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SMALL SATELLITE MISSIONS SYMPOSIUM (B4)
Small Satellites Potential for Future Integrated Applications and Services (4)

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COMMISSIONING THE S3S NANOSATELLITE STAR TRACKER

Abstract

Star trackers have the potential to be an enabling technology for nanosatellites as they provide a robust, 3-axis attitude solution from a single sensor. Difficulties arise when trying to incorporate current star trackers into nanosatellite platforms because of their generally large size and power requirement. This paper presents a novel star tracker, dubbed the S3S, which is being developed specifically for the micro/nanosatellite market. The sensor has a high resolution imager (5 MP) and a fast processor (¿1000 MIPS), making it a versatile and reconfigurable testbed for advanced attitude determination algorithms. The sensor has a 15x21 degree field-of-view, fits comfortably onto a Cube-Sat chassis and has a power requirement of less than 0.7W. A pre-flight unit has been built and has just finished a series of lab trials; field testing is planned for summer 2010. This paper describes the design and development of the S3S nanosatellite star tracker.

A priority in the design of the S3S was to maximize the robustness of the attitude solution. This is directly related to the minimum star brightness that the sensor can detect as some areas of the sky contain only a few dim stars. The S3S achieves superior star detection by 1) using a low noise image detector, and 2) a combination of detection algorithms that can operate close to the noise floor and matching algorithms that are highly tolerant of false detections.

We have just completed a series of lab trails with the S3S that consisted of focusing the sensor optics, intrinsic parameter determination and the analysis of various noise reduction techniques. This was completed using two newly developed sensor calibration procedures. The first procedure, a focus calibration, was developed for precise control over the size and shape of an imaged star's point-spread-function across the sensor field-of-view. This can be used to improve the minimum detectable star brightness. The second calibration procedure was developed to determine a set of 21 intrinsic sensor parameters that are required for accurate determination of star unit vectors from detector centroid positions. Field testing the S3S is the next phase in the sensor development; scheduled for the summer of 2010. This will focus on validating the accuracy of the attitude solution as well as the detection limits predicted by the lab trials. Although the techniques for testing and calibration have been developed for the S3S, they are applicable to the development of similar star trackers.