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SOLAR ELECTRIC PROPULSION ISOTHERMAL PERFORMANCE & PRESSURE BLOWDOWN MODEL

Abstract

Solar Electric Propulsion (SEP) is a type of spacecraft propulsion that employs the conversion of solar energy into electrical power, which is subsequently used to accelerate charged particles (usually ions) to generate thrust. The Emirates Mission to the Asteroid Belt (EMA) is led by the United Arab Emirates Space Agency (UAESA) in collaboration with its knowledge partners. EMA is planned to launch in 2028 and visit, via high-speed flyby encounters, 6 asteroids in route to an extended rendezvous with a 7th asteroid, utilizing mainly electric thrusters. The SEP architecture design is composed of the tank, a Pressure Management Assembly (PMA), a Xenon Flow Controller (XFC), and the Hall Effect Thrusters (HETs). This paper investigates the existing trajectory design utilizing a Python model, which retrieves the spacecraft's location from the sun. Subsequently, finding the available power, thruster performance parameters like thrust, Isp and mass flow rate. Ultimately, examining the isothermal behavior of the xenon propellant tank while thrusting, and extracting the mass consumption of the SEP system, as well as the pressure blowdown model of the tank. The SEP blowdown model shows mass residuals in the tank accommodating the EMA trajectory design, whilst the residual pressure in the tank facilitates an efficient regulation of the SEP component layout.