SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems (1)

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ASTEROID REDIRECT MISSION CONCEPT USING A VARIABLE ISP PLASMA PROPULSION SYSTEM

Abstract

Today there are more than 15,000 Near Earth Object close to the Earth, and even though none hit our Planet – with some serious consequences – in the modern era, an event in which a body of 100m in diameter hit the Earth is expected once every 500-1000 years. This paper describes and analyzes an operational scenario for a planetary defense system based on VIP technology. The space segment of the proposed system is made of 6 satellites using the Variable ISP Minihelicon Plasma Thruster (VIP) in a heliocentric orbit. The target asteroids are those with a high elliptic orbits, an inclination around 9 and the chance to hit the Earth. We propose a mission concept for planetary defense meant to have a small detection-time response-time ratio to ensure that even if the object is identified within a short time before impact (<10yr) the response can be appropriate. An efficient and flexible propulsion technology with multiple in-space refueling capabilities and high Isp is one of key enabling factors in the successful redirection of an asteroid that may become a threat to the Earth. VIP is a technology that offers high variable specific impulse and relatively high variable thrust as options to increase flexibility in the planetary defense operations. The development of plasma propulsion technologies for space applications is going-on in a number of RD Centers in Russia, United States, Japan, and Europe. Russian companies and RD centers have developed several advanced plasma propulsion concepts and accumulated data and experience in design, development, testing, and implementation of this family of propulsion systems. The already achieved theoretical and experimental levels of this technology can be sufficient for the development of a spacecraft concept that may perform the envisioned Asteroid Redirect Mission concept. The variable Isp and the high power regime of this thruster are key factors of the propulsion design. Having the capability of managing 0.5MW of power at variable thrust and impulse levels, while inducing some constraints in the power system, gives also the possibility of dissociate a wide range of chemical compounds, including water. We consider a nuclear-power source (either RTG or a compact reactor) for this mission. This capability enables our in-orbit refueling using harvested-in-space fuel strategy, reducing the amount of fuel that needs to be lifted from the Earth and so reducing the overall cost of the mission.