Isogeometric Analysis on V-reps

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ABSTRACT

The introduction by Massarwi and Elber in [1] of the B-spline based Volumetric Modeling framework, via volumetric representations (V-reps), has inspired our works on the construction of isogeometric methods for elliptic PDEs on V-reps.

Thus, in our recent work [2] we have set the mathematical background that guarantees the accuracy and optimality of numerical methods for solving elliptic PDEs in trimmed V-reps. The imposition of Dirichlet conditions and its stability were discussed in [3], where a mathematically sound minimal stabilization strategy was proposed for elliptic problems. In [2] we also proposed a novel methodology for the local re-parametrization of 3D cut Bézier elements, based on the use of high-order tetrahedral partitions, that allows to compute accurate numerical integrals and has been proven efficient in both academic and complex test cases. These results will be discussed in our presentation.

Nevertheless, our previous works were restricted to the case of V-reps created by means of subtraction and intersection boolean operations. In this work we will also discuss our first results in its extension to the case of geometries generated through union operations. In this case, the computational domain is composed of multiple independent domains, each of them with its own parametrization. The solution continuity through their interfaces is enforced in a weak way (inspired by the multimesh FEM method proposed in [4]) and calls for a careful treatment of the integrals involved on each interface, which requires us to take into account the parametrizations from both domains of an interface.

As in the case of Dirichlet boundary conditions, stability issues may arise when small cut Bézier elements are present. We will briefly discuss the extension of our stabilization technique [3] to the case of union.

These developments will be illustrated with numerical benchmarks that support our theoretical findings and solid mechanics experiments that show the potential of this methodology for dealing with complex geometries.

REFERENCES

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