FocusOn

Showing Helpful and Unique Features in Gridgen®

Winter 2007

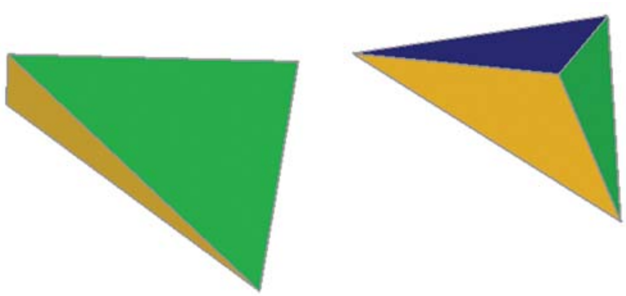
Viscous Unstructured Meshes

In Gridgen V15.10, we introduced a major new meshing feature making boundary layer meshing faster and easier: anisotropic tetrahedral and triangular meshing. Anisotropic means the cells are stretched more in one direction than the other. In the boundary layer, this means you can have very small spacing perpendicular to boundaries while using large spacing in the transverse directions. This gives you the resolution you need for accurate force and heat transfer predictions without using too many grid points.

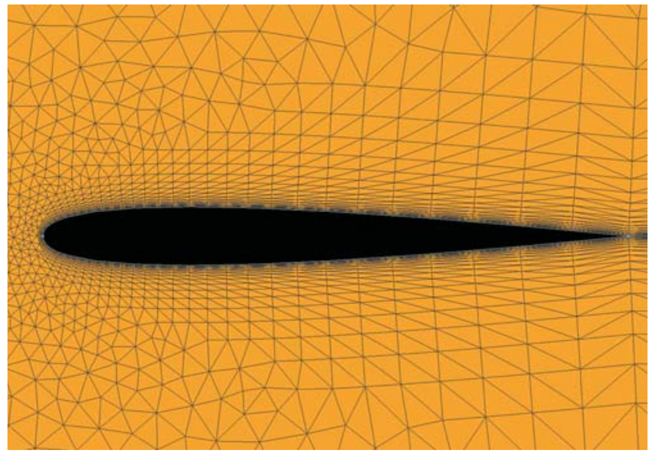
There are other benefits to Gridgen's anisotropic unstructured grids we will discuss below.

Quality control with more flexibility

Extruding tetrahedra or triangles gives you greater control over grid quality and more topological flexibility than other extrusion methods. This means more accurate CFD solutions, better solver convergence, and less grid generation time. Most CFD solvers work better when the maximum included cell angles in the grid are small. Their accuracy and convergence rates decrease when the maximum included angles get large. The anisotropic extrusion methods in Gridgen build right angle triangles and tetrahedra, as shown below on the left, thus minimizing the maximum included angle and increasing CFD solver accuracy and convergence rate.



Solver accuracy and convergence are improved with smaller included angles in tetrahedra like the one shown on the left versus the squashed tet on the right.



Stretched triangles with included right angles improve solution accuracy and solver convergence.

Since triangles and tetrahedra have more topological flexibility than prisms and hexahedra, Gridgen's anisotropic tetrahedral extrusion can locally stop extrusion when quality criteria are met or when collisions are detected.

The above figure shows different extrusion heights around the airfoil as the cells stop extruding locally when they reach an aspect ratio of one. For instance, the extruded layer height around the leading edge of the airfoil is smaller than it is farther aft. Smaller cell spacing at the leading edge causes the extruded cells there to reach an aspect ratio of one and stop extruding sooner than the cells near where the surface spacing is larger.

The figure on the next page shows extrusion off two adjacent surfaces, in this case an airfoil and trailing edge flap that are separated by a small distance. The extrusion stops locally when adjacent extrusion layers begin to interfere. In this way, as much boundary layer grid as possible will be extruded in each area. If the specified layer heights would cause adjacent layers to interfere, Gridgen automatically stops extruding and uses isotropic meshing techniques to fill the remaining void.

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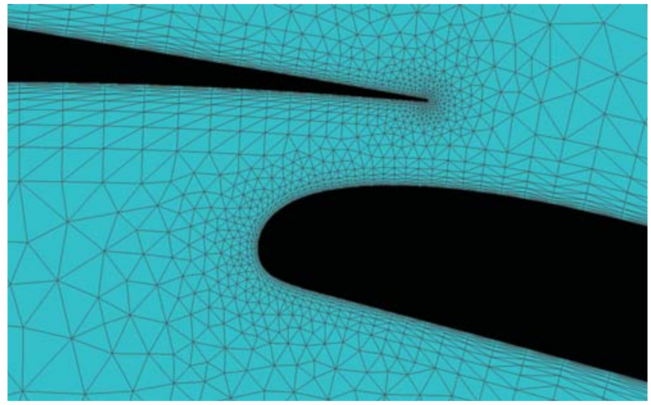
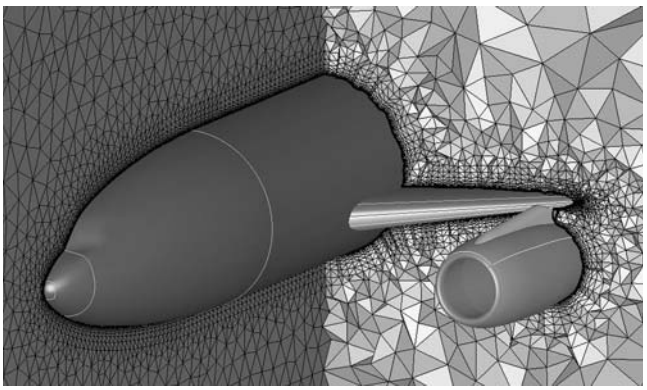
The examples so far have been 2D just to make it easier to see how anisotropic meshing works. The same techniques work in 3D as seen in the slice through a tetrahedral mesh around an aircraft in the figure below. Anisotropic tetrahedra have been extruded from the fuselage, wing, pylon and nacelle to resolve boundary layers. The tetrahedral can optionally be combined into prisms to reduce cell count.

Want to know more technical details about Gridgen's anisotropic triangular and tetrahedral meshing? Then see **AIAA Paper AIAA-2007-0554, Anisotropic Tetrahedral Meshing Based on Surface Deformation Techniques**. If you want to try it yourself, look for the anisotropic meshing parameters in Gridgen's unstructured domain and block solvers.



Layer extrusion automatically stops if it would interfere with adjacent grids.



Anisotropic tetrahedra resolve boundary layers while still giving geometric flexibility.

If you are not already a Gridgen user, visit **www.pointwise.com/focus** to get a free evaluation copy to try for yourself.

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