IAF SPACE PROPULSION SYMPOSIUM (C4)
Joint Session between IAA and IAF for Small Satellite Propulsion Systems (8-B4.5A)

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ELECTROMAGNETIC AND EXTENDED VIBRATIONAL QUALIFICATION CAMPAIGN FOR AN IMPROVED CENTRE-TRIGGERED PULSED CATHODIC ARC THRUSTER

Abstract

Small spacecraft operators require propulsion systems to achieve mission critical outcomes. These range from manoeuvres supporting mission requirements such as constellation dispersion, orbital transfer, orbital station-keeping, as well as responsive space activities such as collision avoidance and end-of-life disposal. The latter are increasingly relevant as the Low Earth Orbit (LEO) environment becomes more congested, requiring more stringent disposal regulations. Operator requirements drive a market need for propulsion systems that provide sufficient manoeuvre authority to small spacecraft, including CubeSats. In this work we report on the qualification tests performed on test articles of Neumann Space's second generation of novel electric propulsion system.

The Neumann Drive, a centre-triggered pulsed cathodic arc thruster (CT-PCAT), is an electric propulsion system that utilises a low voltage, high current, short duration plasma arc to evaporate, ionise, and accelerate metallic propellant, thereby producing thrust. The simplicity of integration and operation make the Neumann Drive attractive to satellite manufacturers, integrators, and operators, who have expressed interest in the progress and results of the qualification test campaign. Neumann Space has previously presented upon the successful qualification campaign of its ND-15 system and the suitability of the technology for orbital nanosatellite use. In the work reported here, the technology is taken one step further

and is shown to be compatible with the enhanced requirements of smallsat-class spacecraft. In particular, Neumann Space's ND-50 propulsion system undertook qualification vibration testing to levels exceeding 25 Grms, almost double the levels usually tested to for nanosatellites. Furthermore, through collaboration with international subject matter experts, the team has performed an electro-magnetic interference test campaign inspired by MIL-STD-461G but with necessary adaptations made to the test program and environment to enable the testing of a pulsed propulsion system under vacuum. This last test is of particular interest to the community, as electromagnetic test standards are not generally applicable to electric propulsion systems, with test methodologies applicable to small spacecraft propulsion systems being particularly absent from the literature.

This paper presents the methodology and results for the electromagnetic and vibration test campaigns conducted on our next generation Neumann Drive, scheduled for orbital launches in late 2024 and early 2025.