Paper ID: 28263
oral

66th International Astronautical Congress 2015

SPACE PROPULSION SYMPOSIUM (C4)
Advanced and Combined Propulsion Systems (8)

Author: Dr. Dan Micheals
Technion, I.I.T., Israel, michaels.danny@gmail.com

Prof. Gany Alon
Technion, I.I.T., Israel, gany@tx.technion.ac.il

MODELING AND TESTING OF A NOVEL THRUSTER CONCEPT FOR SEPARATION OF BODIES IN SPACE

Abstract

A new concept for a thruster specifically designed for separation of bodies in space was investigated theoretically and experimentally. The thruster is based on generation of high pressure gas by combustion of solid propellant and restricting the expansion of the gas only by ejecting the two bodies in opposite directions, in such a fashion that maximizes generated impulse. An interior ballistics model was developed in order to investigate the potential benefits of the thruster for a large range of space body masses and for different design parameters such as geometry and propellant. The model takes into account solid propellant combustion, heat losses, and gas phase chemical reactions. The model shows that for large bodies (above 100 kg) and typical separation velocities of 5 m/s, the proposed separation mechanism may be characterized by a specific impulse of 25,000 seconds, two order of magnitude larger than that of conventional solid rockets. It means that the proposed thruster requires only 1% of the propellant mass that would be needed for a conventional rocket for the same mission. Since many existing launch vehicles obtain such separation velocities by using conventional solid rocket motors (retro-rockets), the implementation of the new thruster design can reduce dramatically the mass of the separation system and increase safety. A dedicated experimental setup was built in order to demonstrate the concept and validate the model. The experimental results revealed specific impulse values of up to 27,000 seconds and showed good correspondence with the model.