Embedded vs. Cut Finite Element Methods for Darcy Flow in Cracked Media

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ABSTRACT

Finite element methods for Darcy flow in a cracked bulk material, where the cracks are allowed to run independently of the bulk mesh, have recently been proposed, in mixed form [1] and in terms of pressure only [2, 3]. In [3], such methods are referred to as Cut Finite Element Methods, CutFEM. The idea is to discretize the differential equations in the bulk on either side of the crack (of codimension 1), and coupling these discretizations to a separate differential equation holding along the crack itself.

In this contribution we compare and contrast the CutFEM approach to that of simply embedding the crack in an uncut mesh, adding the 'stiffness' in the crack to the 'stiffness' of the (continuous) bulk. This simple approach is evaluated against CutFEM in the case of codimension 1 for different ratios of permeability in the crack and in the bulk. We also consider the case of codimension 2 in the embedded approach.

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