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IAF SPACE PROPULSION SYMPOSIUM (C4)
Liquid Propulsion (2) (2)

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ISPACE'S LOW-COST LUNAR LANDER PROPULSION SYSTEM A DESIGN OVERVIEW

Abstract

ispace, inc. has designed a low-cost propulsion system for lunar landers with a first demonstration mission scheduled to take place in 2022. To be used on ispace's first lunar mission, as part of the company's HAKUTO-R program, the propulsion system is part of a robotic lander with the capability to carry payloads to the lunar surface. With the company's first and second missions taking place in 2022 and 2023, its HAKUTO-R program is intended to lay the framework for a continuous support of affordable lunar missions, contributing a sustainable future where human life can be extended into space. The lander has two propulsion systems: The Main Propulsion System (MPS) and the Reaction Control System (RCS). The MPS provides the lander with thrust and attitude control during landing. In addition, it will enable the transfer from Earth to the Moon by performing orbital and trajectory manoeuvres. The RCS will provide attitude control during the cruise phase to allow sun-pointing and communication with the lander. Both propulsion system designs are unique due to their simplicity and the use of reliable components from established suppliers, in order to reduce conservatism and redundancies to an adequate level, and therefore to reduce cost significantly. The MPS consists of one steady-state firing main thruster (MT) and six assist thrusters (AT) capable of pulsing. For the Earth-Moon transfer and orbital manoeuvres, the system operates in a high-efficiency mode, while during landing it provides high thrust and an ability of throttling by adapting the AT pulse duration at a constant pulsing frequency. The MPS is a pressure-fed system with a helium pressure vessel. A mechanical regulator supplies constant pressure to four main propellant tanks. One pair of tanks is used to store the MMH and another pair is used for MON-3. Each of the propellant tank is equipped with a Propellant Management Device (PMD) to provide gas-free propellant to the thrusters. One key feature of the design is the use of two ring manifolds, for each propellant specimen, which connect propellant tanks and all seven thrusters. This architecture ensures best possible distribution of the propellants to each of the thrusters and equal discharge of each pair of tanks. The RCS includes a diaphragm tank which provides hydrazine to eight reaction control thrusters in blow-down mode.