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Author: Dr. Guanghui Liu
Northwestern Polytechnical University, China, liuguanghui@nwpu.edu.cn

Mr. Jun Zhou
Shaanxi Engineering Laboratory for Microsatellites, China, zhoujun@nwpu.edu.cn
Mr. Yaofang Li
Shaanxi Engineering Laboratory for Microsatellites, Northwestern Polytechnical University, China, 18291936172@163.com
Ms. SUN Fei
College of Astronautics, Northwestern Polytechnical University, China, nysunfei@163.com

HIGH-PRECISION SPEED MEASUREMENT BASED ON LINEAR HALL EFFECT SENSORS OF REACTION WHEEL FOR PICO-NANO SATELLITES

Abstract

The speed measurement precision of micro-reaction wheel is crucial to the output accuracy of the attitude control system. In order to improve the precision of rotational speed estimation for micro-reaction wheel, a hybrid speed measurement based on linear Hall Effect sensors instead of switch-type Hall sensors is presented without changing the original structure in this paper. Combining with the advantages of discrete digital measurement and linear analogue measurement, the proposed method adopted the speed switching hysteresis loop to restrain the speed fluctuation with the switching speed at 2500r/min. The rotational speed measurement and electronic commutation were implemented respectively though the differential amplifier and the comparator without adding to the mass and power consumption. The feasibility of the measurement was validated through experiments of prototype measuring system, and the PID algorithm could significantly improve the angular position resolution when the reaction wheel operated at low speed with measuring error and static friction, especially the zero-crossing area. Experiment results show that the hardware and software concept could satisfy the accuracy requirements for the attitude control of Pico-Nano satellites and CubeSat, and the proposed measurement is relatively simple and efficient than conventional strategy by increasing the sensors quantity.