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PRACTICAL STRATEGIES TO STABILISE A NANOSATELLITE PLATFORM WITH A SPACE CAMERA AND INTEGRATED MECHANICAL PARTS

Abstract

The growth and speed of nanosatellite capabilities has led to an increasing demand on the respective attitude control systems. Typically, nanosatellites utilise minaturised reaction wheels for 3-axis stabilisation/manoeuvres, which are desaturated using magnetorquers.

Small space telescopes have been deployed from nanosatellites in the past with capability ever increasing to push the limit of detectors. Previous work has established the feasibility of achieving GSD of 0.7 m in low Earth orbit for a 2.5 U CubeSat using deployable mirrors from a 400 km orbit.

The dynamic model of nanosatellite with the telescope + the deployed mirror systems will be built in this research work. The deployed mirror system will use a diamond turned mirror - it's an off axis paraboloid. The mirror would be light-weighted as much as possible, i.e. the back surface would be carved away with good thermal stability. The mechanisms for mirror systems may use methods like minature geared motors, stiction motors and shape memory alloy hinges. The sensoring and directing of the mirror surface will use an image based detection methods. A closed loop control of the mirror position will be used to iterate to a fully aligned system. This work also considers control strategies to stabilise such a platform against the effects of firstly, the external aerodynamics and secondly, any internal disturbances induced by and the movement of focussing elements. A pointing accuracy of 5-10 arcsec for a 20 min observation over the UK is targeted at a baseline orbit of 350 km sun-synchronous.

Following an initial baseline to establish current state-of-art both based on in-orbit performance and off-the-shelf subsystems available to the market within the constraints of a 3U nanosatellite system, a number of feed-forward/feedback control loops and sensor systems are studied to determine a simple process for compensating for the motion.