Robust multigrid methods based on non-standard approximation error estimates in Isogeometric Analysis

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Isogeometric Analysis is a spline-based discretization for partial differential equations (PDEs) which allows the construction of arbitrarily smooth basis functions. Such discretizations yield convergence rates of a high-order method for costs of a low-order method. Moreover, isogeometric discretizations allow to directly discretize higher-order problems, like the biharmonic equations. We are interested in robust multigrid methods that allow to solve the linear systems obtained by discretizing the partial differential equations with these discretizations. Certainly, the first priority is to obtain robustness in the grid size, i.e., the convergence rates shall be independent of the grid size and the overall computational complexity should grow only linearly with the number of degrees of freedom. We discuss how to archive robustness also with respect to other parameters, like the spline degree, the parameterization of the geometry or other coefficient functions and why special approximation error estimates are of interest in this context. We will see numerical experiments and discuss what can be explained by the convergence theory.