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ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics - Part 2 (6)

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TESTING STRATEGIES FOR VERIFYING THE SLEW RATE TOLERANCE IN STAR TRACKERS

Abstract

A star tracker is a sensor that utilizes a camera and a microcomputer to image stars and compare them against an internal catalog to compute 3-axis attitude. The accuracy and reliability of this attitude solution is dependent on the number of detected stars within each image and the accuracy with which they can be centroided. Various effects can impair the ability of a star tracker to detect stars within an image. Angular motion of the sensor during imaging, commonly known as sensor slew, is one of the most significant of these effects and also unavoidable. This causes the light from an imaged star to spread over a larger region of pixels when compared to static imaging conditions. This effectively reduces the signal-to-noise-ratio of the imaged star, making them not only more difficult to detect but also to accurately centroid. Each star tracker claims to be tolerant of some amount of sensor slew rate; however, this value is difficult to accurately test on the ground. This paper investigates various methods of testing the tolerable slew rate of star trackers and strives to identify what level of testing is sufficient.

Three main categories exist for testing the tolerable slew rate of a star tracker. These are: simulated star images, lab testing using a motion platform and a collimated source and lastly, various degrees of ground testing using the night sky. Each of these types of testing represents a different degree of accuracy, cost, and control (both over desired slew rates and available star patterns). Although night sky tests are the most accurate, they are the most expensive and difficult to control in terms of desired slew rates. At the opposite end of the spectrum, simulated star images are cheap and give complete control over desired slew rates and available star patterns but lack the benefit of putting the imaging hardware into the loop. This in turn doesn't take into account the effects of lens aberrations which can further impact the appearance of imaged stars.

Using a newly developed nanosatellite star tracker, we have just completed a series of initial ground tests using the night sky. These tests have been preceded by a series of lab tests using a motion platform and a collimated source as we well as a large amount of simulated images. This paper utilizes these results to illustrate the benefits and costs associated with each type of testing.