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Partition of unity methods for approximation of point water sources in porous media

People often consider in their models of flow in porous media very large areas which can contain various phenomena of a very small scale compared with the size of the areas. These can be some disruptions of the porous media, e.g. cracks and wells, or material inhomogeneities which cause large gradients in pressure head and velocity or even their discontinuities.

Using the standard Finite Element Method (FEM) with linear finite elements we are unable to properly approximate the quantities in the vicinity of these disturbances, unless we introduce cells of the same scale in the mesh. This leads to very fine meshes and increases computational costs.

We use Partition of Unity Methods (PUM) to overcome this problem and demonstrate it on a steady quasi-three-dimensional model of multi-aquifer system containing hydro-geological wells which cause singularities in the solution. The corrected eXtended FEM (XFEM) and Stable Generalized FEM (SGFEM) will be presented.