NUMERICAL HIGH LIFT PREDICTION ON THE JAXA STANDARD MODEL

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Abstract

A growing interest in the prediction of high lift aerodynamics has grown in recent years, motivated by the AIAA High Lift Prediction Workshop (HiLiftPW) series, which publicly release standard wing-fuselage geometries with experimental results from wind tunnel tests and promote dissemination of meshing strategies, physics modelling, and statistical analyses on the results provided by participants. The object of this work is the JAXA standard model proposed in the 3rd AIAA HiLiftPW. The authors want to propose best practices for numerical meshing and analysis with the lowest possible number of cells, giving indications on physics modelling and on the location of grid refinements for mesh tuning.

1 Introduction

Nowadays the numerical, high lift, aerodynamic analysis of commercial aircraft configurations is a crucial item to reduce the number of wind tunnel tests and give a well-suited instrument for the industrial design of the high lift systems. These numerical simulations are very complex, due to difficulties to simulate separations phenomena, unsteadiness, confluent boundary layers, and flow transition [1]. The authors research is pushing the boundaries of the application of computational fluid dynamics (CFD) technique in aircraft aerodynamic design and analysis [2–9].

To advance the state of the art in predicting high-lift flows, an open international workshop series (HiLiftPW) was established [10–12]. Geometries, numerical grids, and experimental results are publicly released before the workshop date. Participants are also invited to submit their own grids. The first two events highlighted the need to include high lift devices brackets and fairing in the models. In the third and last workshop, held in June 2017 in Denver, Colorado, two models were presented: the NASA High Lift Common Research Model (HL-CRM) and the Japanese JAXA Standard Model (JSM). Both are representative of realistic high-lift swept-wing aircraft (a typical 100-passenger class regional jet airliner) in landing configuration, but only for the latter experimental data were available.

Results of the third workshop were summarized in Ref. [12], which highlighted that: the wind tunnel model was mounted on a 60 mm stand-off without transitional strips, whereas simulations were required to be "free-air" and fully-turbulent, although optional transition modelling was permitted after the conclusion of the required cases; a grid convergence study on the JSM was not required (usually it is), but the implementation of a grid-adapted solution was an option after the conclusion of the required cases; solutions that well predicted the lift coefficient did not keep the same accuracy level for the drag and moment coefficients; accurate prediction of the aerodynamic (global) coefficients may be results of wrong pressure and skin friction distribu-