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In recent years, certain forms of the

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Boltzmann equation--now going by the name of "Lattice Boltzmann equation" (LBE)--have emerged which relinquish most mathematical complexities of the true Boltzmann equation without sacrificing physical fidelity in the description of complex fluid motion.

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Speeds in lattice Boltzmann simulations are typically given in terms of the speed of sound. The discrete time unit can therefore be given as. $\Delta t = \Delta x C^{-1}$ s. $\{\displaystyle$

$$\Delta t = \frac{\Delta x}{C}$$

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$\frac{1}{C_s}$, where the denominator C_s is the physical speed of sound.

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The Boltzmann equation or Boltzmann transport equation (BTE) describes the statistical behaviour of a thermodynamic

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system not in a state of equilibrium, devised by Ludwig Boltzmann in 1872.

The classic example of such a system is a fluid with temperature gradients in space causing heat to flow from hotter regions to colder ones, by the random but biased transport of the particles making up ...

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The Lattice Boltzmann method is relatively new. The Method of lattice Boltzmann equation (LBE) is an innovative numerical method based on kinetic theory to simulate various hydrodynamic systems. The lattice

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Boltzmann equation was introduced to overcome some serious deficiencies of its historic predecessor: the lattice gas automata.

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Abstract. A simple lattice Boltzmann equation (LBE) model for axisymmetric thermal flow is proposed in this paper. The flow field is solved by a quasi-two-dimensional nine-speed (D2Q9) LBE,

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while the temperature field is solved by another four-speed (D2Q4) LBE. The model is validated by a thermal flow in a pipe and some nontrivial thermal buoyancy-driven flows in vertical cylinders, including Rayleigh-Bénard convection, natural convection, and heat transfer of swirling flows.

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Lattice Boltzmann equation for axisymmetric thermal flows ...

This work combines the lattice Boltzmann equation (LBE) and the overset method to simulate moving boundary problems in Navier-Stokes flows in two dimensions

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(2D). The transformation of the velocity moments of the distribution functions between a moving frame of reference and the one at rest is analyzed.

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We define the lattice Boltzmann equation in three dimensions as: (1) $f_{ijk}(x + ic \Delta t)(y + jc \Delta t)(z + kc \Delta t)(t + \Delta t) = f_{ijk}(x, y, z, t) + \Delta t \Omega_{ijk}(x, y, z, t)$. Here ic , jc , and kc refer to the variables in

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momentum space with c being the velocity quantum and $i, j, k \in \mathbb{Z}$, x, y , and z are the variables in space and t is the time variable.

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It is shown that the lattice Boltzmann equation is a special discretized form of the Boltzmann equation. Various approximations for the discretization of the Boltzmann equation in both time and phase space are discussed in detail. A general procedure to derive the lattice Boltzmann model from the continuous

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Boltzmann equation is demonstrated explicitly.

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Description. In recent years, certain forms of the Boltzmann equation--now going by the name of "Lattice Boltzmann equation" (LBE)--have emerged which relinquish most mathematical complexities of the true Boltzmann equation without sacrificing physical fidelity in the description of complex fluid motion.

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The Lattice Boltzmann equation:
mathematical formulation. The lattice
Boltzmann equation reads as follows

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(Wolf-Gladrow, 2000; Succi, 2001)

$$\begin{aligned} f_i(\vec{r} + \vec{c})_i \Delta t, t + \Delta t) = & f_i(\vec{r}; t) + \\ & \Omega_{ij} \\ & (f_{eqj}(\vec{r}; t) - f_j(\vec{r}; t)) \end{aligned}$$

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range of scales, from fully developed turbulence, to multiphase micro-flows, all the way down to nano-biofluidics and lately, even quantum-relativistic subnuclear fluids.

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Lattice Boltzmann Method

Implementation To implement the LBM

method, we separate the solution of the

equation $f_i(x + e_i \Delta t, t + \Delta t) = f_i(x, t) + \Delta t \cdot S_i(t)$.

into two steps, referred to as streaming and

collision steps. This approach is somewhat

analogous to the common splitting

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mechanism used in solutions to the Navier-Stokes equations.

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