

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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AERODYNAMIC PERFORMANCE ANALYSIS OF THE IXV VEHICLE

Abstract

The ESA project IXV (Intermediate Experimental Vehicle) is being developed. In this framework ESA is coordinating a series of technical assistance activities aimed at verifying and supporting the IXV design and development process. As for all the ESA project this technical support is provided both by ESA TEC directorates and by National Organizations, with the supervision and coordination of the ESA IXV project. Namely, for IXV the Italian Space Agency (ASI) is operating this assistance activity by means of the technical support of the Italian Aerospace Research Center (CIRA). Among the topics object of the technical assistance activities carried out by CIRA, this paper deals with the development of an Aerodynamic Database (AEDB), independent from the one developed by the industrial team, to be used by ESA for cross checking and verification purposes. The IXV AEDB tool generates as output the aerodynamic coefficients of IXV provided the state of IXV in terms of flight condition (M, Re, Altitude) and vehicle attitude (e.g., AoA, AoS, e, a). The aerodynamic analysis, including a subset of the CFD and WTT data generated in the previous project phases, was carried out for the whole flight domain down to transonic regime. The reference Mach number range is from M=25 down to M=0.8. Main characteristics of the AEDB tool have been presented in Ref.1. Therefore, a new version has been developed in this paper including new features as, for example, an adequate model of uncertainties by exploiting all the available CFD and WT results and aerodynamics data coming from new experimental test campaigns. The development of an appropriate uncertainty model for the IXV aerodynamics was started with a review of the historical flight test documentation of similar vehicle configuration. By comparing the flight test-measured aerodynamics to wind-tunnel measurements or engineering code estimates of other similar vehicles, a database of actual prediction errors was generated. This database was used as a guide in determining an appropriate uncertainty magnitude for each of the important aerodynamic parameters as a function of flight condition.

Ref.1: Pezzella, G., Marini, M., Rufolo, G., "Aerodynamic Characterization of the ESA Intermediate Experimental Vehicle". 17th AIAA International Space Planes and Hypersonic Systems and Technologies Conference, San Francisco, California, Apr. 11-14, 2011. AIAA-2011-2232.