Lattice Boltzmann from the perspective of classic kinetic theory

Xiaowen Shan

Exa Corporation
3 Burlington Woods Drive
Burlington, Massachusetts 01803, USA

The LB method was traditionally derived from the Boolean lattice gas model. In recent years it has been shown that it can also be derived from continuum kinetic theory. The kinetic approach not only provides a rigorous theoretical framework within which all existing LB models can be analyzed, but also allows the LB method to be extended beyond the application domain of near incompressible isothermal Navier-Stokes flows. In this tutorial, the derivation of LB from continuum kinetic theory will be presented with detail. Various LB models, a-thermal, thermal, multiphase and multi-component models are examined using the new approach.

The outline of the tutorial is the following:
* Brief introduction to LB and kinetic theory
* Hermite polynomials and Grad 13-moment system
* LB via Hermite expansion
* What's new with Hermite?