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MODELLING AND STABILITY ANALYSIS OF GENERIC NON-KEPLERIAN ELLIPTIC ORBITS FOR SOLAR SAILS WITH REFLECTION CONTROL DEVICES

Abstract

Using the reflectivity control technology to generate non-Keplerian orbits for solar sailing has been investigated in recent years. Based on this technology, this paper presents a new approach to design generic elliptic displaced orbits in sun-centered two-body problem. To univocally describe the sail's dynamical equations, a new non-uniformly rotating and pulsating coordinate system has been established and every stationary point in it represents an elliptic displaced orbit in the sun-centered inertial reference frame. It has been verified that two families of the sun-centered elliptic displaced orbits exist and the histories of the sail's desired reflectivity rate and pitch angle for the corresponding elliptic displaced orbit can be calculated. Taking into account the sail's near-term performance, the maximum lightless number is given to study the allowed region of the stationary points. Moreover, the local stability of the elliptic displaced orbits in the allowed region are discussed with the use of linearization technique and Floquet theory. The result indicates the allowed region can be divided into stable region and unstable region according to their stability. Finally, some illustrative examples are given to validate the correctness and effectivity of the presented method.