

GAP-TOLERANT MESHING IN ICONHEXMESH

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Robust and automatic mesh generation still represents a significant challenge in the overall process from CAD to CFD solution in industrial engineering analyses. A major bottleneck in the mesh generation process is the creation of a water-tight representation of the geometry from the original CAD model. Often, problems such as missing or duplicate parts, small gaps and overlaps, sometimes caused by the translation of the geometry from the native CAD into other formats, require labour-intensive and time-consuming geometry repair in order to provide a water-tight model suitable for meshing.

Refined octree or Cartesian-based mesh generation approaches[1], such as the snappyHexMesh mesh generator in OpenFOAM[®], which start with a volume mesh in the interior of the domain and then snap nodes to the geometry, provide a certain inherent tolerance to poor quality or “dirty” geometry. However, such meshing approaches cannot handle gaps in the geometry larger than the local element size.

Another technique used to handle poor quality geometry is to wrap the geometry prior to meshing. The shrink wrapping technique commonly uses a refined Cartesian background grid [3] to generate a water-tight representation of the geometry. The wrapped geometry, however, whilst guaranteed to be watertight, will be of lower fidelity, since it is only an approximation of the original geometry.

This paper describes an integrated approach to wrapping and mesh generation implemented in iconCFD[®] [4], which is able to handle large gaps in model assemblies without significant loss of geometric fidelity. The approach uses an adaptively-refined Cartesian grid to both perform the wrapping of the geometry and simultaneously generate a boundary conforming, hexahedral-dominant mesh of the flow domain. Techniques such as proximity and curvature-based refinement allow automated resolution of key geometric features, whilst quality-preserving snapping and boundary layer generation procedures ensure convergence of the subsequent flow-field analysis. The use of a variable wrapping level enables flexible wrapping of different size holes in the model, as illustrated in Figure 1.

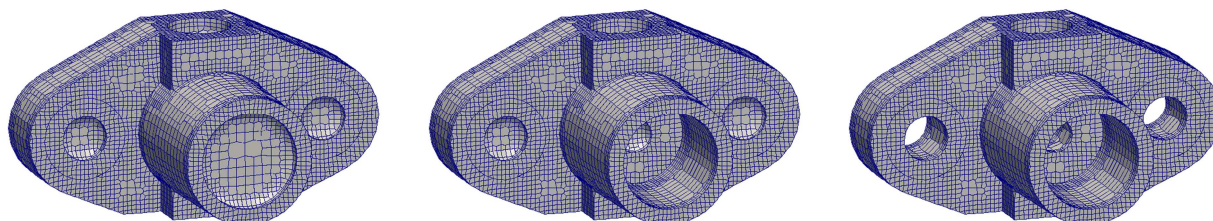


Figure Error! No sequence specified.: Surface wrap of flange geometry at different wrap levels

The combined wrapping and mesh generation technique will be applied to a number of complex automotive models to demonstrate the ability of the approach to handle industrial geometries used in external aerodynamic and under-hood thermal management simulations. Meshes of between 60M to 150M cells are generated for fully detailed vehicle models in less than 2 hours.

References

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