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A double-distribution-function lattice Boltzmann model for high-speed compressible viscous flows. (English) Zbl 1390.76757

Comput. Fluids 166, 24-31 (2018).

Summary: A lattice Boltzmann model for high-speed compressible viscous flows is presented based on the double-distribution-function lattice Boltzmann method proposed by *Q. Li* et al. ["Coupled double-distribution-function lattice Boltzmann method for the compressible Navier-Stokes equations", Phys. Rev. E (3) 76, No. 5, Article ID 056705, 19 p. (2007; doi:10.1103/physreve.76.056705)]. The D2Q17 circle function is introduced to take into account first to fourth order constraints of density equilibrium distribution function, in order for better consistency in the heat flux and the energy dynamics. The corresponding total energy equilibrium distribution function is formed. The present model is tested through three problems, i.e., the Riemann problem, regular shock reflection problem and supersonic boundary layer problem. We also observe improved performance of the new model for a supersonic boundary layer problem in comparison to the original coupled double-distribution-function lattice Boltzmann method.

MSC:

76M28 Particle methods and lattice-gas methods
76J20 Supersonic flows
76L05 Shock waves and blast waves in fluid mechanics
76N20 Boundary-layer theory for compressible fluids and gas dynamics

Keywords:

lattice Boltzmann method; compressible viscous flow; high-speed; boundary layer; shock wave

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