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Investigation of length scale definition influence in LES models

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Large Eddy Simulations (LES) have been increasing popularity due to the decrease of computational power cost. Indeed, engineering applications which have previously involved mainly RANS, are now shifting to LES. Many eddy-viscosity models have been developed during the last decades (e.g. WALE [1], Vreman's, QR, Sigma, S3PQR [4]). They all share a general structure, which derive from a dimensional analysis: $\nu_{SGS} = (C_m\Delta)^2 D(\bar{U})$, where in order appears the model constant, the length scale and the differential operator underlying the model. The aim of this paper is to investigate influence of length scale Δ definition on highly anisotropic grids, because most of the research has focused mainly on the model constant and differential operator roles. The main length scale definitions that will be compared are: i) the most popular is $\Delta_{vol} = V^{\frac{1}{3}}$ ii) Δ_{ω} [2] iii) Δ_{SLA} [3] iv) Δ_{lsq} [4] . In order to do so, we first calibrate the model constant, then we carry out a set of simulations in OpenFOAM to assess the Δ definition influence. In order to assess the resilience of the models for highly anisotropic meshes, these simulations will be carried out also on meshes having control volumes with high aspect ratios. Results for standard test cases such as a decaying Homogeneous Isotropic Turbulence (HIT) and a turbulent plane channel will be presented and compared to reference cases.

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