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A hybrid RANS closure scheme for the near-wall turbulence[1]
FARID KARIMPOUR, SUBHAS K. VENAYAGAMOORTHY, Colorado State University — In this study, we propose a parameterization for the eddy viscosity (ν_t) that can be employed in a wall-resolving standard k-ϵ closure model. To this end, we use the equilibrium assumption between the production rate of the turbulent kinetic energy (P) and ϵ in a wall-bounded turbulent flow. Using this assumption and the linear shear stress distribution, the appropriate velocity scale is $U_S = (\epsilon/S)^{1/2}$ while the corresponding length scale is $L_S = f_\mu \kappa y(1 - y/\delta)^{3/4}$, where κ is von Kármán's constant, f_μ is van Driest's damping function, y represents the vertical distance from the wall and δ is one half of the channel depth. Consequently, ν_t results as a product of these two characteristic scales, i.e. $\nu_t = U_S L_S$. *'A priori'* tests are performed to assess the validity of the proposed eddy viscosity and the corresponding characteristic scales using the direct numerical simulation (DNS) data of unstratified channel flow. Furthermore, a one-dimensional standard k-ϵ model was developed and '*a posteriori*' tests were performed. The comparison of both '*a priori*' and '*a posteriori*' tests with DNS data show excellent agreement.

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