Lattice Boltzmann Equation: Its Mathematical Essence and Key Properties

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This presentation focuses on the mathematical origin and properties of the lattice Boltzmann equation (LBE) --- a solution method for the Navier-Stokes equations (NSE). Unlike the traditional or conventional methods in CFD which are based on direct discretizations of NSE (i.e., finite difference, finite volume, finite element, spectral, and discontinuous Galerkin methods), the LBE is derived from the Boltzmann equation with a linearized collision term. Thus the LBE is a kinetic scheme (for it is derived from kinetic equation) as opposed a usual CFD scheme. However, the LBE can also be explicitly related to central finite-difference schemes with artificial compressibility method. Some numerical results obtained with the LBE will also be mentioned.