COMPUTATIONAL MESH AND RANS MODEL OF TURBULENCE SENSITIVITY IN CFD OPTIMIZATION OF SLOTTED FLAP

Tomáš KOUTNÍK
Brno University of Technology
Fakulta strojního inženýrství
Technická 2896/2
616 69 Brno
koutnik@fme.vutbr.cz

Petr DOUPNÍK
Brno University of Technology
Fakulta strojního inženýrství
Technická 2896/2
616 69 Brno
doupnik@fme.vutbr.cz

Abstract: As a powerful and relatively fast and cheap tools, CFD solvers are used for solution of wide range of problems in the aerodynamics including the search for optimal position of slotted flap. As summarized i.e. in Rumsey et al. [1], lot of effort was made to evaluate the results from CFD against wind tunnel measurements and to recommend best settings for solvers and mesh generation. This work, based mostly on test cases defined in AGARD report [2], still continues as CFD methods evolve. However, typical test case describes the flow and force coefficents for only one position of the flap. Thus, for this geometrical setting only an error between measured and computed data is known.

Since engineers are most interested in change of the force coefficients with the position of the slotted flap in their design space, they should be interested in the error distribution in it also. If relative difference between CFD result and real behavior of the flow varies strongly with the flap configuration, predicted optimum may vary from the real one as well. Therefore a test case focused on estimation of this type of error was conducted.

This article presents results of computed 2D aerodynamic of NACA 66_2-216 airfoil with 25% slotted flap deployed and located at 25 different positions. Combination of hybrid and structured computational meshes with total number of elements ranging from 80 to 320 thousands and three RANS models of turbulence were applied. For each model of turbulence a consistency of results with respect to the mesh density is discussed in the article and compared to the general recomendations. Finaly, the data obtained from CFD solution were validated against the wind tunnel measurement conducted by Holtzclaw and Weisman [3] and conclusions were made.

References

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