Multiphysics Modelling by the lattice Boltzmann method

TRACK Number 2000

Alessandro De Rosis\*

\* Department of Mechanical, Aerospace and Civil Engineering; The University of Manchester

George Begg Building, M1 7DN, Manchester, UK

alessandro.derosis@manchester.ac.uk, https://www.research.manchester.ac.uk/portal/alessandro.derosis.html

**Key words:** Multiphysics Modelling, Computational Fluid Dynamics, Lattice Boltzmann Method

ABSTRACT

The lattice Boltzmann method (LBM) is a popular approach that is widely adopted to perform numerical simulations of viscous fluids [1]. Instead of solving the macroscopic Navier-Stokes equations, the LBM lies at a mesoscopic level where it solves the evolution of collection of fictitious particles moving along the links of a Cartesian lattice. These quantities carry with them information about the macroscopic variables (i.e., density and momentum). The widespread adoption of the LBM stems from several advantages. In contrast to Navier–Stokes solvers, which need to treat the non-linear convection term, the LBM does not include such non-linearity. The resultant algorithmic simplicity of the LBM implies an easy coding and allows it to be particularly well suited for massively parallel computing [2].

The ability to recover different classes of governing equations has promoted its great spread. Fluid-structure interaction, turbulence, passive scalar transport, magnetohydrodynamics, multiphase/multicomponent flows are just few examples of the rich variety of possible applications which have been successfully tackled by the LBM. Relevant industrial applications of the LBM cover external aerodynamics, acoustics, and heat transfer. Moreover, the LBM is also able to simulate reaction-diffusion processes. In this regard, the LBM has proved to be able to simulate biological processes, as wound healing, tumour growth, ecological invasion and spread of epidemics [3].

The aim of this mini-symposium is to highlight the current state of the LBM for modelling of multiphysics processes.

**REFERENCES**

[1] T. Krüger et al., The lattice Boltzmann method, *Springer International Publishing*, 2017.

[2] C. Obrecht et al., "Multi-GPU implementation of the lattice Boltzmann method", *Comput. Math. Appl, Vol.* 65.2, pp-252-261, (2013).
[3] A. De Rosis, "Modeling epidemics by the lattice Boltzmann method", *Phys Rev E, Vol.* 102.2, 023301, (2020).