G^1 volumetric interpolation of unstructured hexahedral meshes

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ABSTRACT

High-order volumetric construction plays a key role in three-dimensional numerical simulation framework, such as isogeometric analysis [1] and high-order finite element method [2]. In particular, constructing unstructured trivariate representation with geometric continuity constraints at extraordinary vertices/edges to interpolate a specified unstructured hexahedral mesh, is still a challenging problem in the field of mesh generation and geometric modeling. In this paper, from an unstructured hexahedral mesh as input, we propose a local and efficient approach to interpolate the vertices of a given arbitrary hexahedral mesh with a high-quality volumetric geometry of overall G^1-continuity. Firstly, the G^1-continuity conditions between Bézier volumes around the extraordinary vertices/edges are proposed; then with the specified vertex normals (or may be derived from the neighboring mesh vertices), we locally construct the interplating lower degree bi-quartic Bézier volumes to satisfy the G^1-constraints based on a 1-to-8 split of the parametric domain. All control points of the Bézier volumes can be computed from explicit simple linear formulas. Thanks to the 8-split method, many independent degrees of freedom can be optimized to construct high-quality volumetric shape and parameterization for numerical simulation applications. Several modeling examples are presented to illustrate the effectiveness of the proposed method.

REFERENCES

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