Paper ID: 55084
student

IAF ASTRODYNAMICS SYMPOSIUM (C1)
Interactive Presentations - IAF ASTRODYNAMICS SYMPOSIUM (IP)

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CMOS BASED HIGH ACCURACY MINIATURIZED DIGITAL SUN SENSOR WITH OPTIMIZED ERROR COMPENSATION ON SONATE

Abstract

This paper presents the design, the error compensation methods and satellite integration of a newly developed high accuracy miniature digital two-axis sun sensor, which will be used in the attitude determination and control system of SONATE, a nanosatellite mission developed at the University of Wuerzburg, scheduled for launch in 2019. Nanosatellite missions are putting difficult constraints on its subsystems in terms of size, power consumption and cost, whilst still demanding high performance. The developed sun sensor has been specifically designed to meet these requirements: Low cost is being achieved by the use of commercial grade components, which also provide high computing performance and small sizes. High accuracy is being achieved by compensating errors in the measurements of a CMOS based imaging sensor by the means of an optimized error compensation method, which also takes into account errors caused by optical refraction. The paper also discusses the integration and testing of the hardware in SONATE as well as the calibration techniques used to achieve a high accuracy in-system performance after the AIT phase. We were able to reduce the physical dimensions of the sensor to 25x14x3mm. Measurement results show that the developed sun sensor achieves an angular accuracy of better than 0.4 degrees with a field-of-view greater than +-50 degrees. The optimized error compensation method effectively reduces major error factors and significantly improves accuracy. Radiation and environmental testing have already successfully verified space suitability of the sensor; in orbit testing will validate the design.