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The Applications of Mixed Finite Element for Coupled Poromechanics Flow and Transport in Heterogeneous Reservoirs

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Abstract:

The volumetric rock deformation caused by fluid pressure alteration and its impact on the productivity of the hydrocarbon reservoirs has been a centre of interest of petroleum industry for many decades.

The coupling between the flow and deformation can be captured through the application of Biot's equation of poroelasticity. The Biot's equation is usually discretised using the two-field formulation frequently used in continuous Galerkin finite element because of its computational efficiency. However, this method has several drawbacks including **(i)** unphysical fluid pressure oscillations at boundaries with high permeability contrast and **(ii)** unsatisfied with local mass conservation.

To mitigate the mentioned problems, we propose three-field formulation using mixed finite element discretisation technique. This proposed formulation diminishes pressure oscillation, conserves fluid mass locally, and thus it is suitable for solving transport phenomena. The accuracy and computational cost of each method, two- and three-field formulation, are investigated and compared for different mesh types (i.e. triangle or quadrilateral) and sizes.