A Novel Enriched Galerkin Method for Flow and Transport in Fractured Porous Media

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Abstract. Fluid flow and solute transport in fractured porous media is the backbone of many applications including groundwater flow, underground energy harvesting, earthquake prediction, and biomedical engineering. The traditional continuous Galerkin (CG) method is not suitable for the transport equation due to lack of mass conservation. The discontinuous Galerkin (DG) method mitigates this problem; however, its computational cost is considerably more than the CG method. In this study, a robust and efficient discretization method based on the interior penalty enriched Galerkin (EG) method is proposed. This method requires fewer degrees of freedom than those of the DG method, while it achieves the same accuracy. The flow and transport models of rock matrix and fractures domains are investigated in both equidimensional and mixed dimensional settings. The CG and EG methods are compared in four geometries to evaluate the accuracy and efficacy of the proposed method [Inga et al., Verification benchmarks for single-phase flow in three-dimensional fractured porous media, 2018]. The results illustrate the superiority of the EG method in solving the flow and transport equations in fractured porous media. Furthermore, the computational burden of the EG method is not significant.

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