An analytical-numerical approach for two-scale relaxation hysteretic two-phase flows

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We introduce a two-scale relaxation projection analytical-numerical approach for hysteretic two-phase flow problems in porous media [1]. Hysteresis plays an important role in significant phenomena and in particular in fluid flow through porous media (see, e.g., [1, 2] and references cited therein). Using the projection method [1], we show the existence by analytical construction of the solution that is lacking of rigorous mathematical analysis in general. We first introduce a new analytical projection method for construction of the wave sequence in the Riemann problem for the system of equations for a prototype two-phase flow model via relaxation. Second, a new computational method is formally developed to corroborate our analysis. The proposed computational method is based on combining locally conservative hybrid finite element method and finite volume discretizations [1, 2] within an operator splitting formulation to address effectively the stiff relaxation hysteretic system modeling fundamental two-phase flows in porous media. We present and discuss a representative set of numerical experiments in 1D and 2D. The overall approach can be extended for three-phase fow systems.

References

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