On lattice Boltzmann schemes with a single distribution for the approximation of Navier Stokes equations

François Dubois[ab] and Pierre Lallemand[c]

[a] *Conservatoire National des Arts et Métiers, LMSSC laboratory, F-75003 Paris, France.*
[b] *Laboratoire de Mathématiques d'Orsay, Université Paris-Saclay, France*
[c] *Beijing Computational Science Research Center, Haidian District, Beijing 100094, China.*

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We study the formal ability of a multiresolution lattice Boltzmann scheme to approximate isothermal and thermal compressible Navier Stokes equations with a single particle distribution. More precisely, we consider a total of 12 classical square lattice Boltzmann schemes with prescribed sets of conserved and nonconserved moments. The question is to determine the algebraic expressions of the equilibrium functions for the nonconserved moments and the relaxation parameters associated to each scheme. We compare the fluid equations and the result of the Taylor expansion method at second order accuracy for bidimensional examples with a maximum of 17 velocities and three-dimensional schemes with at most 33 velocities. In some cases, it is not possible to fit exactly the physical model. For several examples, we adjust the Navier-Stokes equations and propose nontrivial expressions for the equilibria.

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