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Large-eddy simulation of turbulent pipe flow at large Reynolds number NAMIKO SAITO, DALE PULLIN, California Institute of Technology, HUGH BLACKBURN, Monash University — We describe large-eddy simulations (LES), using a spectral-element method, of turbulent smooth- and rough-wall pipe flows. The spectral-element code SEMTEX was used (Blackburn and Sherwin *J. Comput. Phys.* 2004) in a mode where the axial direction is treated using Fourier modes, with a spectral-element representation within the cross-flow plane with Dirichlet boundary conditions on the circular pipe boundary. The stretched-vortex subgrid-stress model is utilized together with the wall-model of Chung and Pullin (*JFM, 2009*). For rough-wall flows, local subgrid roughness is incorporated by the addition of an empirical roughness function $u_\tau\,\Delta^+(k_s^+)$, where $k_s^+ = k_s\,u_\tau/\nu$ and k_s is the equivalent sand roughness. This is used in both the inner-scaling ansatz for the unsteady term of the wall-normal integration of the stream-wise momentum equation, and also in the log-like profile used to give a boundary condition for the outer-flow LES. Results will be discussed that include variation of the skin-friction coefficient as a function of both Reynolds number and the ratio of k_s to the pipe radius, and also mean velocity profiles and some turbulence statistics.

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