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Enriched Galerkin for Darcy flow, reactive transport and elastic wave propagation

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In this presentation, we discuss enriched Galerkin (EG) algorithms for modeling Darcy flow, reactive transport, and elastic wave propagation. This approach involves enriching the continuous Galerkin finite element method with discontinuous elements. For transport EG is coupled with entropy residual stabilization for transport. The method provides locally and globally conservative fluxes, which are crucial for coupled flow and transport problems. In particular, numerical simulations of viscous fingering instabilities in heterogeneous porous media and Hele-Shaw cells are illustrated as well as results for two phase flow. Here dynamic adaptive mesh refinement is applied in order to save computational cost for large-scale three-dimensional applications. In addition, entropy residual based stabilization for high order EG transport systems prevents any spurious oscillations. Recently EG was applied to simulated elastic wave propagation in a fractured media. Here Linear Slip theory was used for incorporating fractures and faults. Specifically, this new approach has the advantage of DG with a computational cost comparable to that of the Spectral Element Method. Computational results demonstrating the effectiveness of EG for these flow and reactive transport and wave propagation are provided. The work on flow and transport was done in collaboration with Sanghyun Lee and the work on elastic wave propagation with Mrinal Sen and Janaki Vamaraju.

References

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