Smoothness of scalar and vector fields in isogeometric analysis

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Abstract

We present a method to model scalar and vector fields using an isogeometric discretization. Given a piecewise rational (NURBS) parametrization of a two-dimensional domain, a scalar isogeometric function is obtained by composing a scalar, bivariate NURBS in the parameter domain with the inverse of the domain parametrization. A vector field defined on the surface is given as the composition of a vector-valued NURBS with the inverse of the domain parametrization.

We take advantage of the projective representation of NURBS as piecewise polynomials in homogeneous coordinates. The function, as well as its derivatives, are represented via their graph surfaces in homogeneous coordinates. In this framework parametric continuity of the isogeometric function is equivalent to geometric continuity of the graph. This way, one can derive smoothness conditions for isogeometric functions defined on non-smooth domains.

Moreover, we present an example of a smooth vector field defined on a surface. The example is derived from an optical flow model for the cell motion in a zebrafish embryo. The talk is based on a joint work with Bert Jüttler (JKU), Guozhi Dong (Universität Wien) and Otmar Scherzer (Universität Wien, RICAM).