The Multiscale Hybrid Method in mixed finite element context

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ABSTRACT

The Multiscale Hybrid Method (MHM) [1, 2, 3] is a numerical technique targeted to approximate systems of differential equations with strongly varying coefficients. In this work we develop different descriptions of the MHM technique such that it can be implemented as a substructuring method where either the singular modes of the solution in each subdomain are modelled as an additional variable or where chosen equations are delayed.

The theoretical analysis of the MHM method is based on considering a piecewise continuous flux space on the boundary of the macroscopic domains and solving the system of differential equations on the interior of the domains exactly. In all publications on MHM, the solution on the interior of the domain has been computed using continuous finite element methods. In this work we develop a numerical formulation of MHM where H(div) approximations are used in the interior of each macro domain. Both formulations are compared when applied to the approximation of Darcy's flow applied to heterogeneous porous media.

Finally MHM approximations using mixed formulation inside the macro elements are applied to the numerical simulation of multiphase flow through porous media emphasizing the advantages in terms of computational cost and numerical precision.

REFERENCES

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