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Meshless Lattice Boltzmann Method for pore-scale porous media flow and parameters calculation

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Lattice Boltzmann Method (LBM) has for long now been successfully used as a numerical tool for modeling fluid flow [1]. This is due to the local treatment of nonlinear parts of the algorithm, the ability to model non-trivial particle interactions in a bottom-up manner, the potential for parallelization, and the ease of implementation. However, applied to complex geometries often encountered in pore-scale porous media research, the inherent feature of LBM - the necessity to operate on square grids - makes the appropriate boundaries discretization and local grid refinement a difficult task. Supplementing the standard, lattice approach with meshless interpolation can bring several advantages, including the ability to operate on discretizations consisting of non-connected nodes with non-uniform spatial density, more accurate boundaries representation, and decoupling of velocity and space discretization. In consequence, combining LBM and meshless interpolation has a perspective to result in an efficient, robust, and flexible numerical method for modeling flow in complex geometries.

In the talk, an application of meshless LBM for the calculation of permeability and drag coefficient will be presented along with a comparison with standard LBM and meshless Navier-Stokes solver results. Special attention will be given to the impact of boundary conditions implementation and hydrodynamic force calculation method on the accuracy of the results. Idealized and real porous samples will be considered.

Participation

In-Person

References

1. Succi, S. The Lattice Boltzmann Equation: For complex states of flowing matter. (Oxford University Press, 2018). doi:10.1093/oso/9780199592357.001.0001.

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Primary authors: STRZELCZYK, Dawid (Institute of Theoretical Physics, Faculty of Physics and Astronomy, University of Wrocław, Wrocław, Poland); Mr ROT, Miha (Parallel And Distributed Systems Laboratory, Institute "Jožef Stefan", Ljubljana, Slovenia)

Presenter: STRZELCZYK, Dawid (Institute of Theoretical Physics, Faculty of Physics and Astronomy, University of Wrocław, Wrocław, Poland)

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