

Mechanical Engineering Thesis Defense

3D Printed Heat Pipe Structures Use Application for Thermal Management on Power Dense Small Satellite Platforms

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Abstract

The technology and science capabilities of SmallSats continue to grow with the increase of capabilities in commercial off the shelf components. As these components increase in capability, they are also increasing in power usage. This introduces a problem with traditional thermal management systems on SmallSat platforms, as they cannot provide the ability for full usage of high-power components with conventional passive thermal management systems. The aim of this study is to explore new methods of using additive manufacturing to enable the usage of heat pipe structures on SmallSat platforms up to 3U's in size. This analysis shows that these novel structures can increase the capabilities of SmallSat platforms by allowing for larger in-use heat loads from a nominal power density of $4.7e3 \text{ W/m}^3$ to a higher $1.0e4 \text{ W/m}^3$, an order of magnitude increase. Along with that, the mechanical properties of the new SmallSat structures are also explored to show that they are still operational under the same dynamic loads experienced in typical SmallSat satellite launch and operation. The advent of heat pipe integration to the structures of SmallSats will lead to an increase in thermal management capabilities compared to the current state of the art systems, leading to larger science and technology capabilities for a field that is growing in both the education and private sectors.



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