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Unstructured Lattice Boltzmann methods for efficient simulation of flow in complex porous media

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The flow permeability of porous rock is the critical control parameter for a number of natural processes in the upper crust. On the pore scale, fluid dynamic simulations are efficient and accurate for determining the flow permeability, while on larger scales where multiple pores are connected in complex networks, the simulations quickly become computationally infeasible. In contrast to flow in open space, porous flow is determined predominantly by the pore geometry. One limiting factor in the computations is the geometrical representation of the pore space. For example, the lattice Boltzmann method, which is often used in direct numerical simulations of flow, is usually implemented using regular cubic grids. Irregular grids, however, allow for a more efficient geometrical representation of space limited by complex boundaries. Here we briefly go through some of the recent advances and advantages of the lattice Boltzmann method on unstructured grids. We briefly discuss basic numerical implementations on the unstructured grids. We show simulations and permeability estimates of flow in real samples of the pore space of chalk.