Isogeometric Solid Modeling Based On The Meccano Method

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We present a new method to construct a volume T-mesh of complex genus-zero solids for isogeometric modeling [1]. The procedure uses the meccano method [2,3,4] to define a volume parameterization between the solid and a unitary cube. The proposed technique only demands a surface triangulation of the solid as input data. The algorithm to get the volume parameterization can be summarized as:

1. Construct a partition of the surface triangulation of the solid with the same topology as the cube boundary, that is, with identical graph connectivity.
2. Determine a one-to-one mapping between the cube faces and corresponding surface patches. This is accomplished by using the parameterization of surface triangulations proposed by M. Floater.
3. Construct a coarse tetrahedral mesh of the cube.
4. Refine the previous tetrahedral mesh by using the algorithm of Kossaczky, in such a way that the mapping of the cube boundary triangulation approximates the solid boundary for a given precision.
5. Map the boundary nodes of the cube to the solid surface.
6. Relocate the inner nodes of the cube and optimize the tetrahedral mesh by applying our simultaneous untangling and smoothing procedure.

The resulting volume parameterization is used to transform a T-mesh defined on the parametric domain (the cube) into the physical domain (the solid). The T-mesh of the parametric domain is the parametric space in which the set of trivariate T-splines are defined. The technique to construct a T-mesh starts by dividing the parametric cube in lower cubes by using a local octree subdivision. The division continues until each leaf of the octree does not contain any node of the Kossaczky mesh in its inner. The octree defines a T-mesh in the parametric space that is used to determine the *local knot vector* and the *anchors* of the T-splines.

References

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