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Multiple-relaxation-time lattice Boltzmann simulations of turbulent channel and pipe flows. HARISH OPADRISHTA, CHENG PENG, LIAN-PING WANG, University of Delaware — The mesoscopic Lattice Boltzmann method (LBM) has become a reliable alternative for solving incompressible turbulent flows. However, the statistics of a simulated turbulent flow near a curved boundary may deviate from the physical rotational invariance (RI) of lattice coordinates. The main objective of this study is to compare the effects of different lattice models on the simulation results of turbulent flows, and explore ways to restore RI near a curved boundary. We will apply D3Q19 and D3Q27 multiple-relaxation-time LBM models to simulate turbulent pipe and channel flows. The statistics of the simulated flows are examined to quantify the nature of departures from RI. To help understand whether the departure is originated from the bounce-back scheme at the solid wall, we will perform simulations of a turbulent channel flow with walls orientated at an angle from the lattice grid, and test the use of an overset lattice grid near a pipe wall. The Chapman-Enskog analysis of these models will be performed to probe RI errors near a boundary. Our goal is to eventually perform an accurate direct numerical simulation of a turbulent pipe flow, and compare the results to previous simulations based on the Navier-Stokes equations.

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