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Thermal lattice Boltzmann simulations with non-space-filling lattices PARTHIB RAO, LAURA SCHAEFER, University of Pittsburgh — Thermal lattice Boltzmann (LB) models that ensure energy conservation have been less than satisfactory, compared to the athermal LB models due to variety of reasons. However, in the last few years, there has been a renewed effort in developing kinetically-consistent, stable, and accurate thermal models based on a new theoretical interpretation of the LB method-the Gauss-Hermite (GH) expansion technique. These, so-called higher-order models have been theorized to be able to model Navier-Stokes level thermo-hydrodynamics. Pursuant to this approach, we propose to use a third-order GH expansion of the equilibrium distribution along with a non-space-filling lattice (D2Q12), to model low-speed thermal flows, where temperature evolves according to an advection-diffusion equation. Additionally, this model is also compared for accuracy and computational efficiency, with an equivalent space-filling lattice (D2Q17) and the passive-scalar model. On benchmark thermal simulations such as Rayleigh-Benard convection and thermal Couette flows, our preliminary results indicate that the D2Q12 lattice is not only as as accurate as the D2Q17 lattice, but also computationally more efficient. Therefore, the D2Q12 lattice can be used modelling flows where temperature plays the role of a passive-scalar.

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