EFFECTIVENESS OF KS ELEMENTS FOR SATELLITE ORBIT PREDICTIONS WITH EARTH'S GRAVITY AND DRAG FORCE

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Abstract

This study is meant for understanding the efficiency of KS regular equations for satellite orbit prediction. The analysis is mainly concentrated on Low-Earth satellite orbit, where the forces due to non spherical nature of the Earth and atmospheric drag, plays important role. The classical Newtonian equations of motions for which solutions are unstable, cannot be used for long term prediction of orbit. Hence, in literature many transformations have emerged to stabilize the equations of motion either to reduce the accumulation of local numerical errors or allowing to use a large integration step sizes, or both in the transformed space. KS transformation introduced by Kustaanheimo and Stiefel, regularize the nonlinear equation of motion to linear differential equations of a harmonic oscillator of constant frequency. In this paper a detailed analysis on KS differential equations is carried out by including perturbations of Earth's gravity and atmospheric drag for orbit predictions. The recurrence relations of associated Legendre polynomial and its derivatives are used for including higher order Earth's gravity terms. To know the effectiveness of the theory, results are compared with the orbit of the actual space object, CZ-2D R/B, for 7 days duration. The comparison shows that the KS theory is one of the best theories for orbit predictions available at present.

Keywords: Orbit Prediction, KS Elements, Atmospheric Drag, Earths Gravity