 Paper ID: 13713
oral

ASTRODYNAMICS SYMPOSIUM (C1)
Attitude Dynamics (1) (8)

Author: Mr. Paride Testani
Scuola Ingegneria Aerospaziale, Italy, paride.testani@gmail.com

DEVELOPMENT OF SUN-POINTING MAGNETIC ATTITUDE CONTROL SYSTEM FOR CXBN CUBESAT

Abstract

The development of magnetic active control systems is nowadays a central topic for Cubesats applications: the small volumes of the components, the reliability and the design plainness make this choice suitable for CubeSats applications. In this paper is presented an active attitude control system realized for the CXBN (*Cosmic X-Ray Background Nanosat*) mission, a nanosatellite built at the Morehead State University, planned to be launched in summer 2012, on a 60 degrees inclined orbit, having a semi-major axis of 7013 km. The ACS of this satellite is demanded to achieve a stable Sun-pointing orientation all long the orbit using three magnetorquers. The pointing stability is acquired with the spin motion along the maximum inertia axis, with a constant spin rate of 60 degrees per second.

A multiple-steps strategy is adopted, realizing different control modes for each mission phase. A "detumbling mode", "coarse Sun pointing and Spin-up" and finally "fine Sun-pointing mode" are implemented. After the detumbling phase, when the dissipation of residual rotational energy is achieved, a spin-up and coarse Sun-pointing phase starts: when the first Sun data are acquired by the coarse Sun sensor (solar cells) the satellite is pointing to the Sun direction and a constant spin rate of 60 deg/s is achieved. After this coarse Sun-pointing acquisition, when fine Sun-sensors provide accurate measurements of the Sun position, the fine Sun-pointing algorithms keep the satellite pointing at Sun maintaining a constant spin rate along the symmetry-axis.

The detumbling is achieved with the widely known "Bdot" control law, implemented with one single coil, in order to preserve a certain angular velocity along the spin axis. The spin-up maneuver is realized with a proportional feedback controller, while the pointing algorithm is a simple and reliable Proportional-Derivative control. Also an active nutation damper is made.

For magnetic control own nature, the magnetic dipole can't be obtained for any arbitrary torque: the effects of underactuated torques are minimum for high inclination orbits (such as typical Sun-syncronous orbits). In this paper is shown how, even with an inclination of 60 degrees, a stable and good accuracy pointing (error of about few degrees) can be obtained, despite of underactuation issues. Simulations are run in the Matlab-SIMULINK environment, for the CXBN nominal orbit, with the implementation of disturbance torques.