Validation, application and integration of advanced DES methods in OpenFOAM®

C. Mockett, M. Fuchs, & F. Thiele

CFD Software Entwicklungs- und Forschungsgesellschaft mbH, Wolzogenstr. 4, 14163 Berlin, Germany

For many industrial CFD applications, turbulence modelling is widely acknowledged as the principal accuracy bottleneck. Combining the high fidelity of LES with the efficiency of RANS, hybrid methods such as Detached-Eddy Simulation (DES) have opened the door to improved reliability at feasible computational cost. DES is particularly advantageous for highly unsteady flows featuring massive separation [3].

The contribution will give an overview of the implementation and validation of state-of-the art DES models and related code features that are soon to be released in the central version of OpenFOAM®. These include the DDES and IDDES methods based on standardised versions of the underlying Spalart–Allmaras and Menter SST RANS models. Furthermore, the hybrid convection scheme of Travin et al. [4] enables robust simulations of complex geometries with minimal numerical dissipation of the finely-resolved turbulent structures.

Figure 1: Example results from a complex helicopter aerodynamic simulation [1]. Instantaneous resolved turbulent structures (left) and comparison of experiment, RANS, URANS and DDES for time-averaged drag coefficient (mid) and mean streamwise velocity in the near wake (right).

Thorough verification and validation exercises on fundamental test cases will be summarised and a demonstration of the performance of the methods for the complex helicopter aerodynamics application [1] will be given (Figure 1).

Finally, ongoing developments will be summarised in the outlook. These include the development of improved DES variants in the EU-funded Go4Hybrid project [2] and the implementation and validation of enhanced features for aeroacoustic simulations.
References

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