Efficient solvers for poroelasticity

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ABSTRACT

We consider the fixed-stress splitting scheme applied to Biot's equations. The method sequentially solves the fluid flow and elasticity subproblems, while stabilizing the flow problem by a scaled increment of the pressure variable. Since the original development of the fixed-stress method, there have been several works concerned with tuning the included stabilization term to ensure convergence at a good rate. It is well known that the convergence properties of the method depends on the choice of this scaling, and theoretical convergence is provided as long as the it is sufficiently large. A theoretical estimate for the optimal choice of the tuning parameter with regards to convergence rate is provided and we show that it depends on both the elasticity and flow parameters. Moreover, we propose a practical technique for choosing the optimal tuning parameter utilizing the mesh independence of the fixed-stress splitting scheme. Its efficiency is shown through illustrative numerical examples showing that the numbers of iterations required for convergence can be reduced considerably by this technique [1]. Furthermore, we exploit the fact that the fixed-stress splitting scheme can be written as a modified Richardson iteration to *a-priori* compute optimal tuning parameters for the special case of low–permeable porous media and near–incompressible fluids [2]. Moreover, we will discuss decoupling methods to extensions of the quasi-static linear Biot equations.

REFERENCES

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