

Are Fluid Clusters Lattice Animals?

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When two immiscible fluids simultaneously flow in a porous medium, they break up into clusters. What shape do these clusters have? So far no-one has delved deep into this question, which is essential for understanding how the fluids interact – or more precisely, how to characterize their interaction. A lot of research was done in the eighties on so-called lattice animals, which essentially are connected clusters in percolation theory. This theory will become useful in this work, but also ideas from integral geometry, more specifically Minkowski functionals that characterize the geometry of shapes, will be essential.

This MSc project is a part of a larger project, namely finding a set of equations describing the simultaneous flow of two immiscible fluids in a porous medium is an outstanding problem in theoretical physics. Today, it is possible to follow the fluids in detail at the pore level using e.g. micro-CT or other such techniques. However, to translate this visualization into a mathematical description at a coarse-grained level where the porous medium may be viewed as a continuum is a step that is still lacking. Finding such a description is a central theme for the Center of Excellence Porelab . Our approach is to emulate the approach of statistical mechanics leading to thermodynamics as the final continuum theory.

The project will involve extensive numerical calculations based on programs that are already in existence. It is necessary with a good understanding of statistical mechanics and a knowledge of fluid mechanics.

The PoreLab environment is highly interdisciplinary, international and dynamic.