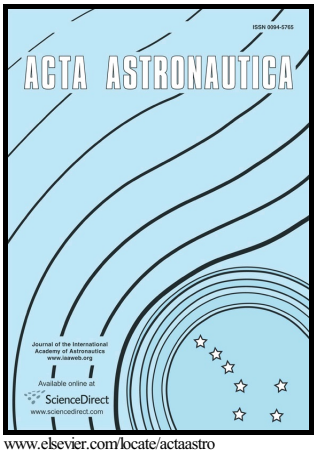

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Design of a cusped field thruster for drag-free flight

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Abstract

Drag-free flight has played a more and more important role in many space missions. The thrust control system is the key unit to achieve drag-free flight by providing a precise compensation for the disturbing force except gravity. The cusped field thruster has shown a significant potential to be capable of the function due to its long life, high efficiency, and simplicity. This paper demonstrates a cusped field thruster's feasibility in drag-free flight based on its instinctive characteristics and describes a detailed design of a cusped field thruster made by Harbin Institute of Technology (HIT). Furthermore, the performance test is conducted, which shows that the cusped field thruster can achieve a continuously variable thrust from 1 to 20mN with a low noise and high resolution below 650W, and the specific impulse can achieve 1800s under a thrust of 18mN and discharge voltage of 1000V. The thruster's overall performance indicates that the cusped field thruster is quite capable of achieving drag-free flight. With the further optimization, the cusped field thruster will exhibit a more extensive application value.

Keywords: cusped field thruster, drag-free flight, GOCE

1. Introduction

Many science missions, such as the test of equivalence principle, the detection of gravitational waves and the measurement of gravity field of the earth, have shown an increasing demands for low-disturbance environments[1,2], in which the residual perturbative acceleration is supposed to be less than 10^{-10}m/s^2. Due to the disturbance of external environment, including the atmospheric

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