Abstract Submitted
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Large-eddy simulation of the zero pressure gradient, turbulent boundary layer[1] MICHIO INOUE, D.I. PULLIN, Caltech — Large-eddy simulations (LES) of the zero-pressure gradient, smooth-wall, flat-plate turbulent boundary layer are presented. The LES combines the stretched-vortex, subgrid-scale (SGS) model with a tailored, near-wall model designed to incorporate anisotropic vorticity scales in the presence of the wall. Specifically, an approximate analytic integration of the stream-wise momentum equation across the near-wall layer, with inner-scaling used to reduce inertial terms, leads to a hyperbolic partial differential equation for the wall shear stress. This is coupled to an SGS model of streamwise, attached vortices in the presence of the wall, constructed to capture the principal dynamical behavior of longitudinal vortices in wall-normal transport of streamwise momentum. The result is an effective slip-velocity boundary condition for the LES at a raised "virtual wall" together with a dynamical calculation of the Kármán constant. Presently we demonstrate LES of the spatially developing, turbulent boundary layer at Reynolds numbers Re_θ based on the free-stream velocity and the momentum thickness in the range $Re_\theta = 10^3 - 10^{12}$. At large Re_θ, the calculated skin-friction coefficient agrees well with the Coles-Fernholz relation.

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