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微推力测量方法及其关键问题分析

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Methods of Micro Thrust Measurement and Analysis of Its Key Issues

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## 摘要

微推力测试技术可为微推进器力学性能提供测量和评估平台。论述了稳态推力、脉冲冲量、平均推力和动态推力的测量原理;总结了国内外典型 的微推力测量系统,将测量系统分为扭摆型、天平型、单摆型和和悬臂型4种基本动力学构型,并对比分析了各种构型的测量特征、用途和优缺点; 指出了测量原理、误差影响因素及应对措施、系统标定和测量自动化等关键问题;并自行设计了一种基于扭摆型的微推力测量系统,该系统测量重 复性好,测量水平可达到µN量级。

关键词: 微推进器 稳态推力 脉冲冲量 平均推力 动态推力 推力测试 冲量测试

## Abstract:

The technology of micro thrust measurement is employed to evaluate the performance of micro-thrusters. The measurement principles of steady thrust, pulse impulse, average thrust and instantaneous thrust are introduced. The classical thrust stands are summarized and classified into types of torsional beam, balance, hanging pendulum and hanging arm according to their dynamic configurations. Their characteristics, purposes, advantages and disadvantages are analyzed. Such key problems as measurement principle research, error influence factors and countermeasures, calibration, and measurement automatization are discussed. Based on the above analysis, a µN-thrust stand is designed and implemented. The experiment results demonstrate that the designed system features good repetitivity of measurement and up to μN levels of accuracy. Thus it verifies the feasibility of the thrust stand for thrust measurement and its effect in improving precision and stability.

Keywords: micro-thruster steady thrust pulse impulse average thrust instantaneous thrust thrust measurement impulse measurement

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