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Improved embedded methods for flow in fractured porous media

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The study of flow in fractured porous media is a key ingredient for many geoscience applications. Modelling and simulation of these highly heterogeneous and geometrically complex systems require the adoption of non-standard numerical schemes. The *Embedded Discrete Fracture Model* (EDFM) [1] is a simple and effective way to account for fractures with coarse and regular grids, but it suffers from some limitations: it assumes a linear pressure distribution around fractures, which holds true only far from the tips and fracture intersections, and it can be employed for highly permeable fractures only. An extension of the EDFM method, namely the *Projection-based Embedded Discrete Fracture Model* (pEDFM) [2], allows to take into account even the impermeable case. We propose an improvement of EDFM which aims at overcoming both its limitations, and this is achieved by solving, on fine conforming grids, different types of local problems, whose definitions are inspired from numerical upscaling techniques: this leads to the computation of new transmissibilities. The new method is called *Local Embedded Discrete Fracture Model* (LEDFM) and the results obtained from several numerical tests confirm the aforementioned improvements. We implemented the local method within the MATLAB Reservoir Simulation Toolbox (MRST) [3], where both EDFM and pEDFM were already available, with the aim of comparing their performance. However, surprisingly enough, inaccurate results were found for pEDFM. These are mainly due to two reasons: the transmissibility formulae implemented in MRST do not apply a distance-weighted harmonic averaging, as required by the original formulation, and fracture projection paths may be discontinuous.

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