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Large Scale Lattice-Boltzmann Simulations: Computational Methods and Applications

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Lattice-Boltzmann and Finite-Element Simulations of Fluid Flow in a SMRX Mixer

Part III

Validation and Applications

In the previous chapters of this thesis we have presented a detailed description of the lattice-Boltzmann method. First, we presented some new results on the accuracy of the boundary conditions. Next, we proposed and validated a new relaxation technique to speed the reaching of time-steps to reach steady state. Furthermore, efficient parallelization of the LBM scheme including load balancing methodologies based on the use of unequal recursive bisection techniques were applied to a number of test geometries. Finally we studied grid refinement for 2D lattice-Boltzmann simulations.

In the remainder of the thesis we will focus our attention on applications. In this chapter, our main interest is fluid flow in complex geometries focusing on dilute porous media. Flow in porous media has many realistic applications as will become apparent in the next chapters. Before going into the details of the hydrodynamic properties of flow through porous media, we report in this chapter a rigorous comparison between the finite-element and the lattice-Boltzmann methods applied to a realistic test case with complex geometry.

We study a 3D fluid flow over a SMRX static mixer. A SMRX static mixer is a piece of equipment composed of eight adjacent pipes with excellent mixing performance that is widely used in a variety of chemical reactors for viscous systems like poly-

