

A hybrid high order (HHO) method with non matching meshes in discrete fracture networks .

Florent Hédin and Géraldine Pichot

INRIA SERENA & ENPC

The motivation of this research work comes from our interest in solving flow in Discrete Fracture Networks (DFN) in an efficient way. Simulations of such flow fields are of interest in a wide range of applications: from studies of sustainable management of groundwater resources, pollution propagation, feasibility assessment of waste storage in deep geological media to improvement of extraction processes of fossil resources (oil, gas ...) and geothermal techniques. As DFN may contain a large number of fractures (several hundred thousand or even millions), there is a crucial need to develop robust and efficient numerical strategies to reduce the computational cost.

To this goal, we propose to combine two strategies: the Hybrid High Order (HHO) method which supports general meshes and face polynomials of order $k \geq 0$ and independent mesh generation from one fracture to another which reduce the number of unknowns with a mesh refinement/coarsening algorithm. We will show that the HHO method is very well suited to deal with such non matching meshes. We have tested the combination on a moderate DFN that contains 32,681 fractures. We show that it saves a lot of computational resources to increase the order of the HHO method in DFN simulations. If one is interested in accurate fine scale solutions, polygonal meshes together with high order reduce the computational time and allow to better approximate the solution by comparison with a triangular mesh, provided a good coarsening/refining strategy.