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SIMULATION OF MASSIVELY SEPARATED FLOWS AND ROTATING MACHINE FLOWS USING HYBRID MODELS

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Several hybrid turbulence modellings are evaluated on the simulation of the flows around a circular cylinder, over an airfoil in a deep stall, and around a cross shaped mixing device rotating inside a cylinder, the target application being the flows around rotating machines such as helicopters and drones. These benchmarks, which contain many characteristics encountered in industrial flows, are challenging due to the complex physics of the flow and the considered high Reynolds numbers. The first hybrid approach investigated in this work is the classical Detached Eddy Simulation (DDES) model [1], the second one blends a dynamic variational multiscale large eddy simulation (DVMS) model and a RANS model (RANS/DVMS, [2]), and the third one combines the DDES model with the DVMS model (DDES/DVMS, [3]). A smooth blending function, which is based on the value of a blending parameter, is used for switching from RANS to DVMS in the RANS/DVMS strategy. In the DDES/DVMS approach, the DVMS model is preferentially activated in the wake in order to more accurately predict this region of the flow thanks to the low dissipation introduced by this model. Results are compared to those of other RANS, LES and hybrid simulations in the literature and with experimental data, and highlight the overall good prediction capabilities of the proposed hybrid strategies for the simulation of such massively separated flows and rotating machine flows.

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