3D NUMERICAL SIMULATION OF COUPLED PROCESSES BETWEEN TWO-PHASE FLOWS AND GEOCHEMICAL REACTIONS IN POROUS MEDIA

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The aim of this work is to develop a parallel code for the coupling between two-phase flows and geochemical reactions in porous media in 3D configurations. The problem is modelled by a highly non-linear system of PDEs (compositional two-phase flow model in porous media) coupled to ordinary or algebraic differential equations (geochemistry)[1].
A fully coupled fully implicit finite volume scheme is developed to avoid splitting errors caused by sequential methods, especially for problems with a strong coupling between flow and reactive transport problems. The latter is implemented in DuMu^X framework, a parallel open-source simulator for flow and transport problems in porous media [2]. Particular attention is paid to the time step strategy to improve the convergence of the Newton method. A heuristic time step strategy is developed to improve the CPU time performance. In this talk, we present 3D test cases for CO_2 injection into a deep saline aquifer, including parallel computing. A numerical convergence study is used to validate our implementation. An analysis of strong and weak parallel scalabilities is also performed. Finally, an advanced comparison with a sequential method developed in [3], is performed in a unified environment. Operator splitting errors are emphasized by an overestimation of the total mass of CO_2 in the sequential method case while the implicit approach is perfectly mass-conservative.

References

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