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Large-eddy simulation of turbulent boundary-layer flow through a rough-smooth wall-surface transition A. SRIDHAR, D.I. PULLIN, California Institute of Technology — We describe results from a large-eddy-simulation (LES) study of a zero-pressure gradient, flat-plate turbulent boundary layer that flows across a discontinuous, span-wise, rough-smooth, wall-surface transition. The virtual-wall model of Saito and Pullin (PoF, 2012) is utilized to model subgrid-scale roughness by use of the Colebrook form of the roughness function $\Delta U^+(k_s^+)$, where $k_s^+ = k_s\, u_\tau/\nu$ and k_s is the equivalent sand-grain roughness. For given $Re_\tau = \delta_0\, u_\tau/\nu$ and ratio of k_s to the boundary layer thickness at the transition k_s/δ_0, the variation of $C_f(x)$ through the surface transition is calculated dynamically from the LES. Results at $Re_\tau \approx 4000$ are compared with detailed measurements for rough-smooth transition obtained at the University of Melbourne. The LES is used to explore the scaling behaviour of the discontinuity in C_f at the transition and also the relaxation of $C_f(x)$ to appropriate downstream, equilibrium conditions (and any dependence on Re_τ and k_s/δ_0).

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