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EXPERIMENTAL INVESTIGATION ON THROTTLING TRANSIENT RESPONSE OF BIPROPELLANT THRUSTER USING CAVITATING VENTURI VALVE.

Abstract

Recently, the interest in interplanetary missions increased with the appearance of private companies, and mainly planetary exploration missions towards the Moon are considered. These ambitions require technologies to control the thrust during descent and ascent for Sample Return Missions. The throttling behaviour of cavitating venturi valve for bi-propellant thruster was investigated to answer lunar descending and ascending missions' requirements. The throttling system was composed of a cavitating venturi valve linked to a servomotor. A pintle was translated in the venturi section by a linear actuator coupled with hardware components and a control algorithm to monitor the mass flow rate. The kerosene (fuel) and 90 wt.% H_2O_2 (oxidizer) flow inlet and out of the cavitating Venturi valve were visually observed through high-speed imaging during the first part of this study. The experiment was composed of a 50-bar propellant tank connected to the cavitating venturi valve then the liquid would be collected in a container from the feeding line. A preliminary analysis of non-reactive cold flow transient response was made. Therefore, the behaviour of the flow was analysed by a frequency method to determine the potential instabilities in the system. Moreover, a visual analysis recorded by camera reinforced the results obtained through the frequency method and an appearance of a small cavitation cloud, located mainly around the throat's wall. The second part of the experiment was to analyse the flow transient response during the combustion test using 400 N class H_2O_2/kerosene bi-propellant thruster. Pressure transducers were implemented to verify the pressure values in the system to validate the requirements. The descending configuration was reproduced with a small translation of the pintle to control precisely the mass flow rate of the system. The propellants' mass flow rates were manipulated corresponding to a range between 400N and 50N. On the other hand, the ascending configuration was tested with a large translation of the pintle to switch from 0