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A moment conservation-based non-free parameter compressible lattice Boltzmann model and its application for flux evaluation at cell interface. (English) Zbl 1284.76313

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Summary: Based on the idea of constructing equilibrium distribution functions directly from the conservation forms of moments, a platform for developing non-free parameter lattice Boltzmann models is presented in this work. It is found that the existing compressible lattice Boltzmann models such as D1Q4L2, D1Q5L2 and D1Q5 models can be derived by the platform. This paper goes further to determine the lattice velocities of a non-free parameter D1Q4 model by incorporating two additional higher order conservation forms of moments. Since the lattice velocities are determined physically rather than specified artificially, the non-free parameter D1Q4 model can be applied to simulate compressible flows with a wide range of Mach numbers. The developed non-free parameter D1Q4 model is then applied to a local Riemann problem at the cell interface to establish a new Riemann flux solver for the solution of Euler equations by the finite volume method (FVM). Some test problems, such as Sod shock tube, shock reflection, compressible flows around NACA0012 airfoil, hypersonic flows around a blunt body and double Mach reflection, are simulated to illustrate the capability of present solver. Numerical results show that the present non-free parameter D1Q4 model can provide accurate results with faster convergence rate.

MSC:

76M28 Particle methods and lattice-gas methods
76N15 Gas dynamics (general theory)

Cited in **1** Review
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Keywords:

conservation forms of moments; compressible flows; Euler equations; non-free parameter D1Q4 model; FV-LBM

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