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A Three-Dimensional Multi-Mesh Lattice Boltzmann Model for Multiphysics Simulations AMIRREZA HASHEMI, Department of Mechanical Engineering, The University of Akron, Akron, OH 44325, MOHSEN ESHRAGHI, Department of Mechanical Engineering, California State University, Los Angeles, CA 90032, SERGIO FELICELLI, Department of Mechanical Engineering, The University of Akron, Akron, OH 44325 — The lattice Boltzmann method (LBM) is known as an attractive computational method for modeling fluid flow and, more recently, transport phenomena. As any numerical method, the computational cost of LBM simulations depends on the density of the computational grids. The cost of simulations can become enormous when multiple equations are solved in three dimensions. In this work, the development of a multi-block multi-grid LBM model is discussed for three-dimensional (3D) multiphysics simulations. In a system of multiple coupled equations with different length scales, a multi-block mesh with different grids for each model would enhance the computational efficiency and stability of the model. Embedded-type grids facilitate the transfer of information between lattices while allowing larger time steps. In addition, a non-uniform mesh is considered within each mode that allows mesh refinement within each physical model when required. The multi-mesh method was developed to solve for transport phenomena including fluid flow, mass and heat transfer. The huge memory demands of LBM simulations in 3D was significantly reduced using this scheme. Moreover, by reducing the number of lattice points, cost communication in parallel processing was largely decreased.

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