An application of the discontinuous Galerkin method for solving kinetic equations

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The discontinuous Galerkin (DG) method seems very appropriate for solving kinetic equations as the classical linear or nonlinear Boltzmann equation for rarefied gases, the Boltzmamn equation for charge transport in semiconductor, the radiative transport equation. The DG scheme is a conservative scheme, that has the advantage of flexibility for arbitrarily unstructured meshes, and relies on an adequate choice of numerical fluxes, which handle effectively the interactions across element boundaries, to achieve stable and accurate algorithms for nonlinear hyperbolic conservation laws, nonlinear convection diffusion equations, etc.

The unknown of a kinetic equation is the distribution function, which, in general, depends on time, space coordinates and particle velocity. The heavy computational cost for solving kinetic equations explains why they are traditionally simulated by the Direct Simulation Monte Carlo (DSMC) methods.

We will show some numerical examples, which indicates that the deterministic DG furnishes an accurate description of the gas dynamics. Some comparisons with DSMC results will be also shown.