Abstract Submitted
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Fokker-Planck Central Moment Lattice Boltzmann Method for Computation of Turbulent Flows[1] WILLIAM SCHUPBACH, KANNAN PREMNATH, University of Colorado, Denver — We present a new formulation of the central moment lattice Boltzmann (LB) method based on a minimal continuous Fokker-Planck (FP) kinetic model, originally proposed for stochastic diffusive-drift processes (e.g., Brownian dynamics), by adapting it as a collision model for the continuous Boltzmann equation (CBE) for fluid dynamics. Rather than using an equivalent Langevin equation as a proxy, we construct our approach by matching the changes in different discrete central moments under collision to those given by the CBE under FP collision. This can be interpreted as a new path in terms of the relaxation of the various central moments to "equilibria", which we term as the Markovian central moment attractors that depend on the adjacent lower order post-collision moments and the diffusion coefficient; the relaxation rates are based on scaling the drift coefficient by the order of the moment. We demonstrate its consistency to the Navier-Stokes equations via a Chapman-Enskog analysis and elucidate the choice of the diffusion coefficient in accurately representing flows at high Reynolds numbers. As illustrative examples, we show 3D simulation of turbulent flows and liquid-gas systems with interfacial effects modulated by surfactant effects.

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