



## Structured Grid Diagnostics



The Database, Connector, Domain, and Block menus in Gridgen include diagnostic tools to provide feedback on the attributes of those entities. These diagnostic tools are accessed using the **Examine** command. Use this command to determine the quality of your grid or to find problems prior to exporting it to your flow solver. This issue of the **Pointwise Pointer** will focus on using the **Examine** command for structured grids.

### Usage

Inside the **Examine** command, you will find the command for choosing a diagnostic function specific to the type of entity you are examining (**Function None**, shown at right), the command for changing the style in which diagnostic information is displayed (**Display Solid+Wire**), and tools for displaying a highlighter on the entity and reference surfaces for blocks.



Generally, you should select a diagnostic function first, then change display attributes if necessary, and finally turn on the highlighter to observe diagnostic data at a specific cell. In the case of blocks, you may turn on a complete reference surface. For structured blocks, most users look at computational coordinate surfaces. Once you examine a specific entity type, e.g. domains, Gridgen automatically recalls the last used diagnostic function when you next examine that entity type. The minimum and maximum values of that function are also retained, whether calculated by default or set to a specific value by you. Next, we will look at some of the more commonly used functions for structured grids.

### Connector Diagnostics

Only a few diagnostics are available for connectors, and these are used infrequently since the same information can be obtained at the domain level. However, because primary distribution control occurs at the connector level, one diagnostic can be useful prior



to domain creation. This is the size ratio measure (**Size Rat i** on the menu shown at left).

The size ratio diagnostic provides a quick and simple means to determine the actual growth rate of the grid point distribution you have applied. You can use this to make any necessary adjustments to connector dimension or spacing constraints in order to achieve your desired cell growth.

### Domain Diagnostics

There are many powerful diagnostic functions available at the domain level. A useful domain diagnostic is the **DB** command (shown in the menu at right). It is accompanied by two toggles, **on** and **off**, that instruct Gridgen to render the individual points by their database constraint status. Points *on* the database are rendered in green; points *off* are rendered in red. In addition, the blackboard lists the number of points in each category and percentages of the total.

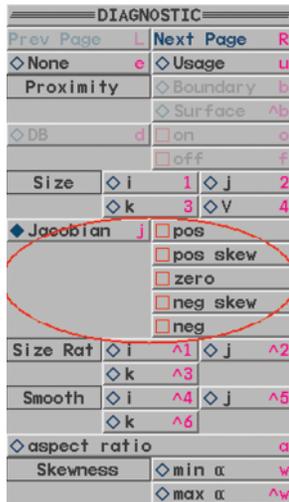


### Block Diagnostics

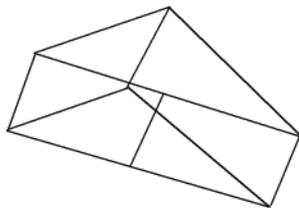
The mostly widely used diagnostic for structured blocks is the Jacobian. Gridgen calculates the Jacobian at each cell vertex and categorizes each cell based on the following table:

Postive	All Jacobians positive
Postive Skew	Jacobians mixed, and average is positive
Zero	Zero volume
Negative skew	Jacobians mixed, and average is negative
Negative	All Jacobians negative

Accompanying the **Jacobian** command are toggles for each of the above categories (see menu at right). These toggles instruct Gridgen to display the individual cells in each category. Be careful not to check every box in this list. Doing so will display every cell in the grid currently being examined. If every block of a multi-million cell grid is being examined, and the default display style remains in effect (Solid+Wire), a very heavy render operation will be under way. You normally only want to display skewed and negative cells.



Most solvers will not accept either negative or negative skew cells. However, some solvers will accept positive skew cells depending on how they are skewed. Positive skew cells are usually either highly sheared, in which case solvers will complain, or they are tent shaped (see image below) where two faces of the cell are nearly co-planar. These latter positive skew cells often are acceptable. They are found where two adjacent block faces are also nearly co-planar.

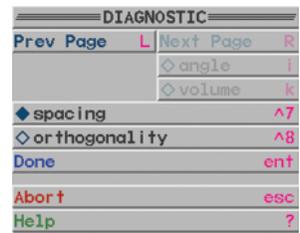


When you find bad cells, the first thing to correct is any connector grid point distribution or dimension that may be causing the problem. If that does not make things satisfactory, then look at domain improvement techniques like the elliptic solver. Finally, if fixing the domain grids still leaves you with problem cells, you can try running the block elliptic solver. You will probably find most grid problems will be solved before you have to run the block solver.

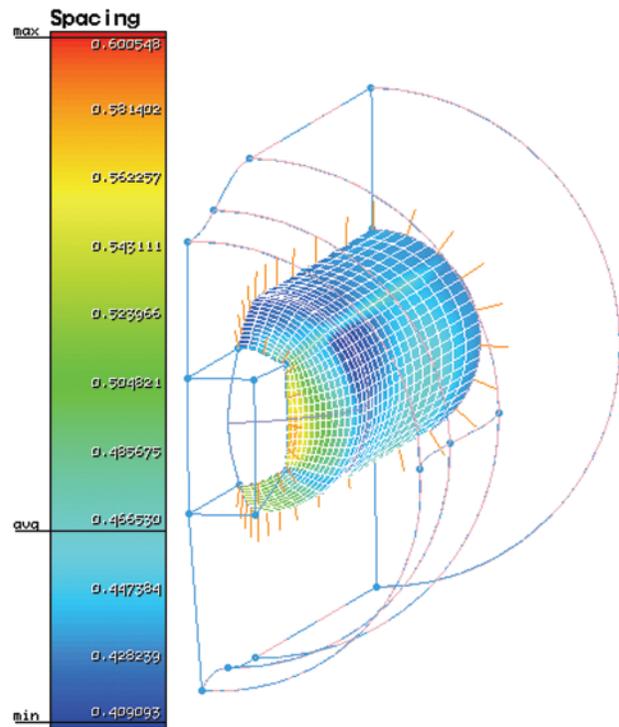
### Analysis Software Diagnostics

There are two useful diagnostics available only when using **Examine** in the ANALYSIS S/W COMMANDS menu. These diagnostics are **spacing** and **orthogonality** (see second page

of DIAGNOSTIC menu to the right). These diagnostics provide information only about the first cell layer adjacent to a block boundary. They will normally be used where viscous clustering is desired and, hence, cell height and orthogonality to the wall are very important.



Using the **spacing** diagnostic on the rear domain on the hub of the 747 tutorial, you can see below that the first layer of cell heights range from approximately 0.4 to 0.6. The surface for which this measure is calculated has been rendered according to the distribution of spacing values.



There are numerous diagnostic functions which have not been covered in this article. Please refer to the **Gridgen User Manual** for details on the other useful diagnostics and features found in the Examine command. In a future issue of the **Pointwise Pointer**, we will look at diagnostics commonly used for unstructured grids.