Applications of a space-time FOSLS formulation for parabolic PDEs

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While the common space-time variational formulation of a parabolic equation results in a bilinear form that is non-coercive, [Führer, Karkulik, Space–time least-squares finite elements for parabolic equations, CAMWA (2021)] recently proved well-posedness of a space-time first-order system least-squares (FOSLS) formulation of the heat equation, which corresponds to a symmetric and coercive bilinear form. In particular, the Galerkin approximation from any conforming trial space exists and is a quasi-optimal approximation. Additionally, the least-squares functional automatically provides a reliable and efficient error estimator.

In [Gantner, Stevenson, Further results on a space-time FOSLS formulation of parabolic PDEs, M2AN (2021)], we have generalized this least-squares method to general second-order parabolic PDEs with possibly inhomogenoeus Dirichlet or Neumann boundary conditions. For homogeneous Dirichlet conditions, we present convergence of adaptive finite element methods driven by the built-in least-squares estimator. Moreover, we employ the space-time least-squares method for parameter-dependent problems as well as optimal control problems [Gantner, Stevenson, Applications of a space-time FOSLS formulation for parabolic PDEs, IMAJNA (2023)].

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