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LES of three-dimensional, shear-driven turbulent wall flow at $Re_\tau \approx 2000$ using a nested-LES wall-modeling approach YIFENG TANG, RAYHANEH AKHAVAN, The University of Michigan, Ann Arbor, MI 48109-2125 — Accurate prediction of high Reynolds number non-equilibrium wall flows presents a major challenge for traditional LES and wall modelling approaches such as hybrid RANS/LES or analytical wall functions. In this study, we investigate the applicability of the nested-LES wall-modeling approach (Tang & Akhavan 2012) to non-equilibrium flow in a 3D turbulent channel at $Re_\tau \approx 2000$. The three-dimensionality was introduced by imposing an impulsive spanwise motion of the walls in an initially 2D equilibrium turbulent channel flow and suddenly stopping the spanwise motion after the turbulence had adjusted to the wall motion. The progression of turbulence statistics in both the sheared and recovery stages was in good agreement with experiments in 3D, shear-driven boundary layers at comparable Reynolds number (Driver & Hebbar 1987). The nested-LES wall-modeling approach couples coarse-grained LES in a full-size domain ($L_x = 4\pi h, L_y = 2\pi h$) with nested fine-grained LES in a minimal domain ($L_x^+ = 3200, L_y^+ = 1600$), both using 64^3 grids. At each iteration, the velocity fields in both domains are renormalized to match the U_i and $u_{i,rms}$ to those of the minimal domain in the near-wall region and the full-size domain in the outer region, respectively.

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