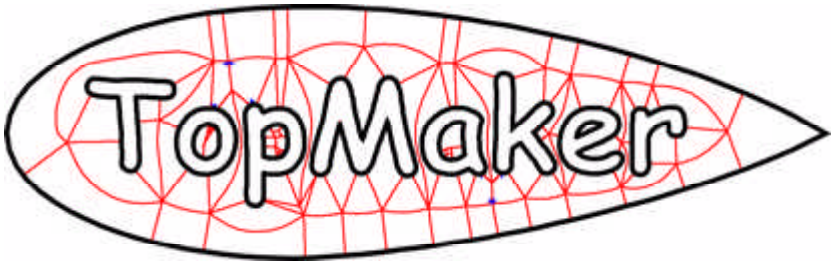
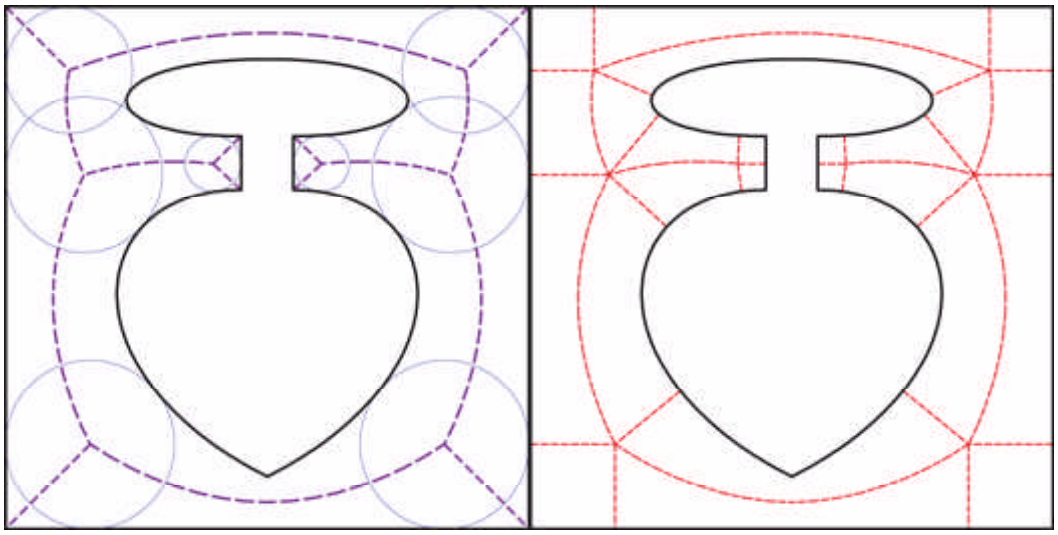
TopMaker: Technique Developed for Automatic Multiblock Topology Generation Using the Medial Axis



Automatically generated blocking topology between the word TopMaker and an airfoil shape.

The TopMaker technique was developed in an effort to reduce the time required for grid generation in complex numerical studies. Topology generation accounts for much of the man-hours required for structured multiblock grids. With regard to structured multiblock grids, topology refers to how the blocks are arranged and connected.

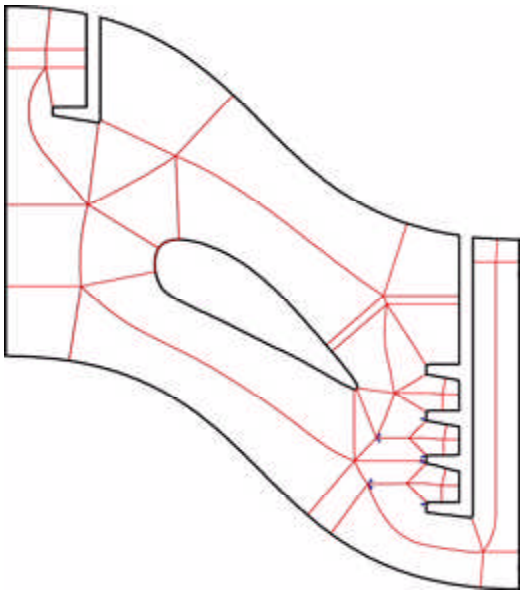
A two-dimensional multiblock topology generation technique has been developed at the NASA Glenn Research Center. Very general configurations can be addressed by the technique. A configuration is defined by a collection of non-intersecting closed curves, which will be referred to as loops. More than a single loop implies that holes exist in the domain, which poses no problem. This technique requires only the medial vertices and the touch points that define each vertex. From the information about the medial vertices, the connectivity between medial vertices is generated. The physical shape of the medial edge is not required. By applying a few simple rules to each medial edge, a multiblock topology can be generated without user intervention. The resulting topologies contain only the level of complexity dictated by the configurations. Grid lines remain attached to the boundary except at sharp concave turns, where a change in index family is introduced as would be desired. Keeping grid lines attached to the boundary is especially important in computational fluid dynamics, where highly clustered grids are used near no-slip boundaries. This technique is simple and robust and can easily be incorporated into the overall grid-generation process.



Left: The medial axis for the region between a square and a more complex toplike shape is shown by the dashed lines. Circles are drawn with centers at the medial vertices. Center: Automatically generated blocking topology for the region between the square and the toplike shape. Right: Automatically generated blocking topology for a turbine blade with probes in the flowfield.

In the left figure, the dashed lines show the medial axis for the configuration defined by the black lines. The gray circles show the defining circle for each medial vertex. Notice that each circle touches the black lines at three locations. In two dimensions, the medial axis is found easily by using available software. In the right figure, outlines of the resulting blocks are shown as dashed lines.

The following figure shows an example of a more complicated configuration. This configuration is a schematic meant to evoke the idea of a turbine blade with measuring probes inserted. The "probes" are artificially large for clarity in showing the block structure. Work is continuing in an effort to extend this technique to three-dimensional configurations.



Automatically generated blocking topology for a turbine blade with probes in the flowfield.

Bibliography

Rigby, David: TopMaker: A Technique for Automatic Multiblock Topology Generation Using the Medial Axis. Proceedings of FEDSM'03 4th ASME-JSME Joint Fluids Engineering Conference, FEDSM2003-45527, 2003.

Find out more about this research at
http://www.grc.nasa.gov/WWW/TURBINE/Turbine.htm

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