Isogeometric Segmentation and Parameterization via Face Pre-segmentation and Midpoint Subdivision

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ABSTRACT

Isogeometric Analysis makes frequent use of trivariate NURBS parameterizations (representing topological cuboids) of the computational domain. Several recent publications [1-5] describe methodologies that decompose a given three-dimensional solid in boundary representation into a collection of topological cuboids, or generate trivariate NURBS parameterizations for each of them in a subsequent step.

We contribute to the splitting-based approach to this decomposition segmentation, which is summarized in [6]. The initial framework [2], which is limited to solids with only convex edges, has been extended to contractible solids that may possess non-convex edges [3]. The application to non-contractible solids (with tunnels but without voids) becomes possible after executing a Reeb graph-based preprocessing step [7]. The important problem of intersection-free splitting surface construction has been addressed in [8].

The decomposition can be derived via a segmentation into sufficiently simple "base solids", for which cuboidal multi-patch representations are readily available. Based on midpoint subdivision, we propose a new class of base solids. In addition, we establish the pre-processing step of face pre-segmentation, which simplifies the splitting operations and improves the shape of the resulting topological cuboids. Finally, we show how to realize the midpoint subdivision by a template mapping approach, which simultaneously generates parameterizations of the base solids as trivariate multi-patch NURBS volumes.

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