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THE EFFECT OF EARTH RADIATION PRESSURE ON THE LONG TERM ORBIT OF SPACE DEBRIS

Abstract

Spacecraft surface forces, while orders of magnitude smaller than gravitational forces are extremely important for accurate determination and propagation of space debris orbits. This paper will outline an improved approach to modelling Earth Radiation Pressure (ERP) and its effect on space debris. ERP is the force exerted on an objects surface due to collision with photons originating from the Earth. A flux is computed that incorporates the fluxes both emitted from, and reflected by, the Earth. The ERP flux model is based on a subdivided surface model allowing the computational complexity of the ERP flux model to be tuned at runtime depending on object altitude and propagation time. A key advance in this technique is that the flux from the Earth is not treated as a point source acting in a purely radial direction. Instead the CERES radiation fluxes are used to determine the flux magnitude and direction from each visible region on the surface of the Earth. The summation of the force on the object from each of these micro-fluxes allows for the better determination of across-track and along-track forces due to ERP. The effect of using different ERP models, including the proposed approach has been simulated for representative space debris objects over a period of 10 years. Models for high degree and order gravitational forces, solar radiation pressure and drag are included and the ERP force discussed within the larger context of precise force modelling.