

# On Adaptivity for SOLD Methods

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## Abstract

In the talk we consider the numerical solution of the scalar convection–diffusion–reaction equation

$$-\varepsilon \Delta u + \mathbf{b} \cdot \nabla u + cu = f \text{ in } \Omega, \quad u = u_b \text{ on } \Gamma^D, \quad \varepsilon \frac{\partial u}{\partial \mathbf{n}} = g \text{ on } \Gamma^N. \quad (1)$$

We present new results of an adaptive technique in finite element method based on minimizing a functional called error indicator  $I_h : W_h \rightarrow \mathbb{R}$ , where  $W_h$  is a FE space for the discrete solution  $w_h$  of (1). The simplest form of such an indicator is

$$I_h(w_h) = \sum_{K \in \mathcal{T}_h, \overline{K} \cap \partial\Omega = \emptyset} h_K^2 \| -\varepsilon \Delta w_h + \mathbf{b} \cdot \nabla w_h + cw_h - f \|_{0,K}^2 \quad \forall w_h \in W_h, \quad (2)$$

where we have used the usual notation from the article of P. Lukáš [1]. It is possible to enrich this indicator by other terms, e.g.  $\|\phi(|\mathbf{b}^\perp \cdot \nabla w_h|)\|_{0,1,K}$ , where  $\phi$  is a function like square root.

We enriched the space of parameters we are changing in the optimization process - currently it is not only the parameter  $\tau$  from SUPG (SDFEM) method but also other parameters, e.g. the parameter called  $\tilde{\varepsilon}$  in [2], equations (30) and (31) on page 2205 for the SOLD method which adds diffusion in the crosswind direction. We use several different FE spaces for both parameters.

## References

1. PETR LUKÁŠ. Optimization of Parameters in SDFEM for Different Spaces of Parameters. Applied Mathematics and Computation 267 (2014), 711-715.
2. V. JOHN AND P. KNOBLOCH. On Spurious oscillations at layers diminishing (SOLD) methods for convection-diffusion equations: Part I - A review. Comput Methods Appl. Mech. Engrg. 196 (2007) 2197-2215.