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SPACE PROPULSION SYMPOSIUM (C4)
New Missions Enabled by New Propulsion Technology and Systems (6)

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OVERVIEW AND ANALYSIS OF MSAIL AND ESAIL PROPULSION FOR INTERPLANETARY MISIONS

Abstract

The need for a "sustainable" spacecraft that can deliver large thrust for near earth, planetary and interstellar exploration mission with less travel time and large payload leads to the efforts of exploring and utilizing new types of sustainable power source to be derived directly from space, without utilizing Earth based propulsion system and propellant. The original idea of magnetic sailing spacecraft (MagSail), as proposed by Zubrin utilizes the interaction between solar wind and an artificial magnetic field that is generated by a loop of superconducting wire attached onboard of the spacecraft to reflect the solar wind particles approaching the coil. An alternative system, Mini-Magnetospheric Plasma Propulsion (Winglee, Funaki), utilizes magnetic field created by currents supported by the injection of low-energy plasma in a small magnetic system attached to the spacecraft; M2P2 spacecraft gains great interest for its potential to gain large acceleration in deep space. From the spacecraft design point of view it is very attractive since no large structure is required. To that end, a propulsion system known as a mini-magnetospheric plasma propulsion or Magneto Plasma Sail was proposed, by inflating the magnetosphere by a plasma jet instead of employing a huge coil. In a parallel development, continuous efforts by Janhunen and colleagues have produced the concept of Electric Sailing Propulsion that have recently been developed into prototypes, that also draws considerable interest for its vast potential for space travel, exploration and creative ventures. Based on the concepts, development and potentials of these novel propellantless propulsion system, the present work attempt to consider the possibility of utilizing these systems for a generis spacecraft configuration, and perform some parametric study and comparative analysis of their performance based on several selected measures, similar to the previous author work on comparative study of FSS and SPT Solar Sailing spacecraft for a selected heliocentric trajectories. To that end, an interplanetary mission is analyzed for each specific trajectory. The equation of motion for orbital dynamic of individual spacecraft is elaborated and parametric studies are carried out to explore the probable trajectories of interest for space missions. The results of the analysis together with circle-to-circle planetary transfer such as Venus and Mars are elaborated for insight and comparative purposes. The advantages and disadvantages of the utilization of these novel propellantless propulsion systems and their specific configurations will be critically discusse