

The following sections explain how to examine the mesh. You can specify various parameters that control the display environment, display the mesh, view histograms of cell and face distribution, modify the mouse button functions, and manipulate the lighting and view in the graphics window.

- [Section 14.1: Displaying the Grid](#)
- [Section 14.2: Checking Face Distribution](#)
- [Section 14.3: Checking Cell Distribution](#)
- [Section 14.4: Modifying the Attributes of the Plot Axes](#)
- [Section 14.5: Controlling Display Options](#)
- [Section 14.6: Modifying the View](#)
- [Section 14.7: Adding Lights](#)
- [Section 14.8: Describing a Scene](#)
- [Section 14.9: Controlling the Mouse Buttons](#)
- [Section 14.10: Controlling the Mouse Probe Functions](#)
- [Section 14.11: Annotating the Display](#)
- [Section 14.12: Shortcuts for Selecting Zones](#)

14.1 Displaying the Grid

In TGrid you can manipulate the display of grid entities and modify the way in which they appear in the graphics window. TGrid allows you to draw selected boundary zones, unmeshed faces, free or multiply-connected faces, and unused nodes.

You can also control the display of items using intrinsic parameters such as skewness. When you specify a range for a particular parameter, TGrid will display entities that satisfy that condition. If more than one range limitation is specified, then only those entities that match all specified range limitations are drawn.

You can also specify information regarding color, display of solid (filled) faces, and shrinkage of faces and cells. These features can help you visualize your mesh effectively and quickly determine the cause of any problems in the mesh. You can perform these operations using the **Display Grid** panel and the associated set of panels or using the associated text commands.

The **Display Grid** panel consists of a series of “tabbed frames” within the main panel. Each tab has a set of related controls and the active tab is indicated by the labeled button which appears depressed.

The **Nodes**, **Faces**, and **Cells** tabs contain controls and zone lists specific to those entity types. The **Bounds** tab contains controls allowing you to limit the display to objects within specific coordinate ranges, or within a distance to a selected object. The **Attributes** tab contains controls allowing you to change how the objects are displayed, and add labels, circumcircles, and normal vectors.

14.1.1 Generating the Grid Display

The procedure for generating the grid display is as follows:

1. Select the entities to be displayed in the zone lists in the **Nodes**, **Faces**, or **Cells** tabs as appropriate. You can also select several entities of the same group by selecting the required group in the respective zone groups lists in the **Nodes**, **Faces**, or **Cells** tabs.
2. Select the display options as appropriate from the **Options** group box in the **Nodes**, **Faces**, or **Cells** tabs.
3. Set the range for limiting the display to a specific coordinate range or within a specific distance from a selected object, if required.
4. Set the display options as appropriate in the **Attributes** tab.
5. Click **Display** to draw the grid in the active graphics window.


14.1.2 Grid Display Options

The grid display options include modifying the grid colors, adding the outline of important features to a display, displaying normals, circumcircles, shrinking the faces and/or cells in the display, adding lights for filled grid displays, etc.

Modifying the Grid Colors

You can control the colors used to render the grid for each zone type or entity. You can modify the colors using the Grid Colors panel (see Section 14.1.5: [The Grid Colors Panel](#)).

1. Click the Colors... button in the Display Grid panel to open the Grid Colors panel.
By default, the Color by Type option is selected, allowing you to assign colors based on zone type.
2. To change the color assigned to a particular zone type, select the zone type in the Types list.
3. Select the required color in the Colors list.
4. If you prefer to assign colors based on the zone ID, select the Color by ID option.

 You can set colors individually for the grid displayed on each of the zones using the Scene Description panel (see Section 14.8.1: [The Scene Description Panel](#)).

Adding Features to an Outline Display

For closed 3D geometries, the standard outline display may not show sufficient details to accurately depict the shape. This is because for each boundary, only the edges on the outside of the geometry (i.e., those used by only one face on the boundary) are drawn. You can capture additional features using the Feature option in the Display Grid panel (see Section 14.1.3: [The Display Grid Panel](#)). Specify an appropriate value for the Feature Angle to obtain the outline display required.

Shrinking Faces and Cells in the Display

To distinguish individual faces or cells in the display, you may want to enlarge the space between adjacent faces or cells by increasing the Shrink Factor in the Display Grid panel (see Section 14.1.3: [The Display Grid Panel](#)). The default value of zero produces a display in which the adjacent faces or cells overlap. A value of 1 creates the opposite extreme, where each face or cell is represented by a point and there is a considerable space between entities. A small value such as 0.01 may be sufficient to allow you to distinguish a face or cell from its neighbor. Figure 14.1.1 shows displays with different Shrink Factor values.

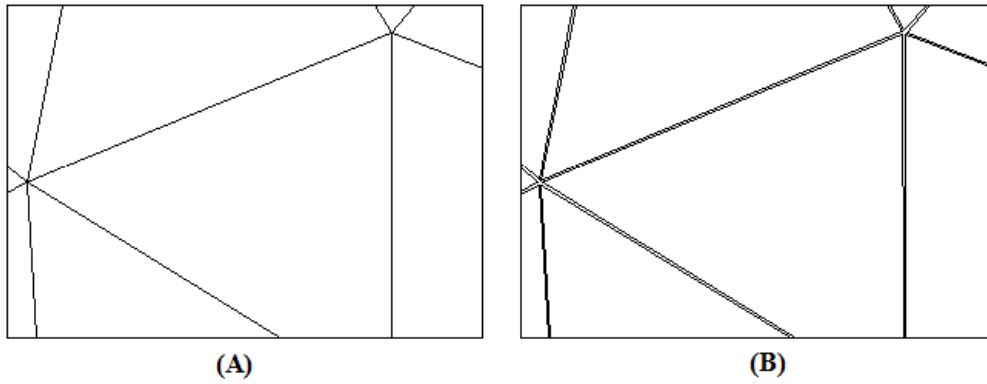


Figure 14.1.1: Grid Display (A) With Shrink Factor = 0 (B) With Shrink Factor = 0.01

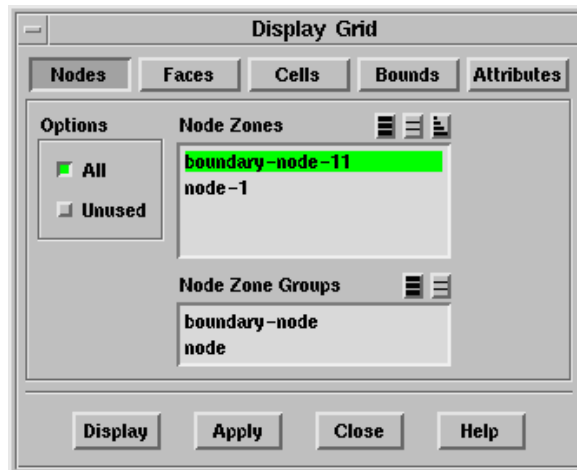
14.1.3 The Display Grid Panel

The Display Grid panel allows you to select the grid zones to be drawn. You can also display unmeshed, free, or multiply-connected faces, or unused nodes, and you can limit the display to objects within certain quality and/or size ranges. These controls may help you in determining the causes of boundary mesh problems.

