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DYNAMIC SIMULATION OF ELECTRICAL AND THERMAL SYSTEMS FOR RAPID DESIGN ITERATION AND VALIDATION OF POWER PROFILES FOR 3U IMAGING CUBESAT

Abstract

Traditional simulation of CubeSAT subsystems involved separate analysis of subsystems followed by a heavy, multi-physical co-simulation using large FEA solvers. This approach, while very accurate, is not suitable for the rapid design and validation iterations of small satellite teams due to lengthy simulation times and complex setups, which often require a lot of vacillating between the EPS and STS teams. This type of development is also heavily centered around the thermal side of the simulation, with little effort put into developing both systems in tandem on the electrical side of the design. Presented here is a novel approach to utilizing transfer-function modeling in Simulink to couple electrical and thermal models. This permits faster iterations and indications of design limitations in early stage integration studies, which often lack the time and attention dedicated to more complete co-simulation strategies in primarily FEA software suites like ANSYS and Siemens NX. The component variation efficiency due to temperature changes and thermal component life degradation is taken into account, especially for the sensitive solar panels. This thermal model is developed from a coarse sweep of FEA solutions through a mathematical system which yields a comprehensive approximation of thermal characteristics of the CubeSAT subject to various power profiles, integrated with existing electrical models in Simulink .The electrical distribution model provides the thermal dissipation of the various components. Faster iterations were achieved and early design limitation indications were overcome by coupling electrical and thermal models in Simulink to optimize the electrical system design of a 3U multi-spectral imaging CubeSAT.