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PARAMETRIC STUDY OF SOLAR ELECTRIC SAIL THRUST MODELING FOR INTERPLANETARY MISSIONS UNDER VARIOUS SOLAR WIND VARIABILITY

Abstract

The development of Solar Electric Sailing introduced by Janhunen in 2004 for interplanetary travel has gained significant progress in theoretical, laboratory and experimental fight tests. The electric solar wind sail (E-sail) uses the natural solar wind dynamic pressure for producing thrust for a spacecraft by Coulomb interaction. The baseline configuration of an E-sail comprises a number of long, thin, conducting and centrifugally stretched tethers; by an onboard electron gun these are kept in a high positive potential. The positively charged tethers repel the solar wind protons and hence produce thrust as well as attract electrons. E-sail gains its efficiency since the effective sail area of the tethers can be millions of times larger than the physical area of the thin tethers wires, thus offsetting the very weak dynamic pressure of the solar wind. Theoretical development has indicated that E-sail is capable of producing a dramatic level of specific acceleration for interplanetary travel propulsion. In the present work, by comprehensively review the status of solar electric sailing thrust modeling, a baseline Electric Sailing Spacecraft is modeled. The variability of solar wind field in the solar System and influence of solar wind field fluctuations on solar electric sail thrust for various solar electric thrust modeling is considered. Then a parametric study is carried out to investigate the heliocentric interplanetary trajectories of a baseline Electric Sailing Spacecraft under selected solar wind conditions. Some examples are presented and elaborated.