Cells (including boundary cells), interior nodes, and interior faces will be displayed only if they are in the active cell zones. In addition, if you have used domains to generate the mesh or grouped zones for reporting (as described in Section 13.10: [Using Domains to Group and Mesh Boundary Faces](#)), only the cells, faces, etc. in the active domain can be displayed.

Display → Grid...

Controls



Nodes contains options for displaying nodes.

Options allows you to select one or more of the following options:

All draws all nodes in the node zones selected from the **Node Zones** list, colored by their zone type. Select one or more zones for any to be displayed.

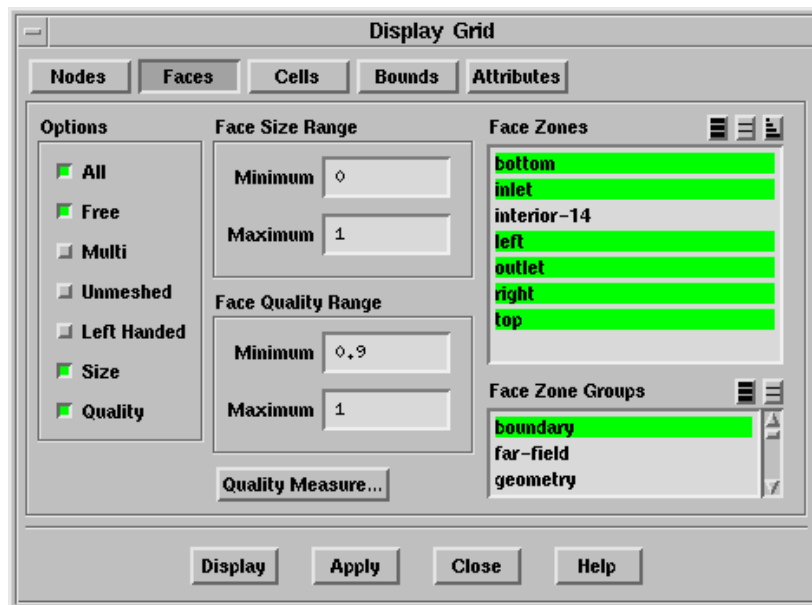
Unused draws nodes that are not currently used by any faces or cells. The unused nodes are usually displayed with a different color and marker symbol to distinguish them from nodes in use.

Node Zones contains a list of node zones from which you can select those to be drawn.

Node Zone Groups contains a list of node zone types. Selecting a zone type from this list (e.g., **boundary-node**), will select all node zones of that type (**boundary-node-1**, **boundary-node-2**, etc.) in the **Node Zones** list.

This shortcut allows you to select all zones of a certain type without having to select each zone individually.

Faces contains options for displaying faces.



Options allows you to select one or more of the following options:

All draws all faces in the selected face zones, colored by their zone type. Select one or more zones from the **Face Zones** list for any to be displayed.

Free draws free faces (faces with no neighboring face on at least one edge) on the selected zones.

Multi draws multiply-connected faces on the selected zones, along with their nodes.

- In 3D, a multiply-connected face is a boundary face that shares an edge with more than one other face, and a multiply-connected node is a node that is on a multiply-connected edge (i.e., an edge that is shared by more than two boundary faces).
- In 2D, a multiply-connected face is a boundary face that shares a node with more than one other face, and a multiply-connected node is a node that is shared by more than two boundary faces.

Multiply-connected faces or nodes are usually an indication that something is wrong with the surface mesh, and it needs to be regenerated. Such a surface mesh is often referred to as “non-manifold”. However, if you are creating a mesh with more than one fluid, solid, or porous zone, you can expect multiply-connected faces or nodes to occur at the edges of adjacent zones. This does not indicate any problem.

Unmeshed draws unmeshed faces on the selected zones, along with their nodes. Unmeshed nodes and faces are those that were not inserted into the initial mesh. If any unmeshed nodes or faces are displayed, you need to regenerate the initial mesh.

Left Handed draws left-handed faces on the selected zones. If the normal on a face (defined using the right-hand rule) does not point into the cell, the face is left-handed. Since the solver assumes a right-handed relationship between faces and cells, left-handed faces introduce errors into the solution. Left-handed faces may be created if there are problems with the generation of prismatic cells. See [Section 10.12: Negative Volumes/Left-Handed Faces/High Skewness](#) for details.

Size draws faces within the size range indicated by the **Face Size Range** limits.

Quality draws faces within the quality range indicated by the **Face Quality Range** limits. The default measure of quality is skewness, but you can use the **Quality Measure** panel (see [Section 15.5.2: The Quality Measure Panel](#)) to specify aspect ratio or change in size instead.

Face Size Range limits the faces displayed to those with a size within the specified range. To specify a face size range, enable **Size** in the **Options** group box, set the appropriate **Minimum** and **Maximum** values, and click **Display** or **Apply**.

Minimum sets the minimum value for the size range, in the physical dimensions of the mesh. This value should be less than the **Maximum** value.

Maximum sets the maximum value for the skewness range, in the physical dimensions of the mesh. This value should be greater than the **Minimum** value.

Face Quality Range limits the faces displayed to those with a quality measure value (skewness, by default) within the specified range. To specify a face

quality range, enable **Quality** in the **Options** group box, set the appropriate **Minimum** and **Maximum** values, and click **Display** or **Apply**. Use the **Report Face Limits** panel (see Section 15.2.1: [The Report Face Limits Panel](#)) to determine an appropriate range.

