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ANALYTICAL AND NUMERICAL STUDY OF THE N2O FLOW IN THE FEED SYSTEM OF A SMALL SATELLITE.

Abstract

Hybrid propulsion systems have been shown promising options to be applied in small spacecraft that require high thursts and low electrical power consumption. One of the main advantages of this kind of system is the possibility to control the oxidizer flow rate, which provides the capability to stop/restart the engine and throttling. Besides, it often uses low-cost green propellants enabling its research by several universities and institutes. Nowadays the School of Aerospace Engineering of the University of Rome - La Sapienza (Italy), in partnership with the University of Brasilia (Brazil), is developing a hybrid rocket engine to be assembled in a microsatellite in order to perform capture maneuvers in a Mars orbit. The propellants chosen for the mission are paraffin wax, as fuel, and nitrous oxide (N2O), as oxidizer. The use of N2O is advantageous due to its self-pressurizing properties, eliminating the need to use a pressurizing system, which reduces the complexity, total weight, and costs of the system. The goal of this work is to design the feed system and perform analytical and numerical studies of the N2O flow, considering its multiphasic behavior and the problems connected to the reduced dimensions. The expected results are the prediction of nitrous oxide thermodynamic states, temperature and pressure, before the injector during the system operation; and the comparison between the models assuming the oxidizer only in liquid phase and multiphasic flow.