Title: Numerical Solution of Convection-dominated Problems

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Abstract: Numerical solution of the scalar convection-diffusion-reaction problems often possesses spurious oscillations which appear in the discrete solution when convection dominates diffusion and standard non-adaptive discretizations are used.

Numerical solution of convection-dominated problems requires special techniques to suppress these oscillations. Often stabilized methods are applied which involve free parameters. These parameters significantly influence the quality of the solution but their optimal choice is usually not known. In this work we define them in an adaptive way by minimizing an error indicator characterizing the quality of the approximate solution. We consider new nonlinear limited-memory optimization methods.

A nontrivial requirement on the error indicator is that its minimization with respect to the stabilization parameters should suppress spurious oscillations without smearing layers. In this thesis novel error indicators are introduced and their suitability is considered on different benchmarks.

Keywords: FEM, optimization, SUPG, SDFEM, SOLD, Error indicator