Minimum sets the minimum value for the quality range. This value should be greater than or equal to zero, and less than the **Maximum** value.

Maximum sets the maximum value for the quality range. This value should be greater than the **Minimum** value. If the quality measure being used is skewness, it should also be less than or equal to one.

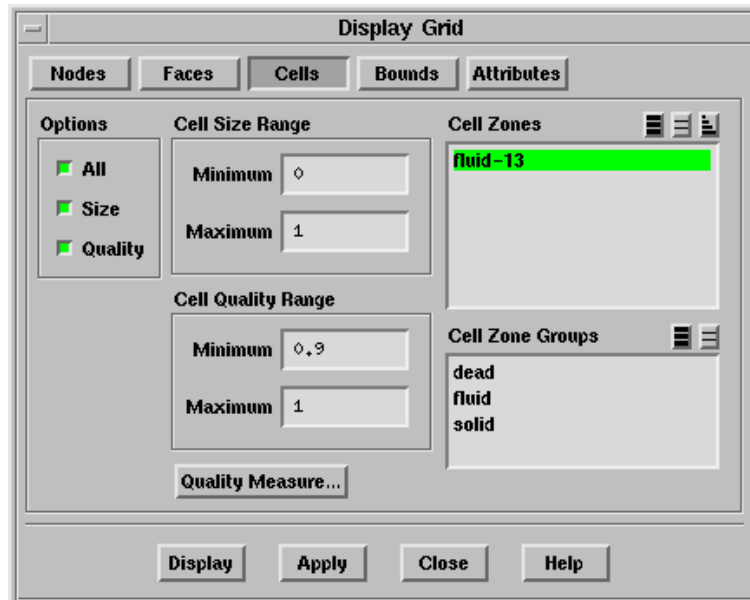
Quality Measure... opens the **Quality Measure** panel (see Section 15.5.2: [The Quality Measure Panel](#)), in which you can select the measure of quality to be used (skewness, aspect ratio, change in size, etc.).

Face Zones contains a list of face zones from which you can select those to be drawn.

Face Zone Groups contains a list of face zone types. Selecting a zone type from this list (e.g., **inlet**), will select all face zones of that type (**pressure-inlet-3**, **velocity-inlet-5**, etc.) in the **Face Zones** list. This shortcut allows you to easily select all zones of a certain type without having to select each zone individually.

You can also select multiple zone types in the **Zone Groups** list to select all zones of different types (e.g., **wall** and **symmetry**).

Cells contains options for displaying cells.



Options allows you to select one or more of the following options.

All draws all cells in the selected cell zones, colored by their zone type.

Select one or more zones from the **Cell Zones** list for any to be displayed.

Size draws cells within the size range indicated by the **Cell Size Range** limits.

Quality draws cells within the quality range indicated by the **Cell Quality Range** limits. The default measure of quality is skewness, but you can use the **Quality Measure** panel (see Section 15.5.2: [The Quality Measure Panel](#)) to specify aspect ratio or change in size instead.

Cell Size Range limits the cells displayed to those having a size within the specified range. To specify a cell size range, enable **Size** in the **Options** group box, set the appropriate **Minimum** and **Maximum** values, and click **Display** or **Apply**.

Minimum sets the minimum value for the size range, in the physical dimensions of the mesh. This value should be less than the **Maximum** value.

Maximum sets the maximum value for the skewness range, in the physical dimensions of the mesh. This value should be greater than the **Minimum** value.

Cell Quality Range limits the cells displayed to those with a quality measure value (skewness, by default) within the specified range. To specify the cell quality range, enable **Quality** in the **Options** group box, set the appropriate **Minimum** and **Maximum** values, and click **Display** or **Apply**. Use the **Report Cell Limits** panel (see Section 15.3.1: [The Report Cell Limits Panel](#)) to determine an appropriate range.

Minimum sets the minimum value for the quality range. This value should be greater than or equal to zero, and less than the **Maximum** value.

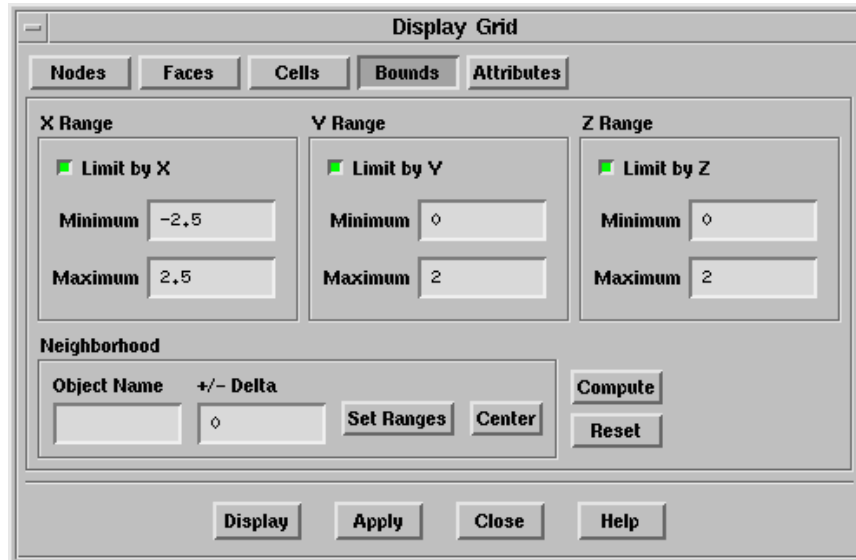
Maximum sets the maximum value for the quality range. This value should be greater than the **Minimum** value. If the quality measure being used is skewness, it should also be less than or equal to one.

Quality Measure... opens the **Quality Measure** panel (see Section 15.5.2: [The Quality Measure Panel](#)), in which you can select the measure of quality to be used (skewness, aspect ratio, change in size, etc.).

Cell Zones contains a list of cell zones from which you can select those to be drawn.

Cell Zone Groups contains a list of cell zone types. Selecting a zone type from this list (e.g., **solid**), will select all cell zones of that type (**solid-4**, **solid-5**, etc.) in the **Cell Zones** list. You can select multiple zone types in the **Zone Groups** list to select all zones of several different types (e.g., **fluid** and **solid**).

Bounds contains options allowing you to limit the items drawn in the display to those objects inside specified bounds or passing through them.



