

A new approach of the fluid model based on the LBM method

Mohamed ALAHYANE, Cadi Ayyad University

Abdelilah HAKIM, Cadi Ayyad University

Said RAGHAY, Cadi Ayyad University

As a mesoscopic method based on the kinetic Boltzmann equation, the lattice Boltzmann method (LBM) has been developed rapidly in the last three decades. As an alternative scheme of solving the Navier-Stokes equations, the LBM is usually designed as a fully discretized version of the Boltzmann equation with a set of symmetric discrete velocities to ensure isotropy in the kinetic theory. In the LBM, only a few discrete, kinetic-particle velocities are used, and the kinetic velocities are fully coupled to the lattice grid in the physical space and the time step size, which makes the numerical implementation highly efficient when compared to other kinetic schemes. Through multiscaling expansion, the incompressible Navier-Stokes equations can be recovered from the lattice Boltzmann BGK equation. The advantage of the lattice Boltzmann method is that it provides easily implemented fully parallel algorithms and the capability of handling complicated boundaries. In this work, we propose a new approach to fluid image registration problem by using LBM method, and the partial differential equation (PDE) that we used to solve this problem is the incompressible Navier-Stokes equation.

Références

- [1] W. ZHANG, B. SHI, *Application of lattice Boltzmann method to image filtering*, J. Math Imaging Vis., Vol. 43, pp. 135-142, 2012.
- [2] D. L. G. HILL, P. G. BATCHELOR, M. HOLDEN, D. J. HAWKES, *Medical image registration*, Physics in medicine and biology, Vol. 46, N.3, pp. R1, 2001.
- [3] B. JAWERTH, P. LIN, E. SINZINGER, *Lattice Boltzmann models for anisotropic diffusion of image*, Journal of Mathematical Imaging and Vision, Vol. 11, N.3, pp. 231-237, 1999.
- [4] Z. GUO, B. SHI, N. WANG, *Lattice BGK model for Incompressible Navier-Stokes Equation*, Journal of Computational Physics, Vol. 165, N.1, pp. 288-306, 2000.
- [5] C. PENG, Z. GUO, L. P. WANG, *A Lattice-BGK model for the Navier-Stokes equation based on a rectangular grid*, Computers and Mathematics with Applications, 2016.
- [6] J. MODERSITZKI, *Numerical Methods for Image Registration*, Oxford university press, 2004.
- [7] U. FRISCH, D. D'HUMIERES, B. HASSLACHER, P. LALLEMAND, Y. POMEAU, J. P. RIVET, *Lattice gas hydrodynamics in two and three dimensions*, Complex systems, Vol. 1, N. 4, pp. 649-707, 1987.

Mohamed ALAHYANE, LAMAI, FSTG, Cadi Ayyad University, Marrakesh, Morocco
alahyanemohamed89@gmail.com

Abdelilah HAKIM, LAMAI, FSTG, Cadi Ayyad University, Marrakesh, Morocco
abdelilah.hakim@gmail.com

Said RAGHAY, LAMAI, FSTG, Cadi Ayyad University, Marrakesh, Morocco
s.raghay@uca.ac.ma