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Applications of standard and mixed Virtual Elements to the simulation of physical phenomena in poro-fractured media

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When dealing with poro-fractured media, performing efficient simulations of physical phenomena such as the transport of contaminants, subsidence or computing the hydraulic head distribution can be very challenging due to the high number of possible geometrical configurations that have to be taken into account. Recently, the flexibility of the Virtual Element Method in dealing with complex geometries has been exploited in order to successfully tackle the mesh generation issues that arise when performing simulations on Discrete Fracture Networks [1–4], that represent the fractures inside rocks as sets of planar polygons intersecting each other in space. These networks are usually randomly generated starting from statistic distributions of the physical properties of the soil and fractures can thus intersect with all sort of configurations, including, for example, the case of intersections that are parallel but very close to each other, or intersect with very small angles. The proposed strategies start from triangulations that are generated independently of intersections and are cut into polygons by the intersections. This allows to apply standard domain decomposition techniques (suitable for a parallel implementation of the code) and to discretize each fracture independently, possibly using different approaches: standard and mixed Virtual Elements have been used, obtaining solutions that can be either strongly or weakly continuous, and very good approximations of the fluxes that enter or leave each fracture at intersections.

References

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