SPACE POWER SYMPOSIUM (C3)
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Author: Dr. Longlong Zhang
Shandong Aerospace Electro-technology Institute, China Academy of Space Technology, China, zjupeson@163.com

Mr. Lin Li
Shandong Aerospace Electro-technology Institute, China Academy of Space Technology, China, yanjiuyishi@163.com
Mr. Jia Tian
China Academy of Space Technology (Xi'an), China, jia_epfl_tian@163.com

RESEARCH ON CONTROL STRATEGY OF FUEL CELL POWER SYSTEM FOR SPACECRAFT APPLICATION

Abstract

With the demand of future deep space exploration, especially in space habitats and planetary surface systems requiring above 10 kW electrical powers, large-scale energy storage device with high energy density and high round trip efficiency is needed. Among the energy storage techniques, regenerative fuel cell (RFC) based on proton exchange membrane fuel cell (PEMFC) and electrolyzer is a promising choice for the space missions because of its high energy density.

Due to the advantages of high efficiency, high power density, low noise, etc., PEMFC has drawn a lot of attentions and been gradually developed in electrical vehicle, distributed power system, portable power supply, etc. In order for spacecraft application, the reliability of the power system based on fuel cell needs to be improved. Paralleled fuel cell modules provide a high reliable solution to prevent the spacecraft from breakdown caused by malfunction of single fuel cell module. Furthermore, the energy management unit based on ultracapacitor and bi-directional DC/DC converter needs to be adopted in order to reduce the effect of load variation on lifetime of fuel cell itself.

This paper will discuss the structure of high reliable spacecraft power system based on modular fuel cell, ultracapacitor and bi-directional DC/DC converter, study the model of fuel cell and the energy management unit based on ultracapacitor and bi-directional DC/DC converter, and finally give the simulation results of the high reliable power system under different load condition.