X Range allows you to limit the display of grid objects to the specified x coordinate range. To use the range, enable **Limit by X**, then enter the required Minimum and Maximum values, in the physical dimensions of the mesh.

Y Range allows you to limit the display of grid objects to the specified y coordinate range. To use the range, enable **Limit by Y**, then enter the required Minimum and Maximum values, in the physical dimensions of the mesh.

Z Range allows you to limit the display of grid objects to the specified z coordinate range. To use the range, enable **Limit by Z**, then enter the required Minimum and Maximum values, in the physical dimensions of the mesh.

Neighborhood allows you to set the range to be within a specified neighborhood of a specified grid object. Specify the **Object Name** and **+/- Delta**, and click **Set Ranges**.

Object Name specifies the name of the object on which the specified range is based. You can select objects with the mouse in the graphics window if the mouse probe function (see Section 14.10: [Controlling the Mouse Probe Functions](#)) is currently select and the filter is currently node, edge, face, cell, or zone.

+/- Delta specifies the neighborhood range about the specified object.

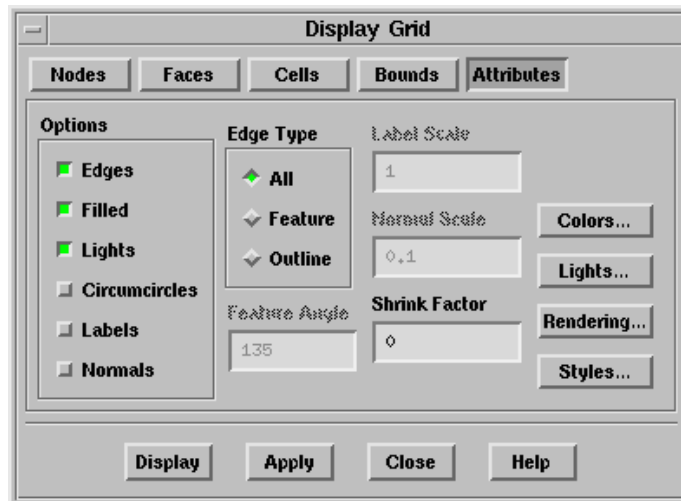
Set Ranges sets the X, Y, and Z Range to the values determined by the Neighborhood settings.

Center changes the display to place the selected object in the center of the view.

Compute sets the range to include the entire geometry.

Reset restores the controls to their default settings (i.e., no limits on x , y , or z range). The previously set maximum and minimum values for each range will remain visible, but they will be grayed out, indicating that they are not in effect.

Attributes contains options for customizing the display.



Options allows you to select one or more of the following options:

Edges enables display of face edges.

Filled enables faces and cells to be drawn with filled polygons. This is most useful when the **Lights** option is enabled.

Lights enables display lighting to make the display realistic. This is only useful if **Filled** is enabled.

Circumcircles allows you to display face circumcircles for triangular faces.

Labels allows you to display labels. You can control the size of the labels using an appropriate **Label Scale**.

Normals enables the display of face normals. You can control the size of the normal vectors using an appropriate **Normal Scale**.

Edge Type contains options controlling the display of edges. These options are available only when the **Edges** option is enabled. See Section 14.1.2: [Adding Features to an Outline Display](#) for details.

All enables the display of all grid edges.

Feature enables feature lines in an outline display.

Outline enables the display of the grid outline.

Feature Angle controls the amount of detail added to a feature outline display.

This item is available only when **Feature** is selected in the **Edge Type** list. See Section 14.1.2: [Adding Features to an Outline Display](#) for details.

Label Scale controls the size of the labels displayed.

Normal Scale controls the size of the face normals displayed.

Shrink Factor specifies the amount by which to shrink faces and cells.

Colors... opens the **Grid Colors** panel (see Section 14.1.5: [The Grid Colors Panel](#)), using which you can specify colors for different grid zones.

Lights... opens the **Lights** panel (see Section 14.7.1: [The Lights Panel](#)), using which you can control the lighting used in the display.

Rendering... opens the **Display Options** panel (see Section 14.5.1: [The Display Options Panel](#)), using which you can control various rendering options.

Styles... opens the **Style Attributes** panel (see Section 14.1.7: [The Style Attributes Panel](#)), where you can change how various types of grid objects are displayed.

Display updates the display according to the options selected in all frames in the **Display Grid** panel. All options are saved before the display is updated, as if you had clicked the **Apply** button.

Apply saves the options selected in all frames of the **Display Grid** panel, but does not update the display.

*The **Display** and **Apply** buttons (along the bottom of the panel) apply to all controls in all frames of the panel (i.e., for all tabs). For example, you can change some controls in the **Faces** tab, then click the **Bounds** tab and change some controls there, and then click **Display** to draw the grid with the new settings. Even though a tab's controls are not visible, its current settings affect the display.*

14.1.4 Text Commands for Displaying the Grid

The following text interface commands are similar in functionality to the controls in the **Display Grid** panel:

`display/all-grid` displays the grid according to the currently set parameters.

`display/boundary-cells` displays boundary cells attached to the specified face zones.

`display/boundary-grid` displays only boundary zones according to the currently set parameters.

`display/draw-cells-using-faces` draws cells that are neighbors for the selected faces.

`display/draw-cells-using-nodes` draws cells that are connected to the selected nodes.

`display/draw-face-zones-using-entities` displays the neighboring face zones of the selected entity.

`display/draw-zones` draws the boundary/cell zones using the zone ID as input.

`display/redisplay` redraws the grid in the graphics window.

`display/set-grid/all-cells?` toggles the display of all cells.

`display/set-grid/all-faces?` toggles the display of all faces.

`display/set-grid/all-nodes?` toggles the display of all nodes.

`display/set-grid/circumcircles?` toggles the display of face.

`display/set-grid/free?` toggles the drawing of faces/nodes that have no neighboring face on at least one edge.

`display/set-grid/left-handed?` toggles the display of left-handed faces.

`display/set-grid/multi?` toggles the display of those faces/nodes that have more than one neighboring face on an edge.

`display/set-grid/refine?` toggles the display of those faces that have been marked for refinement.

`display/set-grid/unmeshed?` toggles the display of nodes and faces that have not been meshed.

`display/set-grid/unused?` toggles the display of unused nodes.

