Parallel Space-Time Finite Element Methods for Parabolic Optimal Control Problems

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Abstract

We present new locally stabilized space-time finite element methods on fully unstructured simplicial space-time meshes for the numerical solution of space-time tracking parabolic optimal control problems with the standard L_2-regularization. We perform an a priori discretization error analysis, and derive a priori discretization error estimates in terms of the local mesh-sizes for shape-regular meshes.

The adaptive version is driven by local residual error indicators, or, alternatively, by local error indicators derived from a new functional a posteriori error estimator. The latter provides a guaranteed upper bound of the error, but is more costly than the residual error indicators.

We perform numerical tests for benchmark examples having different features, where we additionally consider the parallel performance of our method. In particular, we consider different algebraic multigrid (AMG) preconditioners for the solution of the linear system of finite element equations corresponding to the discretization of the reduced first-order optimality conditions.