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SPACE PROPULSION SYMPOSIUM (C4)
Advanced Propulsion: "Non Electric Non Chemical" (8)

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BEAMED ENERGY FOR ABLATIVE PROPULSION IN NEAR EARTH SPACE

Abstract

We consider an ablation based propulsion engine for use in near-earth space. Key goals are a close approach to unit efficiency and a simple engine design. We propose to deliver the beamed energy in near earth space using a novel energy infrastructure design we are currently exploring. Objectives are to use the relatively simple design to : (1) reduce spacecraft weight; (2) gain reliability; (3) facilitate maintenance and repair and; (4) approach unit propulsion efficiency. The ultra-short laser pulses distributed by the beamed energy system we are examining assist in accessing this high efficiency. We propose a combination of pulse spacing, pulse duration, and oblique excitation of the propellant to minimize loss caused by interference of the material ejected in the process of generating thrust with the incident beamed optical energy. Further gains can be achieved by use of an energetic material as the propellant. Heat minimization is also an advantage of this ablation driven engine. The heat from the ablation process is largely carried off with the ejected material. It is important that the ejected material from the ablation process does not contaminate the optics delivering the pulses to propellant or interfere with the incoming pulses by scattering or absorption, causing a loss in power of the beam. Design strategies are considered that minimize this problem. One approach, e.g., introduces the beamed energy at an oblique angle relative to the exiting cone of ejected material through the use of off-axis parabolic mirrors. We find a potential for rapid orbit change. For example, an analysis of an orbit changing application indicates 2 MT can be lifted from low Earth orbit to geostationary orbit in 16 hours using this method at an average beamed energy per unit time of one megawatt. We also consider use of spatially distributed and simultaneously energized propulsive events as providing novel capabilities for propulsion in space.