Paper ID: 78456
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IAF SPACE PROPULSION SYMPOSIUM (C4)
Interactive Presentations - IAF SPACE PROPULSION SYMPOSIUM (IPB)

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USING THE INTRINSIC MAGNETIC SUSCEPTIBILITY CHANGE OF METHANE COMBUSTION TO INCREASE MANEUVERABILITY OF RCES

Abstract

This paper ponders the employment of methane as a cryogenic fuel for rocket engines and how few intrinsic properties of methane combustion can be used to improve the performance of the Reaction Control Engines(RCEs) in spacecraft passively. Methane propulsion is a field that is being widely experimented on to be used in future rocket engines for space travel. The two liquids are transported through pumps from storage tanks to the combustion chamber and ignited, which generates high-temperature and high-pressure gases, which expand rapidly, creating a high-velocity exhaust stream. It has many advantages to liquid hydrogen fuel, like the capability of the fuel and oxidizer to be stored at similar temperatures, higher specific impulse, non-toxicity, in-situ production capabilities, and the absence of coking. Nevertheless, there are a few challenges faced, like: Reaction control thruster(RCE) design maturation, etc, Design of low-leakage, long-duration cryogenic valves Pump-fed LOX/LCH4 engines with deep throttle capability Leak detection

RCEs are used as supplements with larger main engines to provide precise control and stability to a spacecraft. Because RCEs are typically used for small, precise maneuvers, they require a high degree of reliability and precision. They also need to be designed to operate in the vacuum of space, where there is no atmospheric pressure to assist with combustion or cooling. Experiments were conducted by scientists earlier, to show that a gradient magnetic field, causes a significant effect in a combustion reaction. The reaction is promoted when a fuel gas flows in the direction of a decreasing gradient field. On the other hand, it is quenched when a fuel gas flows in the direction of an increasing field. This property is also followed by methane due to its inherent magnetic susceptibility change during the combustion reactions. This property can be exploited by RCEs to maneuver in specific directions by using varying magnetic field densities alone. This paper presents an overview of earlier experiments involving magnetic field gradient and its effects on the direction of methane combustion and presents a design idea of how this can be used in RCEs to control maneuverability.