Generic Multiscale Finite Volume Method for Pore Network Simulations

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ABSTRACT

In order to model flow and transport in heterogeneous porous media, various upscaling and multiscale methods have been devised. One of them is the multiscale finite-volume (MSFV) method, for which full convergence of the flow solution is not required, since by construction it always delivers a conservative flow field. Here it is shown how the MSFV method can be employed as a framework for efficient pore network simulations with huge domains. Besides the general advantage of such multiscale methods, the fact that different physical descriptions are appropriate at the fine and coarse scales can be exploited. For example in the presence of two phases, if the capillary number based on the sub-domain length scale is small enough, a static pore network simulator can be employed to compute the basis functions, which is much more efficient than the use of a dynamic pore network model. On the coarse scale, on the other hand, viscous effects are properly taken into account, which is demonstrated by a validation study involving immiscible viscous fingering.

REFERENCES

[1] Khayrat, K. Modeling Hysteresis for Two-Phase Flow in Porous Media: From Micro to Macro Scale. *PhD thesis, ETH Zurich*, (2016).