Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

A Block-Structured Adaptive Mesh Refinement Technique with a Finite-Difference-Based Lattice Boltzmann Method ABBAS FAKHARI, TAEHUN LEE, City College of the City University of New York — A novel adaptive mesh refinement (AMR) algorithm for the numerical solution of fluid flow problems is presented in this study. The proposed AMR algorithm can be used to solve partial differential equations including, but not limited to, the Navier-Stokes equations using an AMR technique. Here, the lattice Boltzmann method (LBM) is employed as a substitute of the nearly incompressible Navier-Stokes equations. Besides its simplicity, the proposed AMR algorithm is straightforward and yet efficient. The idea is to remove the need for a tree-type data structure by using the pointer attributes in a unique way, along with an appropriate adjustment of the child block's IDs, to determine the neighbors of a certain block. Thanks to the unique way of invoking pointers, there is no need to construct a quad-tree (in 2D) or oct-tree (in 3D) data structure for maintaining the connectivity data between different blocks. As a result, the memory and time required for tree traversal are completely eliminated, leaving us with a clean and efficient algorithm that is easier to implement and use on parallel machines. Several benchmark studies are carried out to assess the accuracy and efficiency of the proposed AMR-LBM, including lid-driven cavity flow, vortex shedding past a square cylinder, and Kelvin-Helmholtz instability for single-phase and multiphase fluids.

Abbas Fakhari
City College of the City University of New York

Date submitted: 02 Aug 2013 Electronic form version 1.4