GAP-TOLERANT MESHING IN ICONHEXMESH

DAVID MARTINEAU[1], JEREMY GOULD[1], JACQUES PAPPER[2]
[1]*ICON Technology & Process Consulting Ltd., UK*
[2]*ICON Technology & Process Consulting SAS, France*
{*d.martineau,j.gould,j.papper*}*@iconcfd.com*

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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 [2] 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® [3], 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.

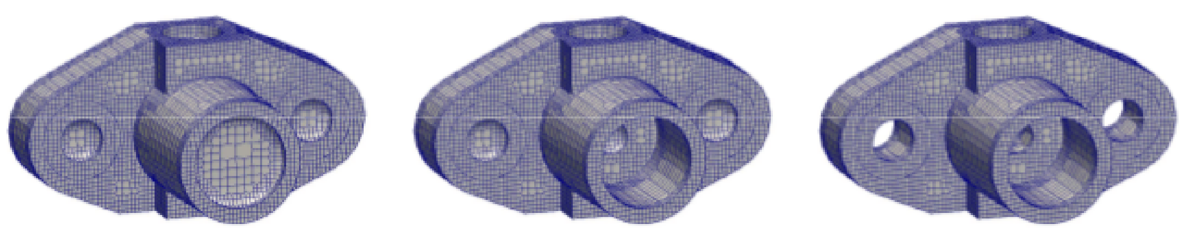

Figure 1: Surface wrap of flange geometry at different wrap levels

References

[1] L. Maréchal, *Proceedings of the 18th International Meshing Roundtable*. Berlin, Heidelberg: Springer Berlin Heidelberg, 2009, ch. Advances in Octree-Based All-Hexahedral Mesh Generation: Handling Sharp Features, pp. 65–84. [Online]. Available: http://dx.doi.org/10.1007/978-3-642-04319-2_5

[2] K. Y. Lee, C. K. Lim, H. Ghazialam, H. Vardhan, and E. Eklund, *Proceedings of the 15th International Meshing Roundtable*. Berlin, Heidelberg: Springer Berlin Heidelberg, 2006, ch. Surface Mesh Generation for Dirty Geometries by Shrink Wrapping using Cartesian Grid Approach, pp. 393–410. [Online]. Available: http://dx.doi.org/10.1007/978-3-540-34958-7_23

[3] D. Martineau, J. Gould, and J. Papper, *Towards an Efficient Distributed Geometry for Parallel Mesh Generation*, ser. Release note. Proceedings of the 22nd International Meshing Roundtable, 2013.