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CONCEPTUAL DESIGN OF A SMALL SATELLITE PROPULSION SYSTEM FOR ENHANCED ATTITUDE AND ORBIT CONTROL CAPABILITIES USING MULTIMODE PROPULSION TECHNIQUE

Abstract

Space propulsion technologies have been identified to be a challenging aspect of the small satellite architecture, given the structural constraints including mass, volume and power systems. Although the independent propulsion methodologies including chemical and electric propulsion have been implemented and proven to be viable solutions for small satellite missions, this paper foresees multimode propulsion as a futuristic technology allowing significant on-orbit adaptations. The paper conceptualizes multimode propulsion system structure and thruster development for chemical and electric mode as a bridging gap between both individually along with addressing challenging aspects like orbit maneuvering, attitude control, orbit insertions and station keeping. Specific propellants for multimode propulsion have been extensively studied concerning dry mass, power, specific impulse, thrust and volume characteristics and concluded for high-performance operation including electrospray propulsion coupled with monopropellant. The baseline design of the system proposes an efficient solution through performance analysis of these propellants in electric and chemical modes. This paper proposes a simulation-based model for efficient system performance with constrained volume and power restrictions and studies architectural reforms and economic tradeoffs as compared to the existing space propulsion technologies. Furthermore, this technology can be useful over a large spectrum of small satellite missions being flexible solutions for mission-specific payload.