`display/set-grid/marked?` toggles the display of marked nodes.

`display/set-grid/tagged?` toggles the display of tagged nodes.

`display/set-grid/cell-quality` sets the lower and upper limits of quality for cells to be displayed. Only cells with a quality measure value (e.g., skewness) within the specified range will be drawn.

`display/set-grid/face-quality` sets the lower and upper limits of quality for faces to be displayed. Only faces with a quality measure value (e.g., skewness) within the specified range will be drawn.

`display/set-grid/neighborhood` sets the x , y , and z range to be within a specified neighborhood of a specified grid object.

`display/set-grid/x(or y or z)-range` limits the display of grid objects to the specified range.

`display/set-grid/normals?` toggles the display of face normals.

`display/set-grid/normal-scale` sets the scale factor for face normals.

`display/set-grid/labels?` toggles the display of labels.

`display/set-grid/label-alignment` sets the alignment of labels that appear in the graphics window. By default, the label is centered on the node, cell, etc. to which the label refers. You can specify `*`, `^`, `v`, `<`, `>` for center, top, bottom, left, or right, respectively. You can also combine symbols—for example, `"*v"` for bottom center.

`display/set-grid/label-font` sets the label font. By default, all labels appear in “sans serif” font. Some other choices are Roman, typewriter, and stroked.

`display/set-grid/label-scale` scales the size of the label.

`display/set-grid/list` lists all the grid display settings.

`display/set-grid/default` resets the grid display parameters to their default values.

`display/center-view-on` sets the camera target to be the center (centroid) of an entity.

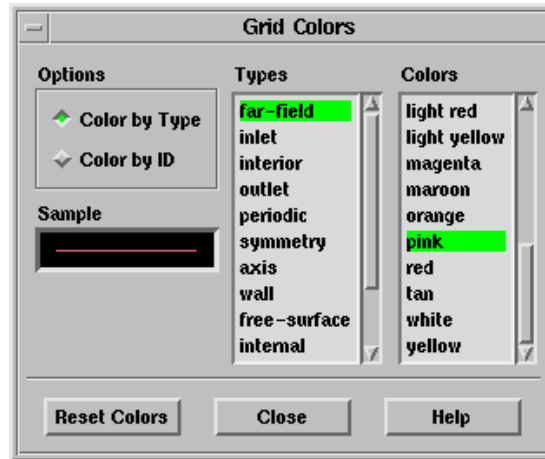
`display/set/edges?` turns the display of face/cell edges on and off.

`display/set/filled-grid?` turns the filled grid option on and off. When a grid is not filled, only its outline is drawn.

`display/set/shrink-factor` sets shrinkage of both faces and cells. A value of zero indicates no shrinkage, while a value of one would shrink the face or cell to a point.

14.1.5 The Grid Colors Panel

You can open the Grid Colors panel by clicking on the `Colors...` button in the `Attributes` tab frame of the `Display Grid` panel (see Section 14.1.3: [The Display Grid Panel](#)). It controls the color of the zones that are displayed using the `Display Grid` panel. You can color zones by their type, or by their ID number. You can see the effect of these changes the next time you display the grid.



Options contains options for setting the colors.

Color by Type allows you to set the color for each type of zone (outlet, wall, etc.).

Color by ID modifies the grid colors so that each zone (wall-1, wall-2, outlet-3, etc.) will be assigned one of the colors from the Colors list. If there are more zones than colors, some zones will be the same color.

Sample displays a sample of the currently selected color.

Types contains a selectable list of zone types. You can select the zone type for which you want to set the color. Note that you can set colors separately for each zone grid, using the Scene Description panel (see Section 14.8.1: [The Scene Description Panel](#)).

Colors contains a list from which you can select a color for the selected type.

Reset Colors clears any colors you have set in the Scene Description panel so that all colors will revert to their definition by type or by ID, as indicated under Options.

14.1.6 Text Commands for Grid Colors

The following text interface commands are similar in functionality to the controls in the Grid Colors panel:

`display/set/colors/color-by-type?` allows you to specify that the entities should be colored by their zone types. The individual zone type colors can be set using the various text-menu options:

- `grid-far`
- `grid-inlet`
- `grid-interior`

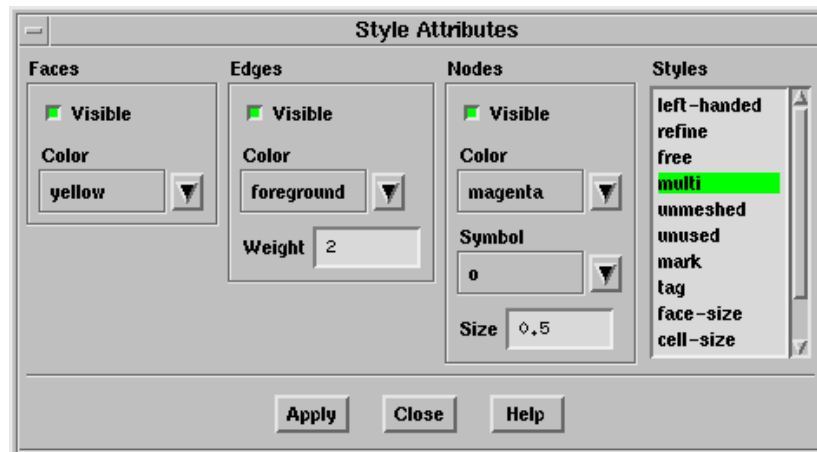
- grid-internal
- grid-outlet
- grid-periodic
- grid-symmetry
- grid-axis
- grid-free-surface
- grid-traction
- grid-wall
- surface

`display/set/colors/list` lists the colors available for the selected zone type.

`display/set/colors/reset-colors` resets the individual grid surface colors to the defaults.

14.1.7 The Style Attributes Panel

The Style Attributes panel is opened by clicking on the `Styles...` button in the Attributes tab frame of the Display Grid panel (see Section 14.1.3: [The Display Grid Panel](#)). It controls the appearance of faces, edges, and nodes that are displayed using the Display Grid panel. To modify the attributes of a certain type of face, edge, or node (e.g., unmeshed), select the appropriate item in the Styles list, change the parameters, and click `Apply`. You can see the effect of these changes the next time you display the grid.



Faces contains parameters that control the display of faces.

