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DEVELOPMENT OF CUBESAT ELECTRIC POWER SYSTEM SIMULATOR WITH COMPLEX GEOMETRY

Abstract

Small satellites offer means to achieve intricate scientific missions at a lower cost. Mission complexity leads to higher power requirements. The Electric Power System then becomes a vital system, responsible for all subsystems functionality and performance. Small size and limited surface area of CubeSats pose limitations to power generation and give rise to design considerations such as deployable panels to increase sun exposed area. However, deployable panels also create partial shading, which can cause high loss in performance of photovoltaic systems. Under these conditions PV characteristics become more complex, and multiple power peaks are generated. To provide the correct DC voltage to subsystems it is important to predict these peaks and maximize power generation of PV arrays. To achieve this, this paper presents an open source MATLAB/Simulink toolbox that can simulate the PV characteristics for complex geometry CubeSats missions. Solar array configurations of the GRACE and MicroNimbus are tested, as well as custom satellite models. This is done by taking the attitude sphere and generating irradiance levels in the mission's target orbit and attitude configuration. The solar panel setup is used to obtain the power profile of the CubeSat. Using MPPT this tool can be connected to a programmable power supply and load to test batteries and regulators in Electric Power Systems. Further on, this toolbox and setup can be extended to design and test more complex Electric Power Systems.