Adaptive Higher Order Methods for Porous Media and Non-Newtonian Fluid Flow Problems

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We present adaptive Finite Element and Discontinuous Galerkin discretizations for Porous media flow and non-Newtonian Fluid flow problems. The adaptive approaches implemented allow in most test cases for refinement/coarsening in both the element size, the polynomial degree and the time step size. To our knowledge, this is the first time the concept of local hp-adaptivity is incorporated in the study of such topics. The implementation is based on the new Python frontend Dune-FemPy [2] to the open source framework DUNE [1]. The efficient strategies for parallelization, adaptivity, and load balancing within the framework allow to aim at a range of complex industrial and environmental applications such as Microbially induced calcite precipitation (MICP) as a leakage mitigate solution in CO_2 sequestration [4] and non-Newtonian fluid flow in complex domains.

This work required a combination of a multidisciplinary expertise in state-of-the-art adaptive, higher order discretization schemes for unsteady problems in porous media flow [3] and transport simulation.

References

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