Visible indicates whether or not the selected type of face should be visible in the graphics display. If a face is visible, its interior will be filled. To see the outline of a face, you can make Edges visible.

Color specifies the color to be used for drawing the selected type of face. Choose the color you want from the drop-down list.

Edges contains parameters that control the display of edges.

Visible indicates whether or not the edges of the selected type of face should be visible in the graphics display.

Color specifies the color to be used for drawing the edges of the selected type of face. Choose the color you want from the drop-down list.

Weight specifies the thickness of edge lines, as a multiple of the default thickness.

Nodes contains parameters that control the display of nodes.

Visible indicates whether or not the selected type of node should be visible in the graphics display.

Color specifies the color to be used for drawing the selected type of node. Choose the color you want from the drop-down list.

Symbol specifies the symbol to be used for drawing the selected type of node.

Size specifies the size of the symbol.

Styles contains a list of all the different types of nodes and faces that can be displayed. The settings under **Faces**, **Edges**, and **Nodes** will apply to the node or face type selected in the **Styles** list. These types correspond to the options in the **Display Grid** panel (see Section 14.1.3: [The Display Grid Panel](#)). The default style attributes are listed in Table 14.1.1.

refine indicates boundary faces to be refined.

free indicates free nodes or faces.

left-handed indicates faces that do not follow the right-hand rule with respect to their cell neighbors.

multi indicates multiply-connected nodes or faces.

unmeshed indicates unmeshed nodes or faces.

unused indicates unused nodes or faces.

mark indicates marked objects (for expert users).

tag indicates tagged objects (for expert users).

face-size indicates faces within the specified face size range.

cell-size indicates cells within the specified cell size range.

face-quality indicates faces within the specified face quality range.

cell-quality indicates cells within the specified cell quality range.

Styles	Faces		Edges			Nodes			
	Visible	Color	Visible	Color	Weight	Visible	Color	Symbol	Size
left-handed	yes	red	yes	red	2	yes	red	o	0.5
refine	yes	magenta	yes	yellow	2	yes	magenta	o	0.5
free	yes	cyan	yes	foreground	2	yes	orange	o	0.5
multi	yes	yellow	yes	foreground	2	yes	magenta	o	0.5
unmeshed	no	—	yes	orange	2	yes	red	o	0.5
unused	no	—	yes	green	2	yes	green	x	0.5
mark	yes	magenta	yes	yellow	2	yes	magenta	o	0.5
tag	yes	magenta	yes	yellow	2	yes	magenta	o	0.5
face-size	yes	blue	yes	foreground	1	no	—	—	—
cell-size	no	—	yes	red	1	no	—	—	—
face-quality	yes	red	yes	foreground	1	no	—	—	—
cell-quality	no	—	yes	red	1	no	—	—	—

Table 14.1.1: Default Style Attributes

14.1.8 Text Commands for Style Attributes

The following text interface commands perform functions similar to those in the Style Attributes panel.

`display/set-grid/node-size` sets the node symbol scaling factor.

`display/set-grid/node-symbol` specifies the node symbol.

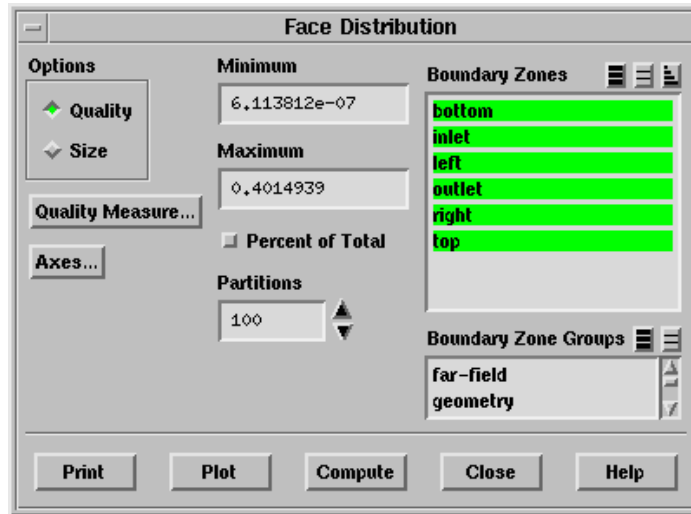
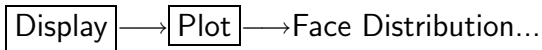
`display/set/styles/` contains commands for setting the display style for the different types of nodes and faces that can be displayed.

14.2 Checking Face Distribution

When checking the quality of the mesh you may find it useful to look at a histogram of boundary face quality. You can generate such a plot or report using the **Face Distribution** panel or the associated text commands. This feature is available only in 3D. When a histogram plot is displayed in the graphics window, you can use any of the mouse buttons to add text annotations to the plot. See Sections 14.9 and 14.11 for more information about using the mouse buttons and annotation features.

14.2.1 The Face Distribution Panel

The Face Distribution panel allows you to generate a histogram of boundary face size or quality.



The number of faces on the selected zones with a size or quality measure value (e.g., skewness) in the specified range in each of the regularly spaced partitions is displayed in a histogram format. The x axis shows the size or quality and the y axis gives the number of faces or the percentage of the total number of faces.

Note: *If you have used domains to generate the mesh or group zones for reporting (as described in Section 13.10: Using Domains to Group and Mesh Boundary Faces), you can report the face distribution only for those face zones that are in the active domain.*

Options specifies a histogram of face Quality or Size. The default measure of quality is skewness, but you can use the Quality Measure panel (see Section 15.5.2: The Quality Measure Panel) to specify aspect ratio or change in size instead.

Quality Measure... opens the Quality Measure panel (see Section 15.5.2: The Quality Measure Panel), in which you can select the measure of quality to be reported (skewness, aspect ratio, or change in size).

Axes... opens the Axes panel (see Section 14.4.1: The Axes - Histogram Panel), in which you can set parameter ranges, number formats, rules, etc.

Minimum specifies that only faces with a quality measure value (skewness, by default) greater than this value will be plotted.

Maximum specifies that only faces with a quality measure value (skewness, by default) less than this value will be plotted.

Percent of Total specifies that the number of faces as a percentage of the total number of faces counted will be plotted. By default, the actual number of faces is plotted.

Partitions specifies the number of partitions in the histogram. Increasing the number of partitions will improve the resolution of the plot (see Figures 14.2.1 and 14.2.2).

