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USAGE OF SOLAR AND GRAVITATIONAL TORQUES FOR REACTION WHEELS DESATURATION

Abstract

Gyroscopic systems, such as reaction wheels and control moment gyroscopes, are widely used for spacecraft attitude control. They can provide fast and precise slew maneuvers and do not consume any propellant. However, because of different disturbance, e.g. gravitational and solar torques, momentum stored by reaction wheels might increase, so after a while it will be necessary to perform reaction wheel desaturation. Usually magnetorquers or thrusters are used for this purpose, but both this approaches have some limitations: magnetorquers can be used only at Low Earth Orbits, and thrusters use propellant, that can greatly affect mission lifetime. Therefore, an algorithm of attitude motion synthesis that does not rely on these systems and uses external torques to decrease stored by reaction wheels momentum might be of use.

In this paper we consider the satellite on high elliptic orbit with periapsis equal to 10 000 km and apoapsis equal to 150 000 km. The satellite is solar stabilized, i.e. normal to its solar panels is aligned with Sun vector in order to recharge the batteries installed on the satellite. The chosen orbit allows us to distinguish two different cases: motion near the pericentre where the gravitational torque prevails, and motion away from the pericentre where the solar torque prevails. For both cases we suggest an algorithm of reference angular motion synthesis that minimizes angular momentum stored by reaction wheels and provides solar stabilization. Constructed angular motion then is provided by Lyapunov based control algorithm.

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