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From Earth Missions to Deep Space Exploration (05)
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IN SPACE CHEMICAL PROPULSION ENGINE SENSITIVITIES FOR DEEP SPACE EXPLORATION

Abstract

The need for high performance, rapid transfer of humans and their payloads for deep space exploration is vital for mission success. While other rapid transfer technologies are being developed, cryogenic chemical propulsion remains the workhorse for these types of maneuvers. The need for enhanced performance, as well as understanding available options for in space chemical propulsion will enable overall mission success to various destinations.

This paper highlights an in space chemical propulsion engine sensitivity assessment performed by NASA's Human Spaceflight Architecture Team (HAT) Cryogenic Propulsion Stage (CPS) element team. Two of the driving missions in the full suite of HAT Design Reference Missions (DRMs) from the Cycle B set of missions were used for this assessment. The crewed GEO mission represents the most demanding mission from a maneuver standpoint, while the Near Earth Asteroid (NEA) mission represents the most demanding from an element stack complexity standpoint. The engine assessment highlights the compilation of several efforts including; high thrust class engines (¿200,000 lbf) versus lower thrust class engines (¡60,000 lbf) and international partnership options. The assessment focuses primarily on the top level impacts to the CPS and other mission elements. These impacts include: CPS propellant mass impacts, CPS burnout mass impacts, total mission run time as well as minimum burn times, and minimum and maximum stack accelerations. Other top level engine implications were documented to further understand the unique characteristics of different engine cycles and their application to in space maneuvers. Understanding the implications of these parameters helps to ensure appropriate engine selection and mission success.