Linearized fully homogenized model for incompressible two-phase flow in double porosity media

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Abstract

We derive the global behavior of the incompressible two–phase fluid flow through porous media with thin fractures. The fractured medium is a type of porous medium frequently encountered in hydrology and petroleum applications, which is characterized by the presence of two porous structures with strongly contrasted transport features: a continuous system of highly conductive fractures, which is assumed to be thin of order $\varepsilon\delta$, is intertwined by a disconnected ε–periodic set of blocks of usual porous media. The permeability of the blocks is proportional to $(\varepsilon\delta)^2$, while the permeability of the fractures is of order one. After passing to the limit as $\varepsilon \to 0$ we obtain the corresponding global δ–model, i.e., the homogenized model with the coefficients depending on the small parameter δ. In δ–model we linearize the cell problem in the matrix block and compare the new linearized cell problem with a known linearization and with the nonlinear cell problem. By letting $\delta \to 0$ we obtain the macroscopic model which does not depend on ε and δ and is fully homogenized in the sense that all the coefficients are calculated in terms of given data and do not depend on the additional coupling or cell problems.

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