Isotropy properties for Lattice Boltzmann schemes, application to the acoustic

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The LaBS project [2] includes industrialists and research laboratories and focuses on the development of a numerical simulation tool in fluid mechanics, based on the method of Lattice Boltzmann (LBM) and optimized for the extensive parallel calculation. The objective is to create scientific, technical and commercial conditions necessary for the industrial distribution of this method of simulation and therefore to ensure the commercial success of the developed software. Thanks to the use of a modeling of the LES turbulence (simulations of large scales) and with the compressibility property of the LBM scheme, the applications concern at once the aerodynamic simulations (in particular the calculation and the optimization of the aerodynamic coefficients), aeroacoustic (sources and distribution in flow) and acoustics (linear acoustics, modeling of the porous materials).
The Lattice Boltzmann schemes are governed by a certain number of parameters which must be carefully chosen according to the applications. The objective of our work is to understand the influence of the choice of these parameters on the properties of isotropy of the solution until high orders. These isotropy properties are essential both from the point of view of the physical applications and of the stability of these plans. In this presentation, we begin by reminding the terminology relative to the Lattice Boltzmann schemes. Then we present a general and automated method which allows to determine the criteria of isotropy that the parameters of the plan have to satisfy.
Finally, we apply this method to some schemes among the most popular in dimension 2 and 3 (D2Q9, D2Q13, D3Q19 and D3Q27). All this work is based on the control of the equivalent equations of these schemes until the order 4. This control is due to the previous works of F. Dubois and of P. Lallemand ([1] for the equivalent equation of the D2Q9).
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Références

[1] F. Dubois and P. Lallemand, *Towards higher order lattice Boltzmann schemes*, Journal of Statistical Mechanics, 2009, P06006 doi : 10.1088/1742-5468/2009/06/P06006, http ://dx.doi.org/10.1088/1742-5468/2009/06/P06006.

[2] http ://www.pole-moveo.org/pdf-projets-das/Labs-F.pdf.

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