THREE DIMENSIONAL HYBRID MESH GENERATION USING A COMBINED CARTESIAN AND TETRAHEDRAL MESH GENERATOR

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In many numerical analyses, a hexahedral mesh is preferable to a tetrahedral mesh because of better computational performance and higher numerical accuracy. However, most practical tools constructing hexahedral meshes rely on mapping techniques that demand extensive user interactions in practical applications. Conversely, many highly automated tetrahedral mesh generators based on Delaunay triangulation or octree techniques are commercially available. In this study, a Cartesian mesh generation technique has been investigated to generate hybrid meshes for complicated geometries.

The hybrid mesh consists of hexahedral, tetrahedral and pyramid elements in this study. The hexahedral elements, so called the hex-core, are created using the octree technique in the interior region of the volume. An unstructured meshing technique is employed to wrap the hex-core with pyramid elements and tetrahedral elements such that a boundary fitted mesh can be obtained. An edge-based data structures is employed to implement the refinement procedure of the Cartesian mesh. Algorithms such as the IN/OUT test have been designed to take advantage of the proposed data structure to achieve higher memory and time performance. The size functions in the Gambit [1] software are have been exploited to control local element sizes.

Meshes generated by the developed mesh generator reduces total number of elements when compared with a full tetrahedral mesh. As a consequence, computational time can be significantly reduced in numerical computations such as the finite volume techniques employed by the Fluent software [2].

References

[1] Gambit 2.0 User's Manual, Fluent Inc., 2002
[2] URL: www.fluent.com, 2003