AERODYNAMIC DESIGN, CHARACTERISATION AND PARAMETER ESTIMATION OF RLV-TD FROM FLIGHT DATA

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Abstract

Maiden successful flight of ISRO's Reusable Launch Vehicle - Technology Demonstrator (RLV-TD) took place in May 2016. The complete aerodynamic design, analysis and data base generation for this indigenously designed and developed vehicle has been obtained through thousands of wind tunnel blow-downs, flow simulations using various Computational Fluid Dynamic codes and tailor made engineering codes. Specific aerodynamic problems like lift-off studies, stage separation studies, Reaction Control System (RCS) jet simulation studies, dynamic derivative estimation and estimation of aerodynamic uncertainties have been addressed. Parameter estimation techniques have been applied in both ascent and descent phases of flight and aerodynamic parameters have been reconstructed using flight data. The pre-flight aerodynamic coefficients like normal force coefficient and drag coefficient during ascent and descent phases and hinge moment coefficient of control surfaces during descent flight compared well with the flight data and, this in-turn indicates the goodness of the ground based simulation results. Flight estimated drag coefficient slightly exceeds the dispersion band in the transonic Mach numbers during descent phase, whereas in the descent phase the drag coefficient was well within dispersion band. The flight estimated roll damping derivatives were higher compared to the pre-flight data and this needs further investigation. Flight data indicated that Reaction Control System (RCS) induced cross coupling was higher than expected. Overall, the present flight data comparison gives high level of confidence in using the ground based data generation techniques and the correctness of the wing body aerodynamic design and characterisation.

Keywords: RLV-TD, Aerodynamic Design and Characterisation, Parameter Estimation