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ON A TIME-SEQUENTIAL ADAPTIVE STRATEGY IN SPACE-TIME FOR FINITE STRAIN CONSOLIDATION PROBLEMS

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Abstract. The paper outlines a time-sequential space-time adaptive FE-strategy applied to finite strain coupled consolidation, which can be viewed as a prototype model of a class of nonlinear and time-dependent poro-mechanics problems. The natural variational setting for the consolidation problem allows for space-time FE using dG- or cG-methods in time depending on the expected character (quasistatic or dynamic). We discuss goal-oriented error computation and the combined space-time adaptivity while accounting for non-linearities in the model as well as the output functional.

One key ingredient in the proposed strategy is to introduce a hierarchical decomposition in space-time of the discrete function space(s) in which the approximate dual solution is sought. As a result, it is possible to decompose the estimated error from the discretization in space and time in a unified fashion within the same algorithm. This decomposition of error contributions allows for efficient adaptive mesh-refinement in space and time separately. Moreover, other sources of error (model and solution errors) can be identified.

Traditionally, controlling the global error in space-time problems involves storing the complete solution and, when adopting an adaptive algorithm, complete re-computation of the solution for each iteration of the space-time mesh. The main idea proposed in this contribution is to increase the computational efficiency of the adaptive scheme by avoiding recursive adaptations of the entire space-time mesh; rather, the space-mesh and the time-step defining each finite space-time slab are defined in a truly sequential fashion. The procedure involves the solution of an initial, approximate, dual solution on a coarse "background" space-time mesh which is kept fixed during the space-time re-meshing for the primal problem.

The overall performance of the proposed strategy is investigated using a few numerical examples.