Estimation of Solar Radiation Pressure on the Geostationary Satellite with a Single Solar Array Configuration

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In the geosynchronous orbit, the solar pressure is the primary source of environmental attitude disturbance on the geostationary satellite. The solar radiation pressure forces and torques are due to photons impinging on a surface in space. Computing the solar radiation pressure torque requires knowledge of the solar flux, the spacecraft orbit, and spacecraft geometry and surface properties. Meteorological satellites such as GOES I-M, GOES N-P, MTSAT, and COMS have three-axis, body-stabilized design capable of continuously pointing the optical line of sight of the imaging and/or sounding radiometers to the earth. Due to the thermal requirements of meteorological Imager, the satellite configuration requires that thereis only one solar array to avoid radiant temperature of objects on the radiant cooler facing the north (or south) side of the spacecraft. The use of a single-wing solar array mounted on the north (or south) panel of the spacecraft allows the passive south (or north)-facing radiation coolers of the imager and sounder to view cold space. However, the single solar array configuration induces a constant unbalance torque in inertial axes that required periodic wheels offloading. The wheel momentum accumulation is along the line orthogonal to the spacecraft-sun direction. In this paper, the solar radiation pressure on the geostationary spacecraft with a single solar array configuration is estimated at the long term and short term basis. In addition, the propellant amount which will be used for dumping of the accumulated momentum in the momentum/reaction wheel is also estimated. Simulations are performed based on worst-case parameters to evaluate the required frequency and durations of spacecraft maneuver.