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EVALUATION OF ADVANCED TECHNIQUES FOR THE GREY AREA MITIGATION IN THE DES APPROACHES

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Among the scale-resolving approaches, hybrid RANS-LES methods present the most competitive balance between accuracy and computational cost. In particular, in those applications where complex turbulent flows at high Reynolds number are involved. One of the most popular, actively evolving and comprehensively studied is the non-zonal DES approaches' family. Their current development is aimed at solving the so-called "grey area" problem which is mostly the delay of RANS-to-LES transition to the mesh-resolved turbulence in the shear layers. To treat it, some modifications of the DES approach are recently proposed. They consist in the use of either a special subgrid scale ($\tilde{\Delta}_\omega$, Δ_{SLA}) [1, 2] adapted to the shear layers, or more advanced alternative (not Smagorinsky) LES models [1] (σ or WALE models), or their joint usage. We present a new approach which is based on the so-called least mean square subgrid length scale, Δ_{lsq} [3], with optional usage of the novel LES subgrid model (named S3QR) presented in [4]. The Δ_{lsq} formulation appear to be simpler in implementation and less empirical in comparison with the $\tilde{\Delta}_\omega$ and Δ_{SLA} ones especially applied to arbitrary unstructured meshes. Evaluation of the new DES modification is done using the three well-known computational cases with reliable reference data: turbulent flows in the channel with a sudden expansion with ratios 5/4 and 2; immersed subsonic round turbulent jet. Two unstructured control volume codes are considered: NOISEtte and OpenFOAM. The analysis based on comparison with reference data and the results obtained using another approaches (proposed in [1, 2]) includes both near field flow characteristics and far field noise (for the jet case).

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