Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Different Scalable Implementations of Collision and Streaming for Optimal Computational Performance of Lattice Boltzmann Simulations. NICHOLAS GENEVA, LIAN-PING WANG, University of Delaware — In the past 25 years, the mesoscopic lattice Boltzmann method (LBM) has become an increasingly popular approach to simulate incompressible flows including turbulent flows. While LBM solves more solution variables compared to the conventional CFD approach based on the macroscopic Navier-Stokes equation, it also offers opportunities for more efficient parallelization. In this talk we will describe several different algorithms that have been developed over the past 10 plus years, which can be used to represent the two core steps of LBM, collision and streaming, more effectively than standard approaches. The application of these algorithms spans LBM simulations ranging from basic channel to particle laden flows. We will cover the essential detail on the implementation of each algorithm for simple 2D flows, to the challenges one faces when using a given algorithm for more complex simulations. The key is to explore the best use of data structure and cache memory. Two basic data structures will be discussed and the importance of effective data storage to maximize a CPU's cache will be addressed. The performance of a 3D turbulent channel flow simulation using these different algorithms and data structures will be compared along with important hardware related issues.

Lian-Ping Wang
University of Delaware

Date submitted: 27 Jul 2015 Electronic form version 1.4