Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Importance sampling based direct simulation Monte Carlo method PRAKASH VEDULA, University of Oklahoma, DUSTIN OTTEN, Lockheed Martin — We propose a novel and efficient approach, termed as importance sampling based direct simulation Monte Carlo (ISDSMC), for prediction of nonequilibrium flows via solution of the Boltzmann equation. Besides leading to a reduction in computational cost, ISDSMC also results in a reduction in statistical scatter compared to conventional direct simulation Monte Carlo (DSMC) and hence appears to be potentially useful for prediction of a variety of flows, especially where the signal to noise ratio is small (e.g. microflows) . In this particle in cell approach, the computational particles are initially assigned weights (or importance) based on constraints on generalized moments of velocity. Solution of the Boltzmann equation is achieved by use of (i) a streaming operator which streams the computational particles and (ii) a collision operator where the representative collision pairs are selected stochastically based on particle weights via an acceptance-rejection algorithm. Performance of ISDSMC approach is evaluated using analysis of three canonical microflows, namely (i) thermal Couette flow, (ii) velocity-slip Couette flow and (iii) Poiseulle flow. Our results based on ISDSMC indicate good agreement with those obtained from conventional DSMC methods. The potential advantages of this (ISDSMC) approach to granular flows will also be demonstrated using simulations of homogeneous relaxation of a granular gas.

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Date submitted: 06 Aug 2010 Electronic form version 1.4