The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

An explicit two-scale scheme for a two-phase porous media flow model: A view on the effective parameters

Manuela Bastidas[1,2], Sohely Sharmin[3], Carina Bringedal[4] and Sorin Pop[3]

[1] Inria, 2 rue Simone Iff, 75589 Paris, France.
[2] CERMICS, Ecole des Ponts, 77455 Marne-la-Vallée, France.
[3] Faculty of Sciences, Hasselt University, Diepenbeek, Belgium.
[4] Stuttgart Center for Simulation Science, Institute for Modelling Hydraulic and Environmental Systems, University of Stuttgart, Stuttgart, Germany.

Keywords: *Multi-scale numerical methods, Two-phase porous media flow.*

The literature on numerical methods for multi-scale porous-media problems is extremely vast, addressing topics from reactive transport to multi-phase flow models. Particularly challenging is the situation when moving interfaces are encountered at the scale of pores. On the one hand, the movement of these interfaces is determined by the velocities of the fluids, in the case of two immiscible fluid phases. On the other hand, through the movement of these interfaces, the behavior of the system is affected, e.g., the distribution of the fluids in the pore or the flow domain. Moreover, such processes encountered at the pore scale impact the behavior of the system at the Darcy scale (macro scale), which is our primary interest.

In this talk, we discuss the design of a two-scale method for the two-scale model of two-phase porous media flow presented in [1]. There, the freely moving interface separating the fluid phases is approximated by solving a Cahn-Hilliard type of equation. The micro-scale solution depends on the macro-scale variables, such as saturation and concentration. We include variable surface-tension effects, depending on the concentration of a surfactant dissolved in one of the fluid phases. The effective parameters, that are needed on the macro scale, are determined by solving micro-scale cell problems which, in their turn, depend on the evolution of the fluid phases.

Here we focus on the computation of the macro-scale effective parameters. We propose a mixed formulation combined with adaptive techniques at both micro and macro scales to solve the associated cell problems.

REFERENCES

[1] S. Sharmin, M. Bastidas, C. Bringedal, I.S. Pop, Upscaling a Navier-Stokes-Cahn-Hilliard model for two-phase porous-media flow with solute-dependent surface tension effects. *(Submitted)*, 2021. https://www.uhasselt.be/Documents/CMAT/Preprints/2021/UP2109.pdf