Paper ID: 6218
student

ASTRODYNAMICS SYMPOSIUM (C1)
Orbital Dynamics (2) (2)

Author: Mr. Jay McMahon
Colorado Center for Astrodynamics Research, University of Colorado, United States,
mcmahojw@colorado.edu

Prof. Daniel Scheeres
Colorado Center for Astrodynamics Research, University of Colorado, United States,
scheeres@colorado.edu

A NEW NAVIGATION FORCE MODEL FOR SOLAR RADIATION PRESSURE

Abstract

This paper presents a new force model for solar radiation pressure acting on a satellite. The model is based on a Fourier series representation of the satellite properties and the position of the Sun with respect to the body. The perturbative effects on the satellite's orbit due to the solar radiation pressure are derived in full, and subsequently averaged to determine the secular change in the orbit due to solar radiation pressure. This preliminary study shows that for a spacecraft in a circular orbit with synchronous rotation, the secular effects of solar radiation can be described with only seven Fourier coefficients. Furthermore, the effects on fully eccentric orbits are also derived, and series expressions in terms of the eccentricity are given for application to low but finite eccentricity orbits.

This theory is compared to previous theories used to describe solar radiation pressure acting on spacecraft. One appealing attribute of the new theory is that the coefficients are derived purely on the spacecraft properties. Therefore once the coefficients have been computed, they can be used through our theory in application to any orbit. This is especially beneficial for navigation/orbit determination.

Two examples are discussed, applying the theory to GRACE and GPS satellites. GRACE is a more simple case because of the shape of the satellite and the simple synchronous rotation of the spacecraft. GPS is a more intense case due to the more convoluted attitude dynamics, shape, and the fact that the solar panels move to track the Sun. It is shown, however, that our theory is able to handle these issues and make predictions for the orbital effects due to solar radiation pressure.