Chapter 1. Introduction to TGrid

This chapter provides an introduction to TGrid, an explanation of its capabilities, and instructions for starting TGrid.

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1.1 Introduction

TGrid is 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.

Unstructured grid generation techniques couple basic geometric building blocks with extensive geometric data to highly automate the grid generation process. In addition, the generalized data structures used in these schemes permit the addition and removal of cells to maximize accuracy and minimize memory and CPU requirements.

For input TGrid requires a discretized boundary mesh consisting of either nodes and edges in 2D, or nodes and triangular/quadrilateral faces in 3D. TGrid contains a number of tools for checking and repairing the boundary mesh to ensure a good starting point for the mesh. A complete mesh can be generated from the boundary mesh automatically or by exercising control of the process.

The user interface to TGrid is written in the Scheme language, which is a dialect of LISP. Most features are accessible through the graphical interface or the interactive menu interface. The advanced user can customize and enhance the interface by adding or changing the Scheme functions.

1.2   Program Structure

TGrid is part of the FLUENT package, which includes the following products:

- FLUENT, the solver.

- GAMBIT, the preprocessor for geometry modeling and mesh generation.

- TGrid, the additional preprocessor that can generate volume meshes from existing boundary meshes.

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

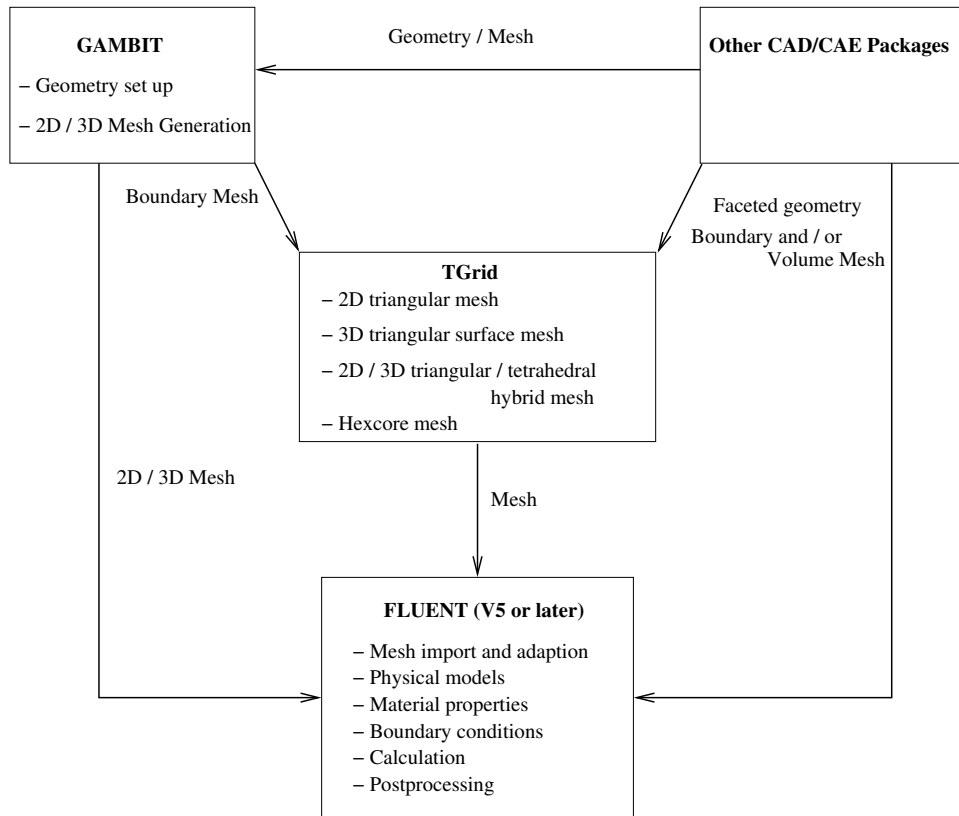Figure 1.2.1 shows how TGrid relates to these products.

Figure 1.2.1: Program Structure

You can use TGrid to generate a triangular, tetrahedral, hexcore, or hybrid volume mesh from an existing boundary mesh.

To create a mesh in TGrid, first use a preprocessor (GAMBIT or a third-party CAD package) to create a boundary mesh in which the boundaries are defined by line segments (2D) or triangular or quadrilateral facets (3D). To create tetrahedral, prismatic, or pyramidal cells, read the boundary mesh (and any hexahedral cells) into TGrid and continue the mesh generation process there.

The first step in producing an unstructured grid is to define the shape of the domain boundaries.

Surface grids created in CAD/CAE packages can be read into TGrid using the appropriate menu item in the File/Import pull-down submenu (or the associated text commands), or converted using the appropriate stand-alone grid filter.

When the grid generation is completed, you can read the 3D grid created by TGrid into the solver. After a grid is read into the solver, the remaining operations are performed there. These include setting boundary conditions, defining fluid properties, executing the solution, and viewing and postprocessing the results.

1.3   Program Capabilities

TGrid is a robust and a highly automated unstructured volume mesh generator with the following meshing capabilities:

- Generates triangles (tris) and quadrilaterals (quads) in 2D.

- Generates tets, hexcore, prisms, pyramids in 2D.

- Generates volume mesh that is accepted by FLUENT.

- Uses Delaunay triangulation method for tris/tets.

- Uses advancing layer method for prisms.

- Generates hexcore mesh.

- Has a robust boundary wrapper tool.

- Can export polyhedral cells.

- Has tools for checking, repairing, and improving boundary mesh to ensure a good starting point for the mesh.

- Is capable of manipulating face/cell zones.

- Is flexible—it allows the most appropriate cell type to be used to generate the volume mesh:

      – Tri/tet meshes are suitable for complex geometries.

      – Hexcore meshes can combine the flexibility of tet, hex, and prism meshes with smaller cell count.

- Hybrid meshes:

      – Prism layers near walls allow proper boundary layer resolution.

      – Allows flow alignments with grid lines.

      – Generates smaller volume mesh with highly stretched prismatic elements.

- Non-conformal meshes:

      – Suitable for parametric studies.

      – Meshes generated separately can be glued together.

1.4 **Accessing** TGrid **Manuals**

The on-line help gives you access to the TGrid User's Guide through HTML files. These files can be viewed with any web browser.

To see the User's Guide, select User's Guide Contents... in the Help pull-down menu in the TGrid GUI. This will open the User's Guide contents page.

You can access the required information by using the Table of Contents that displays a list of chapters, including all section and subsection titles. Each of these, is a link to the corresponding chapter or section or subsection of the manual. You can also use the Index to take you to the relevant section of the User's Guide. For details on using GUI help system, see Section 3.6: Using the GUI Help System.