SPACE PROPULSION SYMPOSIUM (C4)
Electric Propulsion (4)

Author: Mr. Richard Blott
Space Enterprise Partnerships Limited, United Kingdom

Dr. David Robinson
Psi-Tran Ltd, United Kingdom
Dr. Stephen Gabriel
United Kingdom

ELECTRIC PROPULSION VERIFICATION - MANAGING MEASUREMENT UNCERTAINTY

Abstract

In 2003 Alta, Snecma and QinetiQ started an initiative to reduce the cost of electric propulsion (EP) testing. At the time the perceived need was for better test facilities and associated diagnostic equipment. The starting point was considered to be a higher level of standardisation in testing.

Funding for test facilities and diagnostic equipment on the scale identified was not forthcoming but work on standardisation was started in 2007. Initially this focussed on a common understanding and application of definitions and test procedures. The corporate experience of all the European EP test houses was also captured through consultation. This was partly to provide guidance for those less familiar with EP verification testing and partly it was distilled into 'check-off' lists for the reference of both suppliers of and customers.

The effect of the test environment on performance remained a problem because it is almost impossible to recreate it exactly. Consequently, comparison between tests (even those in the same test facility) tends to be inconsistent. This leads to less confidence in the results and frequently lengthy and expensive investigations and re-testing.

Applying the management of measurement uncertainty (as advocated in ISO 17025) makes it possible to overcome these difficulties. The basic requirements are a validated performance model for the equipment under test and calibration of the diagnostic equipment for both it and the test. Using the Guide to Expression of Uncertainty in Measurement (GUM) it is possible to determine the mean performance value measured and the margin of uncertainty to a quantified confidence level. When compared with the target value and specified tolerances (at the quantified confidence level), a judgement made as to whether measured performance is within tolerance.

Managing measurement uncertainty gives the basis to calculate the effect on performance from variation in the test environment. Unfortunately it is not possible to calibrate some of the diagnostic equipment to independent standards. For these equipments, advice was compiled on how to identify sources of measurement uncertainty, minimise them and calculate residual uncertainty. Advice was also compiled on how to identify, remove or manage correlation (or dependencies) between the multiple measurements EP testing requires.

This advice has been compiled in the form of a Draft ESA Handbook on EP Verification by Test which includes worked examples of how to apply the principles. The paper illustrated how the management of measurement uncertainty is key to successful EP verification testing.