Paper ID: 41345
student

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

Author: Mr. Thomas Gemmer
North Carolina State University, United States

Mr. Christopher Yoder
North Carolina State University, United States
Prof. Andre Mazzoleni
North Carolina State University, United States

INCREASING THE ACCURACY OF ELECTRIC SAIL MISSION PERFORMANCE ESTIMATES

Abstract

The electric sail is a propellantless space propulsion concept, proposed in 2004 by Pekka Janhunen of the Finnish Meteorological Institute. An electric sail would consist of several long wires, deployed radially from the body of the spacecraft, and maintained in position by rotating the spacecraft. The wires would be held at a high positive electric potential via an electron gun and the resulting electric field would deflect the charged ions in the solar wind and transfer their momentum to the spacecraft. The electric sail is expected to have thrust dependence on distance from the sun, r, of approximately $1/r$, as compared with $1/r^2$ for a solar sail, as a result of the radially changing properties of the solar wind plasma. This means that the electrical sail has the potential to dramatically outperform the solar sail, especially for missions to the outer solar system.

In papers for the 66th and 67th International Astronautical Congresses, we presented a new model for the interaction of the solar wind with the wires of an electric sail and examined it both analytically and computationally. Here, we use this new model to examine the mission performance of the electric sail. In order to compare the predictions of the new model with those of previous models, we use missions that have been simulated for the electric sail in the past. These include missions to both Mars and Venus as well as missions to outer solar system targets such as the Trojan asteroids. In particular, we consider a fast mission to the heliosheath, which is the mission most often cited as being ideal for the electric sail. This allows us to characterize the implications of our new model for electric sail performance directly in terms of what it means for mission implementation.