SPACE EXPLORATION SYMPOSIUM (A3)
Poster Session (P)

Author: Ms. Tiffany Russell
NASA Marshall Space Flight Center, United States

INVESTIGATIONS INTO INTERPLANETARY APPLICATIONS FOR LARGE IN-SPACE DEPLOYABLE SOLAR SAILS

Abstract

The Space Systems Team in the Advanced Concepts Office (ACO) at the NASA Marshall Space Flight Center in Huntsville, Alabama has investigated several applications for implementation of large in-space deployable solar sails. Missions to Near Earth Objects (NEOs) and Asteroids (NEAs), inner solar system planets, and the Sun have been studied to provide the solar sail community opportunities to test sail sizing techniques, perform trajectory optimization analysis, and mission architecture development. Since solar sails have the potential to provide mass and cost savings for spacecraft traveling within the inner solar system, companies like L'Garde have demonstrated sail manufacturability and various in-space deployment methods via investment through NASA's Office of the Chief Technologist Advanced In-Space Propulsion Systems.

In partnership with the DEPLOYTECH project managed out of the University of Surrey in Guildford, England, ACO has performed a series of studies to showcase applications for large in-space deployable structures. These deployable structures include booms, articulating arms, inflatables, and solar sails. Two particular applications investigated are the Mars Sample Return and the NEO/NEA scout missions.

The Mars Sample Return mission involved the incorporation of an existing design of a solar sail for a Solar Sail Technology Demonstration Mission by L'Garde called Sunjammer. The sail design would be applied to the propulsion system of an existing Mars Exploration Sample Return Mission Architecture developed by the Jet Propulsion Laboratory. The purpose of the study was to estimate the reduction of mission cost and mass for an existing architecture through the inclusion of the solar sail.

The second application focuses on the trajectory optimization of visiting several NEOs that are under consideration for human exploration by NASA. ACO developed a spacecraft bus with an estimated mass in order to size the solar sail. The sail is then modeled using a NASA developed mission modeling tool to calculate the length of each NEO/NEA visit.

In both studies, the use of solar sails has shown a mass savings over conventional chemical propulsion systems while still meeting the mission requirements. These studies demonstrate the potential of large in-space deployable structures for interplanetary exploration.