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A REVIEW OF COUPLING STRATEGIES FOR MODELING FLUID FLOW AND GEOMECHANICS

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Several strategies for the coupling of subsurface flow and geomechanics have been proposed in the literature. In theory, the fully-implicit or monolithic approach is the best because it naturally satisfies the equations for flow and geomechanics. However, problems related to the solution of a single system have limited the use of such approach, particularly for large-scale applications. Alternatively, sequential or two-way strategies have been used to link existing codes for flow and geomechanics, overcoming the difficulties presented in the fully-implicit approach [1]. Several studies have focused on the improvement of the accuracy of sequential strategies, in particular through iterative schemes [2]. Unfortunately, they require a lot of computational effort and are time-consuming. Due to these drawbacks, sequential strategies based on explicit schemes have been proposed. Those schemes are faster than the iterative ones, but their accuracy depend on the time-step used for the exchange of information between the flow and geomechanics solvers. Inappropriate time-steps can turn instable the solution process, leading to inaccurate or inconsistent results. For such reason, some studies have proposed algorithms for the automatic assessment of suitable time-steps [3]. Finally, we have the one-way coupling approach. It has been the approach with the most applications because is the easiest to be implemented and the fastest in computational time. However, it requires that the influence of geomechanics on flow is much smaller than the accuracy required for the analysis. In this study, we discuss the use of different coupling strategies and analyse their impact on the numerical accuracy and the expected computational effort. All these approaches were implemented in an in-house framework [4]. The study shows that during the solution process, it is possible to combine all coupling strategies to take advantage of each one to produce more accurate and faster solutions.

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