30th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Interactive Presentations - 30th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (IP)

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PASSIVE THERMAL CONTROL TO MAINTAIN EARTH-LIKE TEMPERATURES INSIDE A CUBESAT

Abstract

Nowadays nanosatellites have opened access to space to many universities, businesses, and research facilities because they allow people with small budgets to lead missions. Thermal management is key for making sure that the satellite components keep working properly, but so far, the bounds of acceptability have been fairly tolerant because mechanical and electrical components have a wide working range for temperatures. This is not the case for biological payloads. Unfortunately, so far, there have only been very few examples of biological CubeSats, and they always involve active thermal management in the form of radiators and heaters. Given the availability of permanent direct sunlight, and the increased knowledge of material thermal and optical properties, is it possible to fully maintain a CubeSat's inner temperature in a "livable" range without active methods? The goal is to use passive thermal control to promote biological research on CubeSats. The approach presented starts with Python and Thermal desktop simulations. In those, material absorptivity and emissivity along with orbits choices are used as variables in order to control the temperature inside the CubeSat. Furthermore, a comparison of those simulation results with physical testing will be presented. Our research indicates that it is indeed possible to use only material and a wise choice of orbit to keep the temperature around 20 degrees average. The restricted space and power in the CubeSats hardly allow the installation of heating or cooling systems aboard. This is why fine biological research is usually done on larger satellites. Therefore, this research in thermal passive control will unlock and promote the use of CubeSat missions with biological payloads, allowing faster development of biological research under microgravity.