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Reynolds-stress-constraint large eddy simulation of turbulent flow over rough walls[1] WEN ZHANG, MINPING WAN, Southern University of Science and Technology, SHIYI CHEN, Southern University of Science and Technology;Peking University — In the large eddy simulation (LES) of turbulent flow, only the large-scale fluid motions are resolved and the effect of small-scale fluctuations is incorporated using the sub-grid-scale (SGS) models. When applying LES to investigate the turbulent flow over rough walls, the surface roughness is also filtered due to the relatively large grid spacing. The sub-grid-scale roughness can have a great impact on the turbulent flow, and must be properly modeled. Although some efforts have been made, the LES of turbulent flow over rough walls still remains an open problem. Typically, the roughness effect is modeled by prescribing the instantaneous stress on the first grid point above the wall according to the equilibrium log-law assumption. However this method tends to overestimate the mean stress. Instead of that, we propose that the effect of surface roughness can be effectively simulated by constraining the near-wall Reynolds stress, which is incorporated into the SGS stresses in the LES. The simulation results indicate that Townsends Reynolds number similarity hypothesis is still valid at relatively low Reynolds number and relatively large roughness height, which is consistent with existing experimental results.

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Wen Zhang
Southern University of Science and Technology

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