An isogeometric mortar-based surface coupling method for trimmed multipatch NURBS models with application to fluid-structure interaction and shape optimization

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ABSTRACT

Within this contribution, a method for transferring a field quantity between an isogeometric [1] and a classical Finite Element/Finite Volume discretization of a surface is presented. The method is based on the mortar approach [2] where the difference between the given and the projected field is minimized in the L^2 space. As the parametrization of the isogeometric discretization is taken directly from real-world engineering Computer-Aided Design (CAD) models, multiple coupled and trimmed Non-Uniform Rational B-Spline (NURBS) patches are involved. Accordingly, the continuity of the field and its gradients between the different patches is addressed [3, 4] and its impact on the surface coupling is discussed. Special emphasis is given to the treatment of patches which are coupled along trimming curves.

The proposed method is then used for fluid-structure interaction simulations where either directly an isogeometric discretization of a structure is involved or a fictitious interface layer is employed for smoothening the field when transferred from one mesh to another.

An additional field of application is shape optimization, where the isogeometric mortar mapping method can be used for both sensitivity filtering and CAD regeneration purposes during the optimization process. The usage in shape optimization is inspired by Vertex Morphing [5], an explicit filtering method, which has been proven to robustly converge to the solution of such non-convex problems.

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