Construction of volume T-meshes of genus-zero solids for isogeometric analysis

J.M. Escobar [*], J. M. Casón [+], E. Rodríguez [*] and R. Montenegro [*]

[*] Institute for Intelligent Systems and Numerical Applications in Engineering,
University of Las Palmas de Gran Canaria, Spain
[+] Department of Economics and Economic, Faculty of Economics Management,
University of Salamanca, Spain

We present a new method to construct a volume T-mesh of genus-zero solids for the application of isogeometric analysis based on the *meccano method*. The proposed technique only demands a surface triangulation of the solid as input data. The key of this method lies in obtaining a volume parametrization between the solid and a unitary cube. The procedure to get the volume parametrization 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 parametrization 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 parametrization 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 an octree in such a way that each leaf of the octree is divided in eight children (eight cubes). 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.

2 J.M. Escobar [*], J. M. Casón [+], E. Rodríguez [*] and R. Montenegro [*]