Completing Volumetric Representations of Models defined by (trimmed) B-spline B-reps

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The rising of importance of IsoGeometric Analysis (IGA) highlights the need to define volumetric representations of models, preferably as semi-structured trivariate B-spline variants (such as T-splines or L-R splines). Higher smoothness between elements has led to better analysis results at lower resolution and fewer problematic results. Moreover, representing and designing models of heterogeneous material require volume representations.

Much research has been focused on transforming a polyhedral boundary representation into such a representation. However, many of todays CAD systems generate Boundary Representation Models (B-Reps) whose geometries consist of trimmed B-splines or trimmed NURBs, and allow subsequent design modifications at later stages. Hence, if it is possible to maintain the original B-spline based B-rep within the completed volume representation, then CAD systems can further modify the original B-rep and subsequently regenerate a corresponding completed volume.

The few existing research advances that support volume completion with semistructured trivariate B-splines while maintaining the original B-rep model have been for special cases. Some new research results aimed at completing volumes of more general (trimmed) shapes are presented. The proposed methodology results in a hybrid volumetric representation with semistructured tensor product trivariates near the boundary and unstructured elements deeper in the interior. The goal is to maintain significant benefits of the B-spline representation near the boundary, while taking advantage of the flexibility of higher order unstructured C^0 elements in the interior.

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