

IAF SPACE PROPULSION SYMPOSIUM (C4)
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DEVELOPMENT AND VERIFICATION OF A THRUST VECTOR BALANCE FOR ELECTRIC
PROPULSION SYSTEMS

Abstract

The thrust vector of electric thrusters, such as gridded ion thrusters or FOTEC's FEPP multi-emitter, is not always perfectly aligned with the geometric axis due to non-uniform contributions of multiple emission sites, the ion current distribution over the grid area or due to manufacturing and assembly tolerances. During acceptance testing of such a propulsion system at FOTEC, the off-axis angle is characterized for different operation points with the in-house developed plasma diagnostic facility. The good correlation between the computed thrust vector and its magnitude based on the acquired ion current distribution and direct thrust measurements with FOTEC's horizontal torsion-based N thrust balance was shown recently.

Although FOTEC has developed advanced Digital Faraday Cups (DFCs) for fast and precise ion current measurement, a complete high-resolution scan over the hemisphere requires several minutes. To reduce the time to determine the horizontal and vertical angle of the thrust vector w.r.t. the geometric axis, a so-called Thrust Vector Balance (TVB) is being developed. Based on the long heritage on the development of ultra-precise thrust balances at FOTEC, a sophisticated setup was elaborated to measure both the magnitude of an electric propulsion system and the respective off-axis angles. This can be achieved by a two-pendulum system with independent force-feedback control loops. During the measurement, the thruster is rotated to precisely determine the lateral thrust components in dependency of the orientation. This not only allows a faster computation of the aforementioned properties, but also to characterize the thrust vector stability over time.

The design and the status of the TVB will be presented as well as preliminary results acquired with FOTEC's IFM Nano Thruster as Device Under Test (DUT). The results are compared with the indirect measurements gathered from plasma diagnostic scans.