

ASTRODYNAMICS SYMPOSIUM (C1)
Interactive Presentations (IP)

Author: Dr. Yunhua Wu

Nanjing University of Aeronautics and Astronautics, China, yunhuawu@nuaa.edu.cn

Mr. Ze-Zhong Zhang

Nanjing University of Aeronautics and Astronautics, China, 15509151081@163.com

Mr. Chendi Jin

Nanjing University of Aeronautics and Astronautics, China, jinchdi@163.com

Dr. Zhiming Chen

Nanjing University of Aeronautics and Astronautics, China, zenkichen@gmail.com

Dr. Hua Bing

China, huabing@nuaa.edu.cn

A NEW TYPE OF SUN SENSOR FOR MICRO-SATELLITE BASED ON BIONIC COMPOUND EYE

Abstract

Micro-satellite has potential civil and military applications for future space missions, and is of interest for many countries. The development of micro-satellite has raised many demands for its components, such as non-cable, modularization and plug-and-play of the modules. This paper presented a new type of sun sensor which is one of the attitude determination sensor for satellite. The design of the new sensor is inspired by the structure of bionic compound eye. Considering the versatility and symmetry of C60 and truncated pentagonal hexecontahedron and practical installation constraints, the structure of the sun sensor uses a half truncated pentagonal hexecontahedron as the carrier of the solar cells. There are 36 cells adhere on the surface of the sun sensor. Multiple solar cells layout is a redundant design, which can improve the reliability of the sun sensor, achieve self-power capability, and ensure the field of view is larger than 150 degrees as well. The new sun sensor estimates the sun vector using the current measurements of each cell, and the calculated results will be sent to the on-board computer through wireless communication. For sun vector estimation, six pieces of solar cells are used to participate in the calculation. The symmetry structure of the selected solar cells in the group can effectively improve the accuracy of the algorithm. With the consideration of high computational efficiency, low power consumption and real-time output requirement, the algorithm is improved based on the basic fuzzy cone algorithm. The circuit design of the new sun sensor mainly takes into account the low power consumption, self-powered supply, co-processing and wireless communications, etc. The current measurement system converts the current into the voltage to facilitate the measurement of current of each cell. There are two power sources available in the intelligence power management system, the first one is battery and the other one is the power generated by the solar cells. Besides, wireless communication system and power dissipation system are also integrated in circuit board. Finally, simulations are carried out to verify the effectiveness and feasibility of the sun vector estimation method. The designed new sun sensor has great potential application for future micro-satellite.