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Theoretical and numerical calculation of the Eddy viscosity in smooth and rough turbulent boundary layers JORGE BAILON-CUBA, LUCIANO CASTILLO, Department of Mechanical, Aerospace, and Nuclear Engineering, Rensselaer Polytechnic Institute — A numerical implementation of the theory of George and Castillo (GC-97) for smooth and Seo (2003) for rough, is being done for the computation of the Reynolds shear stresses, $- < uv >$, and the eddy viscosity $< \nu_T > /\nu$. Starting with the similarity solutions of the Navier Stockes equations for the inner and outer flow, the resulting partial differential equations are integrated considering asymptotic boundary conditions consistent with the physics of the inner and outer flow. The empirical and theoretical velocity profiles proposed by GC-97 are used for the inner and outer flow respectively. The results are compared with experimental data showing an excellent agreement in the inner region, and a reasonable accuracy in the outer region, for hydraulically smooth surfaces ($k^+ \leq 5$). Comparison with LES of Bohr et al., is also done, showing an excellent agreement, despite of the method simplicity. Influence on the physics of the Reynolds number, δ^+, and the roughness parameter, k^+, are also discussed. The accuracy of the computed $< uv >$, allows the resulting eddy viscosity, $< \nu_T >$, can be used in turbulence modeling and simulations (i.e. LES subgrid scale model).

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