Paper ID: 46374
student

IAF SPACE POWER SYMPOSIUM (C3)
Interactive Presentations - IAF SPACE POWER SYMPOSIUM (IP)

Author: Mr. Melvin Lugo-Alvarez
University of Puerto Rico, Puerto Rico, melvin.lugo@upr.edu

USE OF CASCADED DC-DC CONVERTERS FOR MPPT AND VOLTAGE REGULATION TO REDUCE BATTERY SYSTEM SIZE

Abstract

The bulk power system of a satellite is comprised of solar photovoltaic panels (PV) and some type of storage, be it fuel cell or more traditionally batteries. The latter prove to be easily implemented due to their solid state and rechargeable nature. Battery chemistry advances have provided improved power density, but the reality of limited charge/discharge cycles and a very temperature dependent efficiency still continue to pose a problem in the power system longevity. The proposed system uses a single-ended primary inductor converter (SEPIC) to provide maximum power point tracking (MPPT) of the PV array and combines a cascaded buck converter to provide voltage regulation of the load. The system reduces the required battery capacity by operating without storage during the availability of solar power, thus eliminating the temperature inefficiencies introduced by the battery and lowering the battery fatigue. The MPPT of the system is done using the approximation of the optimum voltage using a fractal polynomial PV panel model with integral control of input voltage to the SEPIC; output voltage control is done using a more traditional proportional-integral control. System simulation results performed in MathWorks MATLAB Simulink under changing irradiance conditions are presented as well as the system response of a working prototype.