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Three-dimensional Cascaded Lattice Boltzmann Model for Thermal Convective Flows FARZANEH HAJABDOLLAHI, KANNAN PREMNATH, University of Colorado Denver — Fluid motion driven by thermal effects, such as due to buoyancy in differentially heated enclosures arise in several natural and industrial settings, whose understanding can be achieved via numerical simulations. Lattice Boltzmann (LB) methods are efficient kinetic computational approaches for coupled flow physics problems. In this study, we develop three-dimensional (3D) LB models based on central moments and multiple relaxation times for D3Q7 and D3Q15 lattices to solve the energy transport equations in a double distribution function approach. Their collision operators lead to a cascaded structure involving higher order terms resulting in improved stability. This is coupled to a central moment based LB flow solver with source terms. The new 3D cascaded LB models for the convective flows are first validated for natural convection of air driven thermally on two vertically opposite faces in a cubic cavity at different Rayleigh numbers against prior numerical and experimental data, which show good quantitative agreement. Then, the detailed structure of the 3D flow and thermal fields and the heat transfer rates at different Rayleigh numbers are analyzed and interpreted.

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