not very well suited for the creation of one-off parts due to the custom fixtures and long setup procedures required. Additive manufacturing requires very little in the way of setup and thus more suited to one-off components.