JOHANNES KEPLER UNIVERSITY LINZ

Johannes Kepler Universität Linz
Institut für Numerische Mathematik

o.Univ.-Prof. Dr. Ulrich Langer

Talk announcement

Dr. Svetlana Matculevich
(RICAM)

Tuesday, Mar 28, 2017
15:30, S2 059

Functional a posteriori error estimates and adaptivity for IgA schemes

We are concern with guaranteed error control of Isogeometric Analysis (IgA) numerical approximations of elliptic boundary value problems (BVPs). The approach is discussed within the paradigm of classical *linear Poisson Dirichlet* model problem: find $u : \overline{\Omega} \to R^d$ such that

$$-\Delta_x u = f \ \text{ in } \ \Omega, \qquad u = u_D \ \text{ on } \ \partial\Omega, \tag{1}$$

where $\Omega \subset R^d$, $d \in \{1, 2, 3\}$, denotes a bounded domain having a Lipschitz boundary $\partial\Omega$, Δ_x is the Laplace operator in space, $f \in L^2(\Omega)$ is a given source function, and $u_D \in H_0^1(\Sigma)$ is a given load on the boundary.

We conduct the numerical study of the functional a posteriori error estimates integrated into the IgA framework. These so-called majorants and minorants were originally introduced in [1] and later applied to different mathematical models. This type of error estimates can exploit the higher smoothness of B-Splines (NURBS, THB-Splines) basis functions to its advantage. Since the obtained approximations are generally C^{p-1}-continuous (provided that the inner knots have the multiplicity 1), this automatically implies that their gradients are in $H(\Omega, \mathrm{div})$ space. Therefore, there is no need in projecting it from $\nabla u_h \in L^2(\Omega, R^d)$ into $H(\Omega, \mathrm{div})$.

The functional approach to the error estimation in combination with IgA approximations (generated by tensor-product splines) was investigated in [2] for eq:poisson. In the current work, we test the algorithm of the majorant reconstruction suggested [2], which allows the considerable reduction of the time-costs for the error estimates calculation and , in the same time, generates guaranteed, sharp, and fully computable bounds of errors. Moreover, we combine functional error estimates with THB-Splines (the implementation provided by *G+smo*) and demonstrate their efficiency with respect to adaptive mesh generation in IgA schemes.

[1] S. Repin, A posteriori error estimation for nonlinear variational problems by duality theory, Zapiski Nauch. Sem. V. A. Steklov Math. Institute in St.-Petersburg (POMI), 243, 201–214, 1997.
[2] S. K. Kleiss and S. K. Tomar, Guaranteed and sharp a posteriori error estimates in isogeometric analysis, Computers & Mathematics with Applications 70 (3), 167-190, 2015.
[3] G. Kiss, C. Giannelli, U. Zore, B. Jüttler, D. Grossmann, and J. Barner, Adaptive CAD model (re-)construction with THB-splines, Graph. Models, 76, 273–288, 2014.