Hybrid FV – FE methods for modeling flows in fractured porous media

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August 2, 2018

This work is devoted to the new hybrid FV – FE methods for solving a system of advection-diffusion equations in a bulk domain coupled to advection-diffusion equations on an embedded surface. The method is applied for modeling flows in fractured porous medium. Fractures in a porous medium are considered as sharp interfaces between the surrounding bulk subdomains. The surface of fracture is not fitted by the mesh and can cut through the background mesh in an arbitrary way. The background mesh is an octree grid with cubic cells. A monotone nonlinear finite volume method [1] for equations posed in the bulk is combined with a octree trace finite element method for equations posed on the surface [2]. In the octree TraceFEM one considers the bulk finite element space of piecewise trilinear globally continuous functions and further uses the restrictions (traces) of these functions to the surface. The hybrid method demonstrates great flexibility in handling curvilinear or branching embedded structures. The numerical properties of the approach are illustrated in a series of numerical experiments with different embedded geometries.

References

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[2] A. Chernyshenko, M. Olshanskii (2015) An adaptive octree finite element method for PDEs posed on surfaces. Computer Methods in Applied Mechanics and Engineering. 291: 146–172.