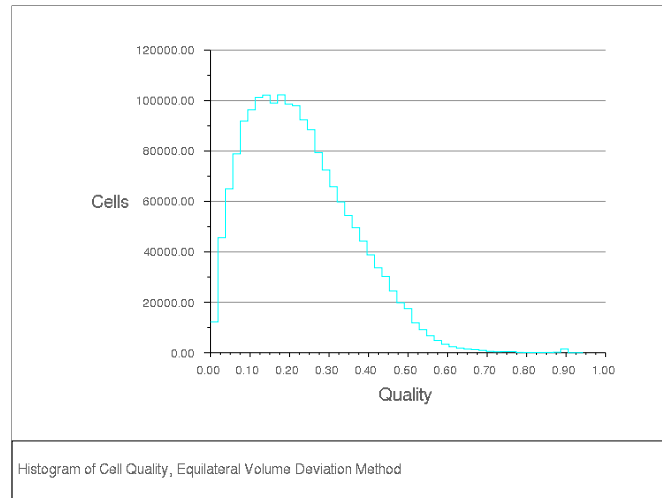


Figure 14.2.1: Histogram with 50 Partitions

Boundary Zones contains a list from which you can select one or more zones to be used to generate the histogram.

Boundary Zone Groups contains a list of boundary zone types. If you select a boundary type from this list (e.g., inlet), all boundary zones of that type (for this example, all **pressure-inlet** and **velocity-inlet** boundaries) will be selected in the **Boundary Zones** list. This shortcut allows you to easily select all boundary zones of a certain type without having to select each zone individually. Note that you can select multiple boundary types in the **Boundary Zone Groups** list to select all zones of several different types (e.g., inlet and outlet).

Print reports the distribution of face size or quality in the text window.

Plot plots a histogram of boundary face size or quality.

Compute determines the minimum and maximum face size or quality.

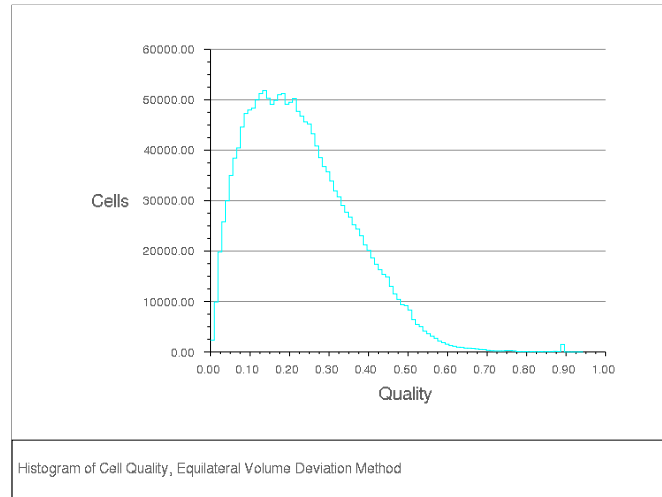


Figure 14.2.2: Histogram with 100 Partitions

14.2.2 Face Distribution Text Interface

Text commands with functionality similar to that of the controls in the Face Distribution panel are:

`/display/xy/face-distribution` plots a histogram of face quality.

`/boundary/face-distribution` reports the distribution of face quality in the text window.

`/display/xy/set/xy-percent-y?` toggles whether the y-coordinate should be scaled to show a percent of total values being plotted.

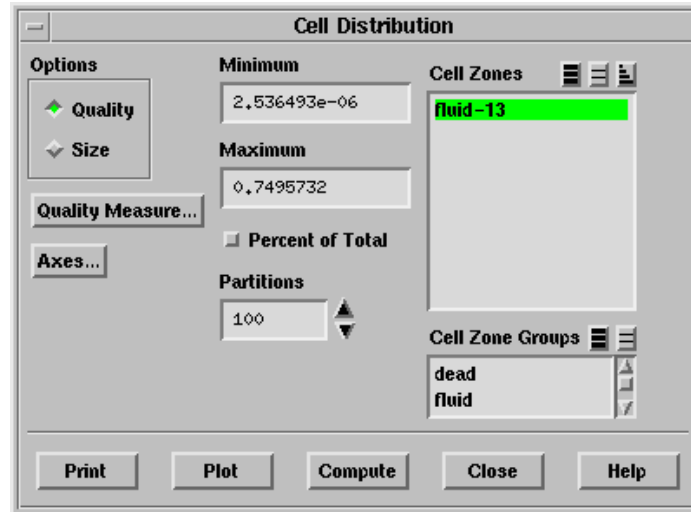
14.3 Checking Cell Distribution

You can check cell size or quality by using the controls in the Cell Distribution panel (or the associated text commands) to generate a histogram plot or report. When a histogram plot is displayed in the graphics window, you can use any of the mouse buttons to add text annotations to the plot. For more information about the annotation features, see Sections 14.9 and 14.11

14.3.1 The Cell Distribution Panel

The Cell Distribution panel allows you to generate a histogram of cell size or quality.

Display → Plot → Cell Distribution...



The number of cells in the specified range in each of the regularly spaced partitions is displayed in a histogram format. The x axis shows either the size or the quality and the y axis gives the number of cells or the percentage of the total.

Note: *If you have used domains to generate the mesh or group zones for reporting (as described in Section 13.10: Using Domains to Group and Mesh Boundary Faces), you can report the cell distribution only for those cell zones that are in the active domain.*

Controls

Options specifies a histogram of cell **Quality** or **Size**. The default measure of quality is skewness, but you can use the **Quality Measure** panel (see Section 15.5.2: The **Quality Measure Panel**) to specify aspect ratio or change in size instead.

Quality Measure... opens the **Quality Measure** panel (see Section 15.5.2: The **Quality Measure Panel**), in which you can select the measure of quality to be reported (skewness, aspect ratio, or change in size).

Axes... opens the **Axes** panel (see Section 14.4.1: The **Axes - Histogram Panel**), in which you can set parameter ranges, number formats, rules, etc.

Minimum specifies that only cells with size or quality measure value (skewness, by default) greater than this value will be plotted.

Maximum specifies that only cells with size or quality measure value (skewness, by default) less than this value will be plotted.

