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Scalable Multilevel Methods for Poroelasticity

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Developing efficient solvers for coupled PDE systems is often a non-trivial task, since one must combine suitable schemes for time integration and linear solvers. In this study, we suggest a combination of methods for the quasi-static Biot system, which scales on nowadays's HPC systems.

One classic approach is the fixed stress iteration, e.g. (Kim et al., 2011). This be interpreted as a special block-LU decomposition for the coupled system, where degrees of freedom for deformations and pressures are separated. It is a key observation that the Schur complement, when formed w.r.t the pressure, can be approximated by a properly scaled identity (e.g., Mikelic and Wheeler, 2013). The method can be generalized to deal with jumping coefficients in heterogeneous media (e.g., Both et al., 2017).

In this work, we avoid the aforementioned splitting and employ a multigrid solver for the fully-coupled system. The method is based on the fixed-stress smoothers suggested by (Gaspar und Rodrigo, 2017). We investigate its robustness for heterogeneous media and provide a scaling study in an HPC environment. Our numerical experiments also include a combination with linearly-implicit extrapolation schemes which allow for an adaptive time-stepping.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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