Manifold-based B-splines on unstructured meshes

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ABSTRACT

We introduce new manifold-based splines that are able to exactly reproduce B-splines on unstructured surface meshes. Such splines can be used in isogeometric analysis (IGA) to represent smooth surfaces of arbitrary topology. Since prevalent computer-aided design (CAD) models are composed of tensor-product B-spline patches, any IGA suitable construction should be able to reproduce B-splines. The utility of manifold-based surface construction techniques in isogeometric analysis was first demonstrated in Majeed and Cirak. The respective basis functions are derived by combining differential-geometric manifold techniques with conformal parametrisations and the partition of unity method. The connectivity of a given unstructured quadrilateral control mesh in $\mathbb{R}^3$ is used to define a set of overlapping charts. Each vertex with its attached elements is assigned a corresponding conformally parametrised planar chart domain in $\mathbb{R}^2$, so that a quadrilateral element is present on four different charts. On the collection of unconnected chart domains the partition of unity method is used for approximation. The transition functions required for navigating between the chart domains are composed out of conformal maps. The proposed constructions automatically reproduce B-splines in regular parts of the mesh, with no extraordinary vertices, and polynomial basis functions in the remaining parts of the mesh.

REFERENCES

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