

24th IAA SYMPOSIUM ON SMALL SATELLITE MISSIONS (B4)
Generic Technologies for Small/Micro Platforms (6A)

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A LOW COST SELF-POWERED WIRELESS ATTITUDE SENSOR FOR CUBESATS

Abstract

Lots of CubeSats use the sun sensor and magnetometer as their attitude sensors. According to the requirements of easy to use, low cost and high reliability, Shaanxi Engineering Laboratory for Microsatellites, Northwestern Polytechnical University and the Delft University of Technology jointly developed an innovative Self-Powered Wireless Attitude Sensor (SPWAS). It incorporates a twin-hole sun sensor, a three-axis magnetometer, power system, data processing and wireless system together. The sun sensor consists of two separate quadrant detectors. Each of them is mounted at a different angle and has independent signal processing circuit. The objectives of this configuration are three folds: (1) To improve the reliability, if one detector is at fault, the other could still work. (2) To expand the field-of-view (FOV), the FOVs of two quadrant detectors are not overlapped for different installation angle. (3) To improve the accuracy, the accuracy of a quadrant detector is not the constant but related to the incident angle of sunlight. If both of the two detectors receive the sunlight simultaneously, the SPWAS will select one angle output with higher accuracy. Usually, the magnetometer is mounted on the on-board computer board. The incorporation of the magnetometer is to avoid the possible interference by nearby subsystems. Besides, the shell of SPWAS is grounded, which could also decrease the interference. The power comes from solar cells and an innovative supercapacitor-based energy storage system, which has better space performance comparing with a lithium battery. In other wireless sun sensor systems, there is no energy storage system. This design could prevent the data loss in case of poor light condition or instantaneous no sunlight, so as to guarantee the smooth attitude output. In the eclipse, the energy storage system could also provide power for the magnetometer. We use a high integrated System On Chip (SOC) as the data processing and wireless system. The processor is a Cortex M4 ARM core with hardware floating point unit, which makes the onboard digital signal processing algorithm realizable. Bluetooth Low Energy wireless transceiver is used to transmit the attitude information to the receiver. The SPWAS is a small size, high reliability and easy to mount attitude measurement unit. The CubeSat only needs a few grams, small sized receiver to get the attitude information, and no wires are required.