Contribution ID: **730** Type: **Oral Presentation**

A multiscale mixed finite element method applied to the simulation of two-phase flows

Wednesday, 2 June 2021 19:20 (15 minutes)

The multiscale hybrid mixed finite element method (MHM-H(div)), previously developed for Darcy's problems, is extend for coupled flow/pressure and transport system of two-phase flow equations on heterogeneous media under the effect of gravitational segregation. It is combined with an implicit transport solver in a sequential fully implicit (SFI) manner. The MHM-H(div) method is designed to cope with the complex geometry and inherent multiscale nature of the phenomena. The discretizations are based on a general domain partition formed by polyhedral subregions, where a hierarchy of meshes and approximation spaces are considered. The multiscale approach is applied to the flux/pressure kernel making use of coarse scale normal fluxes between subregions (trace variable). The fine-scale features inside each subregion are determined by resolving completely independent local Neumann problems, the boundary conditions being set by the trace variable, by the mixed finite element method using fine flux and pressure representations. These properties imply that the MHM-H(div) can be interpreted as a classical mixed formulation of the model problem in the whole domain, based on a H(div)-conforming space with normal components over the macro-partition interfaces constrained by the trace space, and showing divergence compatibility with the pressure space [1]. Consequently, local mass conservation is observed at the micro-scale elements inside the subregions, an essential property for flows in heterogeneous media, and divergence-free constraint strongly enforced for incompressible flows. The efficient use of static condensation leads to a global system to be solved only in terms of primary degrees of freedom associated with the trace variable and of a piecewise constant pressure for each subregion. An iterative coupling technique is adopted to solve the two-phase flow equations. The numerical examples show that the proposed scheme is able to solve coupled flow and transport problems.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

[1] O. Duran, P. R. B. Devloo, S. M. Gomes, F. Valentin, A multiscale hybrid method for Darcy's problems using mixed finite element local solvers, Computer Methods in Applied Mechanics and Engineering 354 (2019) 213–244.
URL https://doi.org/10.1016/j.cma.2019.05.013

Acceptance of Terms and Conditions

Click here to agree

Newsletter

Student Poster Award

Primary authors: Prof. DEVLOO, Philippe Remy Bernard (LabMeC-FEC-Universidade Estadual de Campinas, Campinas-SP, Brazil); Dr DURAN, Omar (Department of Mathematics, University of Bergen); Mr VILLEGAS, Jose (DEP-FEM-Universidade Estadual de Campinas, Campinas, SP, Brazil)

Presenter: Dr DURAN, Omar (Department of Mathematics, University of Bergen)

Session Classification: MS7

Track Classification: (MS7) Mathematical and numerical methods for multi-scale multi-physics, non-linear coupled processes