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*Space-time HDG for the advection-diffusion equation on time-dependent domains in the limit of small diffusion*

This work is in collaboration with Yuan Wang. The time-dependent advection-diffusion equation on a time-dependent domain $D(t) \subset R^d$ is given by:

$$\partial_t \theta + \mathbf{u} \cdot \nabla \theta - \nu \nabla^2 \theta = f, \qquad \mathbf{x} \in D(t),\ t \in (0, T]. \qquad (1)$$

Here $\theta$ is the quantity of interest, $\mathbf{u}$ is a flow field, and $\nu > 0$ a diffusion parameter.

The space-time framework facilitates the discretization of PDEs on moving domains: a time-dependent PDE is re-formulated as a "stationary" PDE in $(d+1)$ space-time which is then discretized by a finite element method.

In [1] we introduced the space-time hybridizable discontinuous Galerkin method for (1). In [2] we analyzed this discretization assuming a sufficiently large diffusion parameter $\nu$. In this talk I will present a new analysis of the space-time HDG method focusing on the small diffusion limit ($\nu \ll 1$).

[1] S. Rhebergen and B. Cockburn, Space-time hybridizable discontinuous Galerkin method for the advection-diffusion equation on moving and deforming meshes, in The Courant-Friedrichs-Lewy (CFL) condition, 80 years after its discovery, ed. C.A. de Moura and C.S. Kubrusly, pp. 45-63 (2013).

[2] K.L.A. Kirk, T. Horvath, A. Cesmelioglu and S. Rhebergen, Analysis of a space-time hybridizable discontinuous Galerkin method for the advection-diffusion problem on time-dependent domains, SIAM J. Numer. Anal., 57, 4, pp. 1677-1696 (2019).