Estimation of Online Power Behavior in PHOENIX’s Electrical Power Subsystem

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Introduction

Research in space technology and small satellite development is getting more prosperous in recent years. The 2U CubeSat PHOENIX is developed at NCKU as part of the QB50 mission, which will be launched in 2017. PHOENIX consists of several subsystems and one of the most critical one is the Electrical Power Subsystem (EPS), which provides, stores, distributes and controls the satellite's electrical power. Prior to execute any mission, it is necessary to ensure that the power margin is sufficient. The paper provides a power system model to predict the online power behavior to avoid overloading. The purpose of the power system model is to maximize the mission performance and to prevent the CubeSat from entering the safe mode repeatedly, which interrupts the scientific mission operation. The model is built up and verified based on the simulation software, PHOENIX’s data, and QB50 precursors’ data.

Power Generation

The model exploits the STK to combine the four parameters, which is solar panels, orbit, absorptivity and assembly degradation, especially the most crucial factor as the orbital and solar panels. Then, three correction terms make the model more accurate. Some of them decrease or increase power. Consequently, total seven parameters form the model with a step by step flow, not a single one of these parameters can be omitted. The model simulates that the generated power of PHOENIX is 2.1W which is quite close the real condition compared to other CubeSat.

Energy Storage

Li-ion batteries are served for energy storage in PHOENIX. Since different C-rate and temperature correspond to the different performance, the methodology of fuzzy logic is applied to model the Li-ion batteries. Before using the fuzzy rules, the sophisticated experiments are performed to get the characteristics of the batteries. There uses the ΔV’s variation to temperature and C-rate represented by fuzzy rules which could model the battery dynamics accurately.

Conclusion

A power system made for CubeSat is developed ready to a power simulation and monitoring software for better utilization of satellite power to fulfill the mission operation.