Nečas Center for Mathematical Modeling

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Spatial distribution of errors in numerical solution of PDEs

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Discretization error

A posteriori error estimation + local mesh refinement lead to quasi-equilibration of the discretization error.

Adaptive numerical solution of PDEs

Discretization error

A posteriori error estimation + local mesh refinement lead to quasi-equilibration of the discretization error.

Algebraic error

The discretized algebraic system is not solved exactly.

Discretization error

A posteriori error estimation + local mesh refinement
lead to quasi-equilibration of the discretization error.

Algebraic error

The discretized algebraic system is not solved exactly.

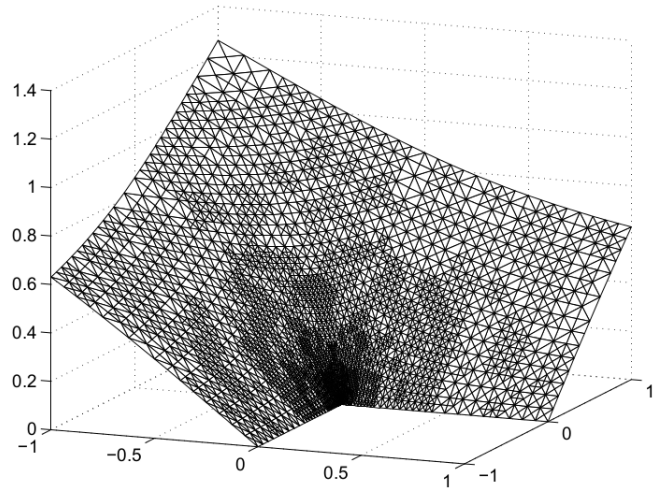
- What is the spatial distribution of the algebraic error?
- Is it analogous to the spatial distribution of the discretization error?

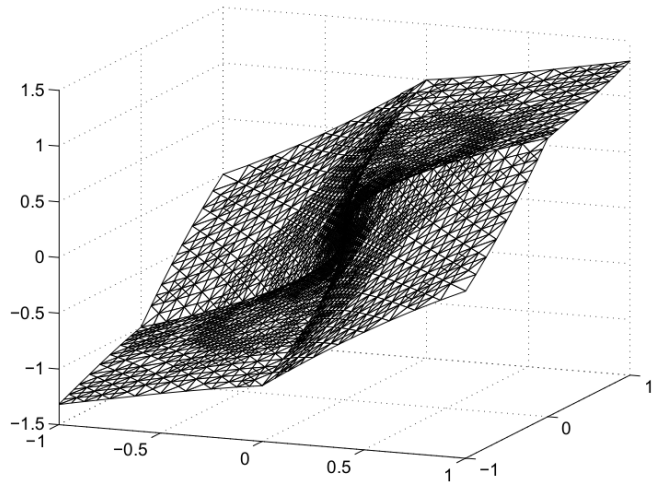
Test problems

We consider the boundary value problems from the class

$$-\nabla \cdot (\mathbf{S}\nabla u) \quad = \quad f \quad \text{in } \Omega\,, \qquad u = u_D \quad \text{on } \partial\Omega\,,$$

where $\mathbf{S}$ is a symmetric, bounded and uniformly positive diffusion tensor.



