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A non-conforming and a conforming approach for non stationary flow simulations in DFMs with complex geometries

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Two approaches are described for flow simulations in porous media with an embedded network of fractures, modeled by means of the DFM model. Simulation domains are usually characterized by a complex and multi-scale geometry, as fractures are allowed to be arbitrarily oriented in the three dimensional space: fracture dimensions can indeed span several orders of magnitude and can form intersections with lengths on different scales. One of the main difficulties lies in the generation of a good quality mesh of such domains. One possibility is to generate meshes for the 3D porous matrix and for each of the 2D fractures and for the 1D fracture intersections independently, and rely on the numerical scheme for the coupling. This is the idea at the basis of the proposed optimization based domain decomposition approach [1], where a cost functional is designed and minimized to enforce the matching conditions at the various interfaces, and constitutive constraint equations are written on each domain. Another possibility involves, instead, the use of polytopal/polyhedral methods, such as the VEM, [2], to easily generate conforming meshes of complex domains, relying on the robustness of such methods in handling also highly distorted elements. The latest developments of these approaches are here presented and discussed also in relation to non-stationary simulations in realistic domains.

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