Contribution ID: **792** Type: **Oral 20 Minutes**

Apriori Error Estimates for the Undrained Split Iterative Coupling Scheme for Coupling Flow with Geomechanics

Thursday, 17 May 2018 10:02 (15 minutes)

Recently, the accurate and efficient modeling of flow-structure interactions has gained more importance and attention for both petroleum and environmental engineering applications. Three main coupling approaches exist in practice: the fully implicit, the explicit or loose coupling, and the iterative coupling methods. The first approach solves the two problems simultaneously, and is considered the most accurate one. However, it poses several computational challenges to the underlying linear solver. The second approach, on the other hand, decouples the two problems and is only conditionally stable. In this work, we consider the last approach which combines the advantages of stability and decoupling and lies in between these two extreme by imposing an elegant iterative coupling iteration between the two decoupled problems. Specifically, we will focus on the undrained split iterative coupling scheme which starts by solving the mechanics problem, followed by the flow problem, and assumes a constant fluid mass during the deformation of the structure. The convergence of this scheme has already been established in [1, 2] for the single rate scheme, and in [2] for the multirate scheme (in which the flow problem takes multiple fine time steps within one coarse mechanics problem). Here, we will derive a priori error estimates for quantifying the error between the solution obtained at any iterate and the true solution for the single rate undrained split iterative coupling scheme. The approach we will follow is based on studying the equations satisfied by the differences of coupling iterates to establish a Banach contraction argument, which is then used to derive the targeted apriori error estimates, and is an extension of the work presented in [3]. To the best of our knowledge, this is the first rigorous derivation of a priori error estimates for the single rate undrained split iterative coupling scheme for solving the coupled Biot system.

References

[1] Mikelic, A. and Wheeler, M. F. “Convergence of iterative coupling for coupled flow and geomechanics”. Computational Geosciences, 17:455-461, 2013.

[2] Kumar, K., Almani, T., Singh, G., and Wheeler, Mary F. “Multirate Undrained Splitting for Coupled Flow and Geomechanics in Porous Media”, Springer International Publishing, 43—440, 2016.

[3] Almani, T., Kumar, K., and Wheeler, M. F., “Convergence and error analysis of fully discrete iterative coupling schemes for coupling flow with geomechanics”. Computational Geosciences, 21: 1157-1172, 2017.

Acceptance of Terms and Conditions

Click here to agree

Primary author: Dr ALMANI, Tameem (Saudi Aramco)

Co-author: Dr MANA, Abdulrahman (Saudi Aramco)

Presenter: Dr ALMANI, Tameem (Saudi Aramco)

Session Classification: Parallel 9-H

Track Classification: MS 2.02: Modeling and simulation of subsurface flow at various scales