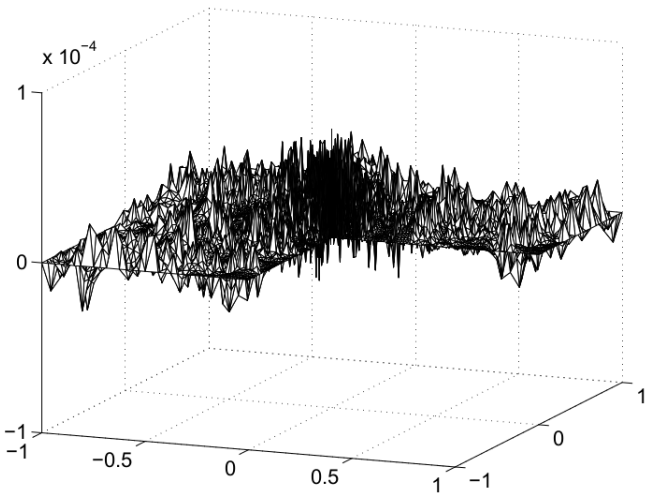


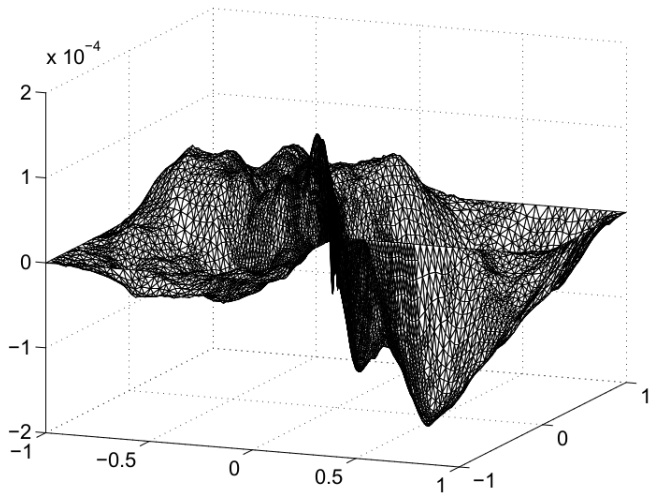
Algebraic solvers

We solve the discretized algebraic system corresponding to an adaptively refined mesh using

- the conjugate gradient method and
- the aggregation-based algebraic multigrid.

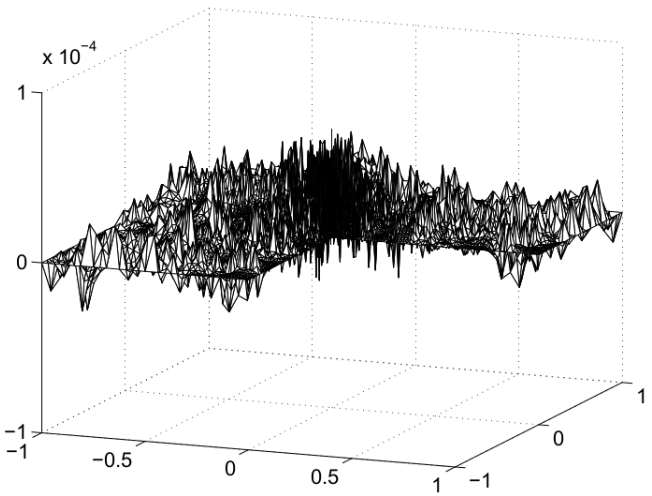
Numerical experiments

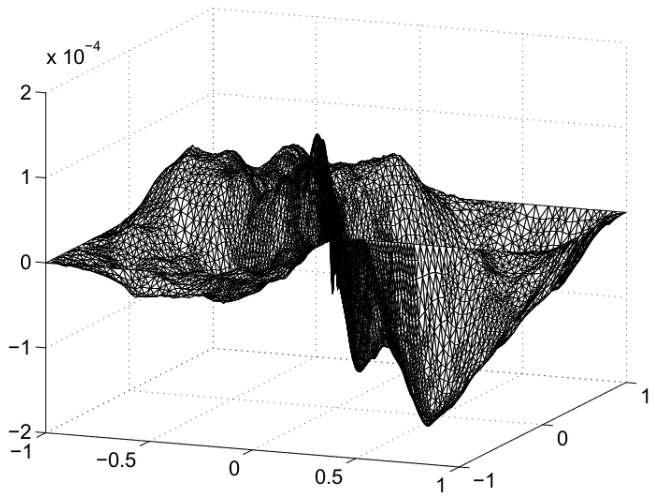




The results demonstrate that the spatial distribution of the algebraic error can significantly differ from the spatial distribution of the discretization error.

Numerical experiments





The results demonstrate that the spatial distribution of the algebraic error can significantly differ from the spatial distribution of the discretization error.

This phenomenon is not restricted to particular problems, dimensions and algebraic solvers.

Thank you for your patience and see you at the poster session!