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COMPARISON OF REACTION WHEELS AND MAGNETORQUERS PERFORMANCE IN PRECISE ONE-AXIS STABILIZATION OF A CUBESAT SOLAR OBSERVATORY

Abstract

Angular motion of a 3U CubeSat solar observatory is investigated. The satellite is equipped with vacuum-ultraviolet sensor with field of view of 1.4 degrees. The required pointing accuracy of the payload optical axis is 26 arcminutes which ensures full solar disk coverage. Simultaneously, the satellite wobble restriction is 2 arcminutes per second. These strict requirements should be met at least a couple of times per orbit revolution with 0.1 second exposure time. Application of the reaction wheels and magnetorquers control is compared. Reaction wheels excel at providing high pointing accuracy but suffer from vibrations. Magnetorquers are free from this problem, but can provide required pointing only in the spin-stabilization regime. This induces wobble due to the cross products of inertia of a rotating body. Requirements on the satellite inertia adjustment accuracy and reaction wheels balancing properties are derived. Magnetic and gyroscopic control strategies are compared in terms of hardware requirements and achievable number of images per satellite orbit.