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Talk announcement

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A robust multigrid method for Isogeometric Analysis

The idea of (single-patch) isogeometric analysis is to use (tensor-product) B-splines or non-uniform rational B-splines (NURBS) as ansatz functions and a global geometry transformation. This approach has many nice features, however the condition number of the resulting stiffness matrix for the Poisson problem grows exponentially in the polynomial degree p and the usual way, i.e., like h^{-2} in the grid size.

The setup of a multigrid method being robust only in the grid size is standard. Numerical evidence shows that such standard approaches do not work well if the polynomial degree p is increased. In this talk, we will discuss how to set up a p-robust multigrid method for a model problem being discretized with B-splines. The main focus is set on the construction of smoothers such that the convergence properties of the multigrid solver do not deteriorate if the polynomial degree p is increased.

This is done based on the recent paper on a robust approximation error estimate for B-splines, where a p-robust approximation error estimate and a p-robust inverse inequality are proven for a subspace of the whole spline spaces. In one dimension, this subspace is the space of all splines, whose odd derivatives vanish on the boundary. So, for typical problems, that space is almost as large as the whole spline space. Based on that result, it is possible to set up a stable splitting of spline space, where for each of the subspaces its own smoother is applied. In the talk both convergence analysis and numerical experiments are presented. They confirm that the proposed method behaves optimal in both the grid size h and the polynomial degree p.