Paper ID: 32673
student

SPACE PROPULSION SYMPOSIUM (C4)
Interactive Presentations (IP)

Author: Mr. Bixuan Che
National University of Defense Technology, China, 15575936694@163.com

Dr. Xiaokang Li
National University of Defense Technology, China, lxk0330@163.com
Prof. Mousen Cheng
National University of Defense Technology, China, chengmousen@vip.sina.com
Dr. Yuguo Cheng
National University of Defense Technology, China, hlcyg@163.com
Mr. Danming Li
Lanzhou Institute of Physics,CAST, China, lidanming@sina.com

SYSTEM & MAGNETOHYDRODYNAMIC SIMULATION INVESTIGATION ON PULSED INDUCTIVE THRUSTERS

Abstract

Pulsed Inductive Thruster (PIT), which is a novel and promising propulsion concept, employs a strong electromagnetic field stroke to generate and accelerate a plasma current sheet. Two simulation models, one 1-D circuit-current sheet coupling model for the whole system while the other a 2-D axisymmetric magnetohydrodynamic(MHD) model for the plasma flow field, are respectively built to study the PIT performance comprehensively. Factors which influence the quality of current sheet formation and acceleration are discussed, and parameter principles are also concluded. Results from the 1-D model indicates that to reach high performance, a critical requirement for the matching between circuit discharge period and current sheet movement must be achieved, and initial gas compressing against the coil face is also highly profitable. Results from the 2-D model indicates that a well-formed uniform current sheet structure could sweep the gas more thoroughly and thus lead to higher propellant utilization efficiency. Moreover, under identical discharge energy, narrower pulse period generates a better current sheet, and this may ask for a relative higher discharge voltage but lower capacitor value. Parameter principles derive from the two models come up with several conflicts, for example: for coil inductance value of the circuit, larger inductance couples more energy to accelerate the propellant but also causes a worse current sheet because its' inductive electric field is weaker. Given both system coupling and plasma flow field, aforementioned two principles are discussed qualitative and quantitatively. Lastly, design and optimization rules for an PIT system are proposed.