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Author: Mr. Xiang Meng
Northwestern Polytechnical University, China

Mr. Xiaozhou Yu
Shaanxi Engineering Laboratory for Microsatellites, China
Ms. Miao Feng
Northwestern Ploytechnical University, China
Dr. Jian Guo
Delft University of Technology (TU Delft), The Netherlands
Mr. Jun Zhou
Shaanxi Engineering Laboratory for Microsatellites, China

DESIGN AND REALIZATION OF A VERY MINIATURIZED LOW-COST WIRELESS SUN SENSOR FOR MICROSATELLITE

Abstract

Wireless Sun Sensor (WSS) is a special type of attitude sensors within the big family of sun sensor. In addition to the standard function of providing sun vector information, WSS does not need any electricity or data cable to be connected to the rest of a satellite, which is a great benefit for satellite integration and testing. A typical WSS relies on a wireless communication module for data interfacing and solar cells for self-powering. So far, several types of WSSs have been developed based on this configuration, and some have even been demonstrated in orbit. However, both ground tests and in-orbit demonstration indicate that excessive sun cells are needed to provide additional current in some special cases such as poor lighting or transceiver working moment. More solar cells result in unacceptable surface area and volume. In this paper, a new type of low-cost WSS is presented. This WSS uses the Bluetooth low energy protocol. An innovation of this WSS is its power module, which utilizes a supercapacitor-based power storage system in combination with solar cell-based power generation. When the generated energy of the solar cell is enough, the solar cells will provide power to the WSS and charge the power storage module. If the generated energy is not sufficient, the power storage module will function. Specifically, power storage module will provide current in two cases. First, when the incidence angle becomes larger but still within the sensor's angle of view, the generated energy of solar panels will decrease, the supercapacitor circuit will assist to power the WSS. Second, during the Bluetooth communication system transfers data, the large peak current is needed, the power storage system will provide large instantaneous current for the transmitter. Compared with a lithium battery, the supercapacitor based storage system has no memory effect, excellent temperature characteristics, and high power density. A prototype of the proposed WSS has been developed. The size is just 30mm×30mm×12mm and the weight is 22g.Test results show that the accuracy is better than 0.5° with a field of view of 120°, the average power is 10mW. All the main components are low-cost Commercial Off-The-Shelf(COTS). This WSS is easy to use and could be fixed on CubeSat flexibly. For the microsatellite developer, no additional components or modification of their microsatellite subsystem is needed, only an external micro receiver module is enough to get the attitude information.