Anisotropic Goal-oriented Error Estimates for HDG Schemes

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Abstract

Many physical phenomena, such as convection-diffusion problems, are characterized by strongly anisotropic features. Numerical simulation of such problems is greatly enhanced by anisotropic mesh adaptation. Moreover, numerical schemes using piecewise polynomial approximation offer increased flexibility by adjusting the local polynomial degree as well (hp-adaptation).

Previously, we have proposed a continuous-mesh (i.e. metric-based) optimization method for higher order discontinuous Galerkin methods on triangular meshes [1]. A metric is obtained by a two-step formal optimization procedure with respect to a suitable continuous-mesh error model. The advantage of such metric-based approaches, is that generating the optimal metric can be done by analytical optimization methods, followed by mesh re-generation using a standard metric-based mesh generator. This approach has been extended to goal-oriented adaptation (e.g. [2], or the more recent paper with more general error estimates [3]), and/or hp-adaptation [4].

The main focus of this talk is the formulation of the continuous mesh approach specifically for HDG schemes. Challenges include the derivation of suitable continuous-mesh error models. In particular, the estimates in [3] are so far available only for SIPG Discontinuous-Galerkin schemes. In addition to the theory, we present several numerical examples for our mesh optimization approach, chosen from linear and nonlinear convection-diffusion models.

References

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