The finite cell method for solute transport problems in porous media

Simulating a solute transport problem in a heterogeneous porous media requires considerable computational effort especially when refined boundary conforming meshes become necessary. The finite cell method, which combines a fictitious domain approach and the high order finite element method, was recently developed for solid mechanics and allows a trivial mesh generation regardless of the possibly complicated geometry. In this contribution, the finite cell method is generalized to solute transport problems in fluid mechanics. The non-smooth problem occurs due to discontinuous material coefficients, i.e. porosity, within the cell being cut by the boundary of the original domain. This problem can be resolved by generating non-uniform sub-cells based on the adaptive integration scheme or by increasing the number of integration points on the cell level. As a validation of our approach, a benchmark problem is solved for a single component solute transport problem. Additionally, the method is extended to multi-component reactive transport problems. A comparison of the convergence rate between the classical finite element method and the finite cell method will be given.

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