# Homogenizer++: a platform for upscaling multiphase flows in heterogeneous porous media

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**Abstract**

The homogenization method is used to analyse the equivalent behavior of a certain number of problems arising in flow and transport through heterogeneous porous media. The mean tools are asymptotic expansions, two-scale convergence and L-convergence. We treat both single and multiphase flow in porous media. Each homogenization method leads to the definition of a global or effective model of a homogeneous medium defined by the computed effective coefficients. Homogenization methods allow the determination of these effective coefficients from knowledge of the geometrical structure of a basic cell and its heterogeneities by solving appropriate local problems. The technique is based on numerics. We assume that data given on a fine grid fully represents the important physical scales and that a practical computational grid must be somewhat coarser. In the homogenization methods described and implemented in this work we use conforming, mixed finite elements and finite volume methods to compute approximate solutions of the local problems used in the calculation of the effective coefficients. We have developed a user friendly computational tool, Homogenizer++, for the computation of effective parameters. The platform Homogenizer++ is based on Object Oriented Programming approach. It was developed within the framework of the GdR MoMaS (http://momas.univ-lyon1.fr/). It currently includes modules to compute effective permeability, effective capillary pressures and relative permeabilities, macrodiffusion in solute transport and simples code for computing solutions for flow in porous media. The software is freely available and the open architecture of the program facilitates further development and adaptation to suit specific needs easily and quickly. Moreover, the user interface has proven to be easy to use and flexible. A series of numerical examples demonstrates the effectiveness of the methodology for multiphase flow in heterogeneous reservoirs.