VI CEAS-SCAD Workshop 2016

A COMPREHENSIVE REVIEW OF VERTICAL TAIL DESIGN

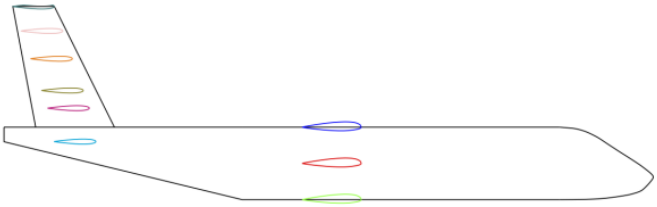
Fabrizio Nicolosi[§], Danilo Ciliberti[*], Pierluigi Della Vecchia[°], Salvatore Corcione*, Vincenzo Cusati[x]
Department of Industrial Engineering (DII) – University of Naples "Federico II"
Via Claudio 21, 80125 Napoli - ITALY
E-mail: fabrnico@unina.it, danilo.ciliberti@unina.it, pierluigi.dellavecchia@unina.it,
salvatore.corcione@unina.it, vincenzo.cusati@gmail.com

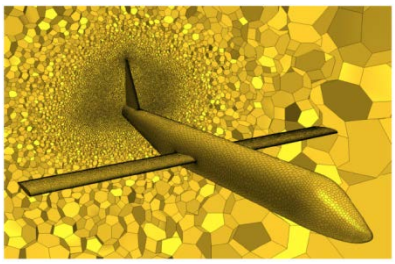
[§]Associate Professor, Department of Industrial Engineering (DII) - Univ. of Naples "Federico II"
[*]Post Doc, Department of Industrial Engineering (DII) - Univ. of Naples "Federico II"
[°]Assistant Professor, Department of Industrial Engineering (DII) - Univ. of Naples "Federico II"
[x]Consultant, Department of Industrial Engineering (DII) - Univ. of Naples "Federico II"

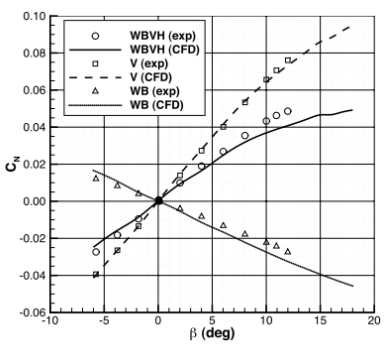
Keywords: Aircraft Design, Vertical tail, CFD, Wind-Tunnel tests.

Abstract

This work deals with a comprehensive review of vertical tail design method for aircraft directional stability and vertical tail sizing. The focus on aircraft directional stability is due to the significant discrepancies that classical semi-empirical methods, as USAF DATCOM and ESDU, provide for some configurations, since they are based on NACA wind tunnel tests about models not representative of an actual transport airplane. This work exploits the CFD to calculate the aerodynamic interference among aircraft parts for hundreds configurations of a given layout, providing a useful method in aircraft preliminary design. A wind tunnel investigation involving more than 180 configurations has validated the numerical approach. The analyses covered both the linear and the non-linear range of the aerodynamic coefficients, including the effects of the dorsal fin and the mutual aerodynamic interference between the fuselage and the vertical stabilizer. In the final part of the paper, a preliminary investigation about the rudder effectiveness, related to aircraft directional control, is presented. The innovation of the work concerns the numerical and experimental parametric study on the static directional stability of a modular model, representative of the regional turboprop aircraft category, and the direct measurement of the vertical stabilizer aerodynamic forces in the wind tunnel, in addition to the force and moments acting on the whole model. In this way, useful data about aerodynamic interference have been extracted from experimental tests, which are in good agreement with the results of numerical simulations.







(B) Low wing.