Accepted Manuscript

Experimental research on low-cost cold gas propulsion for a space robot platform

Jan Kindracki, Karolina Tur, Przemysław Paszkiewicz, Łukasz Mężyk, Łukasz Boruc, Piotr Wolański

PII: S1270-9638(16)30380-7
DOI: http://dx.doi.org/10.1016/j.ast.2016.12.001
Reference: AESCTE 3849

To appear in: *Aerospace Science and Technology*

Received date: 3 August 2016
Revised date: 2 December 2016
Accepted date: 2 December 2016

Please cite this article in press as: J. Kindracki et al., Experimental research on low-cost cold gas propulsion for a space robot platform, *Aerosp. Sci. Technol.* (2016), http://dx.doi.org/10.1016/j.ast.2016.12.001

Experimental research on low-cost cold gas propulsion for a space robot platform

Jan Kindracki[1], Karolina Tur, Przemysław Paszkiewicz, Łukasz Mężyk, Łukasz Boruc, Piotr Wolański

Institute of Heat Engineering, Warsaw University of Technology

Nowowiejska 21/25, 00-665 Warsaw, Poland

Phone: +48 22 234 52 77; Fax: +48 22 234 52 74

E-mail: jkind@itc.pw.edu.pl

Abstract

The attitude and orbit control system of satellites and space probes plays a crucial role in missions. One commonly used attitude control method relies on small rocket thrusters. This paper focuses on experimental research into a low thrust, cold gas satellite thruster, which is the simplest solution in this group. A dedicated research stand was designed and built to measure the key parameters of the thruster: thrust and mass flow rate. The measurements were used to calculate specific impulse and to compare it against expected values. Dynamic parameters were also identified – delay time and valve opening time, and power consumption of the coil. Minimum impulse bit and maximum frequency of operation were determined through research with pulse width modulation. A multicycle experiment was conducted to investigate the effect of the number of cycles on thruster parameters. A detailed description of the research stand and measurement methods is given, followed by the results.

Keywords: cold gas propulsion, satellite propulsion, attitude control system

1. Introduction

Many satellites have some kind of propulsion, which is used in the Attitude Control System (ACS). A cold gas propulsion system has the potential to fulfill this purpose. Its simple design and reliability make it a cost-effective solution. It is fuelled by gaseous propellant delivered directly into the nozzle, where it expands to generate thrust. The ACS system can perform various rotational maneuvers, enabling the satellite to be oriented in a specific direction or rotated on command into a precise angular position. For instance, these maneuvers are required to position the satellite's antenna