A NONLINEAR PRECONDITIONER FOR REACTIVE TRANSPORT IN HETEROGENOUS POROUS MEDIA

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Reactive transport modeling in porous media involves the simulation of several physico-chemical processes: flow of fluid phases, transport of species, chemical reactions between species. The solution of the system of equations that describes the overall model can be obtained either by a fully coupled approach or by a decoupled approach. In [1] we have introduced a method that tries to combine the advantages of both approaches: it allows a separation of transport and chemistry at the software level, while keeping a tight numerical coupling between both subsystems.

The coupled system, written as a fixed point problem, is solved by a Newton-Krylov method, with a block Jacobian computed from the individual subsystems. However, the size of the nonlinear system obtained is quite large, and the Krylov solvers can stagnate.

In this talk, we present a nonlinear preconditioner [2], based on eliminating some unknowns from the coupled system, and we show its relationship with linear preconditioners methods like block Gauss-Seidel or block Jacobi. We present both heuristic and experimental arguments that show that both linear and nonlinear convergence become independent of the mesh size.

The performance of the method will be illustrated on a well known reactive transport test case: the 1D and 2D MoMaS benchmark.

References

[1] L. Amir and M. Kern, *A global method for coupling transport with chemistry in heterogeneous porous media*, Computational Geosciences, 14, pp. 465-481, 2010.

[2] L. Amir and M. Kern, *Preconditioning a coupled model for reactive transport in porous media*, International Journal of Numerical Analysis and Modeling, 16, pp. 18-48, 2019.

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