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THERMAL ANALYSIS OF A 3U CUBESAT WITH PAYLOAD OPERATING IN AIR-PRESSURIZED BOX

Abstract

Thermal analysis represents a crucial aspect in the design of a nanosatellite, whose compact size translates often into multiple thermal links between the onboard subsystems. In the last years, the interest in more sophisticated payload, characterized by strict thermal requirements, emphasized the impact of the power budget on the spacecraft design. In this work, we investigate the relations between some typical attitude configurations and the temperature distribution over a payload which requires a temperature in the range 20C to 40C to operate adequately. The nano satellite operates in a sun-synchronous orbit and the payload is included into a sealed box, filled with air pressurized at 1 bar, similar to the one installed onboard Astro Bio CubeSat. The temperature gradients and rates are determined based on the solution of the thermal equilibrium problem, providing a preliminary semi-analytical solution using MATLAB. The results are then refined through a transient finite element analysis using ANSYS. This analysis is extended to three attitude configurations, tumbling mode at high angular rates, spin-stabilization and nadir pointing, and three different internal heat generation scenarios, which correspond to different operational phases of the Cube Sat.