A Lattice–Boltzmann model for simulating the blood flow in large vessels

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Abstract

Recently, the interest in Lattice–Boltzmann models by the computational fluid dynamics community has notoriously increased with the purpose of modeling complex flows. For instance, computational hemodynamics has been an area of research where this kind of methodologies have received significant attention during last years. In this work, we implement a Lattice–Boltzmann model with the aim of simulating blood flows in the major arteries. The selected model, based on a single-relaxation-time approach, is briefly described in combination with second order boundary conditions for both velocity and pressure and proper equilibrium distributions that take care of the incompressible behavior of the fluid. After the description of the model several numerical examples are presented. We employ the Womersley and Driven Cavity problems as benchmarks. As well, the simulation of blood flows in an arterial bend and in an aneurismal region, both artificially created, are performed. The numerical results are assessed within a framework in which the values of the parameters that set up the physical regimes in the simulations are suitably tuned in order to guarantee the accuracy.

Key words: Lattice–Boltzmann, incompressible flow, hemodynamics.