Numerical methods for multiphase flow Lattice-Boltzmann method

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The Lattice-Boltzmann method is a numerical approach solving a fluid flow on a „molecular level". Here the PDF (probability density function) of the state of fluid elements is solved in time and space. In addition the velocity space is discretized on a pre-defined grid. As a result of that, this method is robust and numerically very efficient.
This lecture will summarise the fundamentals together with the basic equations for an isothermal Lattice-Boltzmann method (LBM). Methods for improving the spatial resolution of the LBM, such as local grid refinement and curved wall boundary condition are presented (Dietzel et al. 2016). The LBM is also very much suitable for the different scales in dispersed multiphase flows. The particle phase can be treated as point-masses (i.e. the usual Lagrangian approach) and simulations may be conducted for systems on a macro-scale, just as in the classical Euler/Lagrange approach (Dietzel et al. 2016). As an example a filtration process on a single pore is presented.
Moreover, LBM, due to its high numerical efficiency may be applied for analysing small systems with fully resolved particles, such as agglomeration processes (Ernst et al. 2013, Ernst and Sommerfeld 2015).
Since the spatial resolution of the LBM was enhanced it is also possible to analyse particle-scale phenomena very accurately. As an example the drag force acting on different-structured agglomerates is presented (Dietzel and Sommerfeld 2013, Dietzel et al. 2016).

References

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