Towards r-h-adaptivity in FEM

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Error control and adaptive algorithms are essential ingredients for accurate and fast FEM simulation. To obtain adapted computational grids, in many FEM packages h-adaptivity, i.e. the selective refinement of single elements, is employed. However, this kind of adaptivity bears disadvantages. Element-based h-adaptivity leads to highly unstructured grids which decrease the numerical efficiency of an FEM code as these grids require many unaligned and costly memory accesses during the program run. In contrast to this, r-adaptivity preserves the topology of the grid and thus is a natural candidate for an alternative adaptivity technique which may overcome the aforementioned difficulties. Moreover, in contrast to h-adaptivity, r-adaptivity allows to adjust the grid to curves in the computational domain like i.e. interfaces with superior accuracy, as in contrast to h-adaptivity the orientation of the grid cells can be aligned. Besides of the presentation of a new deformation technique, the emphasis in the talk is put on the application of the deformation method as tool for grid adaptation in the context of (goal-oriented) error control. We present prototypical test problems as well as comparisons with other mesh adaptation techniques. Lastly, we sketch suitable combinations of both r- and h-adaptivity techniques which feature the advantages of both types of adaptation techniques.

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