SPACE PROPULSION SYMPOSIUM (C4)
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DEVELOPMENT OF SCALING MODELS FOR APPLIED FIELD MAGNETOPLASMADYNAMIC THRUSTERS

Abstract

In order to rate and compare new concepts of propulsion systems for interplanetary space flight a software tool called "Space Vehicle Code" (SVC) is currently under development at the Institute of Space Systems (IRS) in Germany. Its code features a modular design and is generated using the commercial software Matlab. The present contribution represents one module of the SVC and introduces a scaling law for applied-field-MPD thrusters, which belong to a subclass of electric propulsion devices using Lorentz forces to accelerate an ionized propellant. First, the input parameters for the computation are defined. The scaling model is then introduced based on the first principle of thermodynamics and an improved version of Tikhonov's thrust formula. Subsequently, a loss factor is approximated based on empirical data. The model's calculation of the mass flow is carried out by an iterative numerical readjustment. According to this approach the developed code provides data required for mission analysis by the computation of important quantities, such as, exhaust velocity, thrust, or efficiency based on the defined input parameters. To ensure correct data, the scaling model has been validated for thrusters operated at a wide variety of electrical powers and different propellants, including argon, lithium, hydrogen, and xenon.