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MORAZÁN MRZ-SAT CUBESAT: THERMAL MODELING AND ANALYSIS GUIDE FOR ACADEMIC CUBESAT MISSIONS

Abstract

After two successful academic space missions in the Central American region (Batzu-1, Costa Rica, 2018 and Quetzal-1, Guatemala, 2020), Morazán MRZ-SAT is the first Honduran satellite developed by a Central American integration, and the third CubeSat in the Central American region, with academic purposes. MRZ-SAT is developed in collaboration of students and professionals from Honduras, Costa Rica and Guatemala, including the following public universities: Universidad Autónoma de Honduras (UNAH), Universidad de Costa Rica (UCR) and Universidad de San Carlos de Guatemala (USAC), with the support of the United Nations/Japan Cooperation Programme on CubeSat Deployment "KiboCUBE" (UNOOSA/JAXA). The main objective of the MRZ-SAT CubeSat is to develop the proof-of-concept of an early warning system for the mitigation of hydrometereological hazards such as floods and landslides, as well as to develop scientific knowledge, skills and competencies in the design, construction and operation of space missions in the Central American region.

The MRZ-SAT, following the 1U CubeSat standards and JAXA J-SSOD requirements, consists of multiple subsystems that ensures the correct operation in orbit and fulfillment of its scientific mission. One of these is the thermal control subsystem, whose main objective is to maintain each of the CubeSat components within an operational and survival temperature range throughout all phases of the mission. Since active control methods cannot be utilized in every component of the CubeSat, this presents a challenge using passive control methods, which includes, but is not limited to, surface materials and surface finishes. An accurate thermal modeling and analysis is critical to ensure that each component will remain in its allowable temperature range. Therefore, this paper provides a brief explanation of the thermal environment in low-earth orbit the MRZ-SAT is subjected to, as well as the computational thermal modeling and analysis performed for this CubeSat, starting from considering the CubeSat as a unique node, to a multi-nodal analysis, using finite element algorithms, to determine the survivability of the MRZ-SAT and each of its components. Finally, this paper is intended for those involved in academic space projects for the first time, in order to provide a clear and concise starting point for the CubeSat thermal analysis and modeling.