Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Parallel Performance Optimization of the Direct Simulation Monte Carlo Method DA GAO, CHONGLIN ZHANG, THOMAS SCHWARTZENTRUBER, University of Minnesota at Twin Cities — Although the direct simulation Monte Carlo (DSMC) particle method is more computationally intensive compared to continuum methods, it is accurate for conditions ranging from continuum to free-molecular, accurate in highly non-equilibrium flow regions, and holds potential for incorporating advanced molecular-based models for gas-phase and gas-surface interactions. As available computer resources continue their rapid growth, the DSMC method is continually being applied to increasingly complex flow problems. Although processor clock speed continues to increase, a trend of increasing multi-core-per-node parallel architectures is emerging. To effectively utilize such current and future parallel computing systems, a combined shared/distributed memory parallel implementation (using both Open Multi-Processing (OpenMP) and Message Passing Interface (MPI)) of the DSMC method is under development. The parallel implementation of a new state-of-the-art 3D DSMC code employing an embedded 3-level Cartesian mesh will be outlined. The presentation will focus on performance optimization strategies for DSMC, which includes, but is not limited to, modified algorithm designs, practical code-tuning techniques, and parallel performance optimization. Specifically, key issues important to the DSMC shared memory (OpenMP) parallel performance are identified as (1) granularity (2) load balancing (3) locality and (4) synchronization. Challenges and solutions associated with these issues as they pertain to the DSMC method will be discussed.

Da Gao
University of Minnesota at Twin Cities

Date submitted: 05 Aug 2009 Electronic form version 1.4