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Assessment of a DGSEM/WMLES approach on flows featuring adverse/favorable pressure gradients and separation

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As part of an effort within the NASA Transformational Tools and Technologies (TTT) project to improve the efficiency and accuracy of computational predictions of separated flows, a space-time discontinuous-Galerkin spectral-element solver (DGSEM) has been developed over the past few years, as presented in Diosady and Murman [2]. The solver has been validated for Direct Numerical Simulation (DNS) and Large Eddy Simulation (LES) on canonical and industrial flows at moderate Reynolds numbers.

Recently, a Wall-Modeled Large Eddy Simulation (WMLES) strategy has been implemented within the solver, as presented in Carton de Wiart and Murman [1]. WMLES allows to reach high Reynolds number flows at an affordable cost, as shown in the recent review of Larsson *et al.* [3]. An algebraic equilibrium model has been first implemented and gave excellent results on the turbulent channel flow at different Reynolds numbers. Unfortunately, the method failed to represent correctly the non-equilibrium effects on more complex non-equilibrium cases, showing the limitations of the current approach.

In this study, WMLES is further investigated on simpler benchmark featuring non-equilibrium effects, such as adverse/favorable pressure gradients or separation. Cases such as the NASA 2D hump and turbulent channel flows subject to a non-equilibrium forcing are considered. More complex models including non-equilibrium effects will also be implemented and compared with the equilibrium model on the different benchmarks.

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