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Coupling of different numerical approaches for efficient simulations in porous and fractured media

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The simulation of flows in poro-fractured heterogeneous media is a challenging task, manly as a consequence of the geometrical complexity of the domain. Fractures in the porous matrix are dimensionally reduced to co-dimensional interfaces, in order to avoid the resolution of the scale of the fracture thickness, which can be orders of magnitude smaller than the typical dimensions of the computational domain. Fractures, then, act as irregularity interfaces for the solution, and standard numerical approaches based on finite elements or finite volumes are required to conform to these interfaces in order to capture the correct behavior. New numerical approaches are proposed here, born from the coupling of standard discretization techniques with recent and non-conventional methods, such as the Virtual Element Method (VEM), [1,2] or the optimization based non conforming Finite Elements [3 4 5]. This new family of techniques overcomes the need of conformity at the interfaces. Further, the computational domain can be easily split in sub-domains and the most convenient discretization approach can be used in different regions of the domain, thus effectively tackling geometrical complexity and heterogeneity.

References

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