The 8th European Congress on Computational Methods in Applied Sciences and Engineering
ECCOMAS Congress 2022
5-9 June 2022, Oslo, Norway

THE UNDRAINED SPLIT ITERATIVE COUPLING SCHEME FOR A FRACTURED BIOT MODEL: THEORETICAL AND NUMERICAL CONSIDERATIONS

Tameem Almani[1], and Kundan Kumar[2]

[1] Saudi Aramco, Saudi Arabia, tameem.almani@aramco.com
[2] University of Bergen, Norway, kundan.kumar@uib.no

Keywords: *Biot system, poroelasticity, fractured media, undrained-split iterative coupling, contraction mapping*

In this work, we consider a coupled flow and geomechanics problem in a fractured poroelastic media. Mixed dimensional type formulation is considered, in which the flow equation in the d-dimensional porous matrix is coupled with the flow equation in the $d-1$-dimensional fracture surface, following the widely used lubrication-type model [2, 3]. In such a model, fractures are treated as possibly non-planar interfaces, and coupled to the geomechanical model through a term accounting for the change of fracture width due to mechanical deformations. Moreover, the jump in the reservoir flux around the fracture acts as a source term to the right hand side of the fracture mass balance equation. In this work, we extend the widely used undrained split iterative coupling scheme [1, 4] to the aforementioned fractured Biot model. The convergence of the scheme is established for both the single rate case, in which both the flow and mechanics problems share the same time step, and the multirate case in which the flow takes multiple fine time steps within one coarse mechanics time step. The convergence of the scheme is validated numerically for the single rate case, using our theoretically derived undrained split regularization parameter, which is added to the right and left hand sides of the weak form of the balance of linear momentum equation. To the best of our knowledge, this is the first time in literature the convergence and numerical efficiency of the undrained split iterative coupled scheme are established in fractured poroelastic media.

REFERENCES

[1] T. Almani, A. Manea, K. Kumar, and A. H. Dogru. Convergence of the undrained split iterative scheme for coupling flow with geomechanics in heterogeneous poroelastic media. *Computational Geosciences*, 24:551–569, 2020.

[2] V. Girault, K. Kumar, and M. F. Wheeler. Convergence of iterative coupling of geomechanics with flow in a fractured poroelastic medium. *Computational Geosciences*, 20(5):997–101, 2016.

[3] V. Girault, M. F. Wheeler, B. Ganis, and M. E. Mear. A lubrication fracture model in a poro-elastic medium. mathematical models and methods in applied sciences. *Mathematical Models and Methods in Applied Sciences*, 25(4):587–645, 2015.

[4] K. Kumar, T. Almani, G. Singh, and M. F. Wheeler. *Multirate Undrained Splitting for Coupled Flow and Geomechanics in Porous Media*, pages 431–440. Springer International Publishing, Cham, 2016.