Robust meshing of large scale non-watertight geometries

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ABSTRACT

Nowadays large part of the time needed to perform a numerical simulation for industrial complex problems 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, and ensure a given quality in the boundary of the domain.

The presented work is based on a robust octree based tetrahedra mesher [1], which can be used in body-fitted or embedded approaches. Especially in the embedded approach, a very robust and fast volume mesh generation has been proved, getting non-watertight geometries as the definition of the domain and reaching a final mesh with almost no geometry cleaning operation needed.

A Ray Casting based technique is used to determine whether the nodes of the mesh are inside or outside the domain, and their distance to the boundaries. The combination of this strategy with the octree based mesher leads to an extremely robust and fast mesh generation for embedded solutions, even if the definition of the domain is not well defined from a topological point of view.

A shared memory parallel implementation of the algorithm has been done.

An example of a Computational Fluid Dynamics (CFD) simulation of the city of Barcelona is presented, where a mesh of more than one thousand million tetrahedral has been generated. This geometrical model uses a non-watertight Digital Model of the Terrain (DTM) and an unconnected definition of the buildings for the definition of the domain.

References