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

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HYBRID ROCKET PROPULSION SYSTEMS FOR OUTER PLANET EXPLORATION MISSIONS

Abstract

Outer planet exploration missions require significant propulsive capability, particularly to achieve orbit insertion. Missions to explore the moons of outer planets place even more demanding requirements on propulsion systems, since they involve multiple large delta-V maneuvers. Hybrid rockets present a favorable alternative to conventional propulsion systems for many of these missions. They typically enjoy higher specific impulse than solids, can be throttled, stopped/restarted, and have more flexibility in their packaging configuration. Hybrids are more compact and easier to throttle than liquids and have similar performance levels. This paper presents novel hybrid motor designs for exploration missions to Europa, Titan and Uranus. A hybrid motor design for each of these missions shall be optimized across a range of parameters, including propellant selection, O/F ratio, nozzle area ratio, and chamber pressure. The fidelity of these designs shall be improved using the similarity solution to the coupled mass flow equations within a hybrid motor combustion chamber. Predictions for the transient performance of the motors will be used to verify that each design meets the requirements of the mission. Trade studies for each of the missions will also be conducted to explore the pros and cons of the hybrid designs as compared to traditional in-space propulsion systems.