A framework for isogeometric analysis on unstructured quadrilateral meshes

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Abstract

Modeling geometries of arbitrary genus with a finite number of tensor-product polynomial patches invariably lead to surface representations with unstructured quadrilateral meshes and, thus, extraordinary vertices. On regular parts of the mesh, where the quadrilateral elements are arranged in a locally-structured fashion, smooth splines can be easily built. However, there is no canonical way of doing the same on an unstructured arrangement of quadrilateral elements. Application of smooth splines over unstructured meshes is of considerable interest within the field of isogeometric analysis, and a myriad of approaches have been explored that focus on the design and analysis of geometries built over such meshes.

In this talk we present an alternative approach towards construction of smooth splines over unstructured quadrilateral meshes. Acknowledging the differing requirements posed by design (e.g., the convenience of an intuitive control net) and analysis (e.g., good approximation behavior), we propose the construction of a separate, smooth spline space for each while ensuring isogeometric compatibility. A key ingredient in the approach is the use of singular parameterizations at extraordinary vertices. We demonstrate the versatility of the approach with several applications in design and analysis. The constructed spline spaces show superior approximation behavior, and seem to be well behaved even at the singularities [1].

References

[1] D. Toshniwal, H. Speleers, and T.J.R. Hughes. *Smooth cubic spline spaces on unstructured quadrilateral meshes with particular emphasis on extraordinary points: Geometric design and isogeometric analysis considerations*, Comput. Methods Appl. Mech. Engrg., in press.