Glossary

The terms defined in this glossary are those used in the text.

Aspect Ratio The aspect ratio of a face or cell is the ratio of the longest edge length to the shortest edge length. The aspect ratio applies to triangular, tetrahedral, quadrilateral, and hexahedral elements and is defined differently for each element type.

Axial-Wall Shear Stress The axial component of force acting tangential to the surface due to friction.

Barycentric Barycentric coordinates are the set of weighting factors, $w(i)$, that represent a location in space relative to a fixed set of points, $p(i)$. The location is given by the sum of $w(i) \times p(i)$ for all i, where $0 \leq w(i) \leq 1$ and the sum of all $w(i)$ is 1.

Boundary Cell A cell that contains one or more boundary faces.

Cell An n-simplex in n dimensions. It has $n+1$ nodes and faces. In 2D a cell is a triangle, and in 3D a cell is a tetrahedron.

CFD Computational Fluid Dynamics

Convergence The property of a numerical method to produce a solution which approaches the exact solution as the grid spacing control volume size or element size is reduced to zero.

Circumcenter The point equidistant from each of the $n+1$ forming nodes of a cell or face.

Circumcircle A circle/sphere that passes through the n+1 forming nodes of a cell.

Circumradius The radius of a circumcircle/circumsphere.

Clustering The requirement for clustering is that the mesh be fine enough to resolve the primary features of the flow being analyzed. You can control the resolution with the boundary mesh that you start from and also with the parameters that control the generation of the interior mesh.

Dead Cell A cell that is not intended for use in the flow solver. Dead cells are a by-product of the meshing algorithm, which does not know which cells are inside the domain of interest and which are outside (or inside an internal region).

Edge Swapping Face swapping on a surface mesh. Edge swapping is performed on a 3D boundary mesh to reduce problems in generating the initial mesh.

Edge The 1-simplex (a line segment) defining the bounds of a 3D face.

Element Same as simplex. General name for a node, face, or cell.

Face An $(n-1)$-simplex in dimension n. It defines the boundary of an n-simplex (cell). A face has exactly two sides termed left and right. (In 2D a face is a line segment, and in 3D a face is a triangle.)

Face Swapping Switches to the alternate triangulation of $n+2$ nodes in dimension n, based on some parameter such as skewness. There are at most two such triangulations.

Filters Are translators for import of surface and volume meshes from CAD/CAE packages such as ANSYS, I-deas, NASTRAN, PATRAN, and others.

Free Edge An edge used by only one boundary face. A mesh containing free edges is non-manifold.

Free Face A face containing a free edge.

Free Node In 3D, a node that is on a free edge. In 2D, a node used by only one boundary face. A mesh containing free nodes is non-manifold.

GAMBIT The preprocessor for geometry modeling and mesh generation.

Initial Mesh The mesh of all the boundary nodes in which all of the boundary faces are present.

Interior Face A face that is not part of the boundary. A face that is inside the domain.

Interior Node A node that is not on a boundary. A node that is inside the domain.

Isolated Node A node that is not used by any boundary faces.

Live Cell A cell in which solution equations are to be solved. Live cells can represent either fluid or solid material.

Mach Number Mach Number is defined as the ratio of velocity of a fluid to the local velocity of sound in the medium.

Manifold A manifold boundary mesh is a mesh in which each edge is shared by two and only two boundary faces.

Multiply-Connected A condition on the boundary where more than two faces share a common edge. A boundary mesh containing multiply-connected edges is non-manifold.

Node A zero-dimensional entity defined by a coordinate location. Also, a 0-simplex or vertex.

Node Radius For boundary nodes, the average distance to neighboring boundary nodes. For interior nodes, the distance weighted average of the surrounding nodes.

Periodic A periodic boundary can be used to reduce a geometry with a repeating component to its smallest non-repeating section. The periodicity can be either rotational about an axis through the origin or translational. Every periodic boundary actually consists of two boundaries, the primary boundary and its shadow.

Periodic Shadow The matching periodic boundary zone of the primary periodic zone. Each periodic zone must have a unique shadow. (See Periodic.)

Refinement A process of introducing additional nodes into the mesh in an effort to improve the mesh quality.

Region A contiguous group of cells enclosed by boundary faces.

Scheme A statically scoped and properly tail-recursive dialect of the Lisp programming language invented by Steele and Sussman.

Shrink Factor It specifies the amount by which you can shrink faces and cells. It is often difficult to select a face or cell without selecting its neighbor instead. Increasing the shrink factor enlarges the space between adjacent faces or cells enabling you to choose the desired entity more easily.

Simplex An n-simplex is the convex hull of $n + 1$ points. A 0-simplex is a node, a 1-simplex (line segment) is a face in 2D and an edge in 3D, a 2-simplex (triangle) is a cell in 2D and a face in 3D, and a 3-simplex (tetrahedron) is a cell in 3D.

Size Length, area, or volume depending on the dimensionality of the object.

Skewness The normalized measure of how far a cell or face is from its ideal form (similar to aspect ratio). A skewness of zero is equilateral/equiangular and a skewness of 1 is degenerate.

Sliver A boundary sliver is a flat boundary cell containing two boundary faces. It is a tetrahedron in which the 4 forming nodes are nearly coplanar and also nearly lie on a circle. The circumcenter of a sliver is also found to be nearly coplanar with the forming nodes.

Smoothness In a high-quality mesh, the change in size from one face or cell to the next should be gradual (smooth). Large differences in size between adjacent faces or cells will result in a poor computational grid because the differential equations being solved assume that the cells shrink or grow smoothly.

Squish Squish is a measure used to quantify the non-orthogonality of a cell with respect to its faces. Squish is defined as $1 - (\mathbf{A} \cdot \mathbf{r}_c)/|\mathbf{r}_c|$, where $\mathbf{A}$ is the face unit area vector and $\mathbf{r}_c$ is the vector connecting the adjacent cell centroids (for face squish) or connecting the cell centroid and the cell face centroid (for cell squish).

TGrid A highly efficient, easy-to-use, unstructured grid generation program that can handle grids of virtually unlimited size and complexity, consisting of triangular, tetrahedral, hexahedral, prismatic, or pyramidal cells.
It is an additional preprocessor that can generate volume meshes from existing boundary meshes. You can use TGrid to generate a triangular, tetrahedral, hexcore, or hybrid volume mesh from an existing boundary mesh (created by GAMBIT or a third-party CAD/CAE package).

Thread An ordered group of boundary faces that have the same boundary conditions and are treated as a unit.

Note: *The term "thread" has been replaced by "zone".*

Triangulation Any division of 2-space into triangles. This term is also commonly used to refer to an n-dimension simplical division of n-space. The specific term in 3D is tetrahedralization.

Unused Nodes Nodes that are not used by any faces are called unused nodes. They can easily be found and deleted.

Voronoi Regions A map showing the locus of points (region) for each node that are closer to the node than any other node. Its dual is a Delaunay mesh.

Zone A list of nodes, faces, or cells that have some commonality. For instance, they may all be inlet faces or they may be contiguous cells not separated by a boundary.