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Effective Simulation Strategy of Multiscale Flows using a Lattice Boltzmann model with a Stretched Lattice EMAN YAHIA, KANNAN PREMNATH, University of Colorado Denver — Resolving multiscale flow physics (e.g. for boundary layer or mixing layer flows) effectively generally requires the use of different grid resolutions in different coordinate directions. Here, we present a new formulation of a multiple relaxation time (MRT)-lattice Boltzmann (LB) model for anisotropic meshes. It is based on a simpler and more stable non-orthogonal moment basis while the use of MRT introduces additional flexibility, and the model maintains a stream-collide procedure; its second order moment equilibria are augmented with additional velocity gradient terms dependent on grid aspect ratio that fully restores the required isotropy of the transport coefficients of the normal and shear stresses. Furthermore, by introducing additional cubic velocity corrections, it maintains Galilean invariance. The consistency of this stretched lattice based LB scheme with the Navier-Stokes equations is shown via a Chapman-Enskog expansion. Numerical study for a variety of benchmark flow problems demonstrate its ability for accurate and effective simulations at relatively high Reynolds numbers. The MRT-LB scheme is also shown to be more stable compared to prior LB models for rectangular grids, even for grid aspect ratios as small as 0.1 and for Reynolds numbers of 10000.

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