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ROBUST OCTREE BASED TETRAHEDRA MESHER FOR NON-WATERTIGHT GEOMETRIES

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Nowadays large part of the time needed to run a numerical simulation is spent in preprocessing, especially in the geometry cleaning operations and mesh generation. Furthermore, these operations are not easy to automatize because they depend strongly on each geometrical model and they often need human interaction. Many of these operations are needed to obtain a watertight geometry. Even with a clean geometry, classical unstructured meshing methods (like Delaunay or Advancing Front) present critical weak points like the need of a given quality in the boundary mesh or a relatively smooth size transition. These aspects decrease their robustness and imply an extra effort in order to reach the final mesh. Octree based meshers try to relax some of these requirements.

In the present work an octree based mesher for unstructured tetrahedra is presented. One of the key points of this mesher is that it ensures the mesh generation avoiding most of the cleaning operations, so it saves a lot of time in the preprocessing part of the numerical simulation. It is based in the Isostuffing method: fit an octree onto the model, refine it following given criteria, apply a tetrahedra pattern to the octree cells and adapt the tetrahedra close to the contours in order to represent accurately the boundary shape. Special attention is devoted to some strategies which ensure that the final mesh will preserve the geometric topology of the original model. The method uses a Ray Casting based algorithm for the identification of the inner and outer parts of the volumes involved in the model. This technique allows the mesh generation of volumes even with non-watertight boundaries, and also opens the use of the mesher for immersed methods only applying slight modifications to the algorithm. A shared memory parallel implementation of the algorithm has been done.

The main advantages of the presented mesher are: robustness, no need for watertight boundaries, independent on the contour mesh quality, preservation of geometrical features (corners and ridges), original geometric topology guaranteed, accurate representation of the contours, capable to skip small details on user demand, valid for immersed methods, and fast performance. Some examples of complex meshes generated with this method are shown.