Percent of Total specifies that the number of cells as a percentage of the total number of cells counted will be plotted. By default, the actual number of cells is plotted.

Partitions specifies the number of partitions in the histogram. Increasing the number of partitions will improve the resolution of the plot (see Figures 14.2.1 and 14.2.2).

Cell Zones contains a list from which you can select one or more zones to be used to generate the histogram.

Cell Zone Groups contains a list of cell zone types. If you select a zone type from this list (e.g., fluid), all cell zones of that type will be selected in the **Cell Zones** list. This shortcut allows you to easily select all zones of a certain type without having to select each zone individually. You can select multiple types in the **Cell Zone Groups** list to select all zones of several different types (e.g., fluid and solid).

Print reports the distribution of cell quality or size in the text window.

Plot plots a histogram of cell distribution.

Compute determines the minimum and maximum cell size or quality.

14.3.2 Cell Distribution Text Interface

Text commands with functionality similar to that of the controls in the **Cell Distribution** panel are:

`display/xy/cell-distribution` plots a histogram of cell quality.

`report/cell-distribution` reports the distribution of cell quality in the text window.

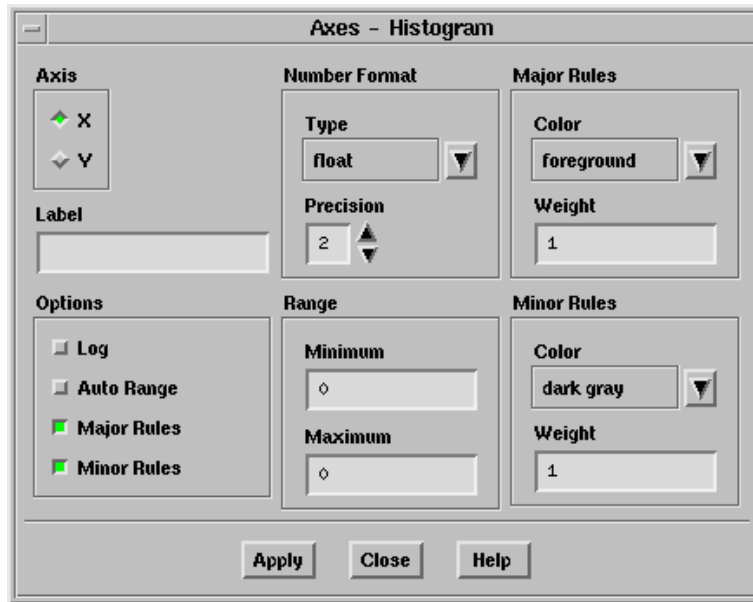
`display/xy/set/xy-percent-y?` toggles whether the y-coordinate should be scaled to show a percent of total values being plotted.

14.4 Modifying the Attributes of the Plot Axes

You can modify the appearance of the axes by changing the parameters that control the labels, scale, range, numbers, and tick marks. These operations are available in the **Axes** panel and in the associated text interface menu.

14.4.1 The Axes - Histogram Panel

The Axes panel allows you to independently control the characteristics of the ordinate and abscissa on an XY plot or histogram. You can change the labels, scale, range, number format, and major and minor rules visibility and appearance. The title following Axes in the panel indicates which plot environment you are changing. You can set different parameters for each type of plot that TGrid can generate.



Axis contains check buttons that allow you to set abscissa (x -axis) or ordinate (y -axis) characteristics.

X allows you to specify the abscissa characteristics.

Y allows you to specify the ordinate characteristics.

Label defines the character string that will label the active axis (the one selected in Axis) in the display.

Options contains check buttons for scale, range, major rules, and minor rules.

Log toggles logarithmic scaling of the active axis. By default, decimal scaling is used.

Auto Range toggles automatic computation of the range of the active axis. If you deactivate this option, you can enter the **Minimum** and **Maximum** values in the **Range** box.

Major Rules toggles the display of major rules on the active axis. Major rules are the horizontal or vertical lines that mark the primary data divisions and span the whole plot window to produce a “grid.”

Minor Rules toggles the display of minor rules on the active axis. Minor rules are the horizontal or vertical lines that mark the secondary data divisions and span the whole plot window to produce a “grid.”

Number Format contains commands for changing the format of the data labels on the active axis. Data labels are the character strings used to define the primary data divisions on the axes.

Type sets the form of the data labels. You may select from a drop-down list of options, including the following:

general displays the real value with either float or exponential form based on the size of the number and the defined **Precision**.

float displays the real value with an integral and fractional part (e.g., 1.0000), where the number of digits in the fractional part is determined by **Precision**.

exponential displays the real value with a mantissa and exponent (e.g., 1.0e-02), where the number of digits in the fractional part of the mantissa is determined by **Precision**.

Precision defines the number of fractional digits displayed in the data labels.

Range contains the range or extents of the active axis. To set the range manually, you must turn off **Auto Range**. Otherwise the extents are computed automatically.

Minimum sets the minimum data value for the active axis.

Maximum sets the maximum data value for the active axis.

Major Rules contains commands for modifying the appearance of the major rules. To use these commands you must activate **Major Rules** in the **Options** list.

Color sets the color of the major rules from a drop-down list with numerous color selections.

Weight sets the line thickness of the major rule. A line of weight 1.0 is normally 1 pixel wide. A weight of 2.0 would make the line twice as thick (i.e., 2 pixels wide).

Minor Rules contains commands for modifying the appearance of the minor rules. To use these commands you must activate **Minor Rules** in the **Options** list.

Color sets the color of the minor rules from a drop-down list with numerous color selections.

Weight sets the line thickness of the minor rule. A line of weight 1.0 is 1 pixel wide. A weight of 2.0 would make the line twice as thick (i.e., 2 pixels wide).

14.4.2 Text Interface for Modifying Axes Attributes

Text interface commands with functionality similar to that of the controls in the Axes panel are:

`display/xy/set/auto-scale?` sets the range for the x- and y-axis. If auto-scaling is not activated for a particular axis, you are prompted for the minimum and maximum data values.

`display/xy/set/background-color` sets the color of the field within the abscissa and ordinate axes.

`display/xy/set/key` sets the visibility and title of the description box that displays the markers and/or lines with their associated data. The key can be positioned and resized using the left mouse button.

`display/xy/set/labels` sets the strings that define the x- and y- axis labels.

`display/xy/set/lines` sets the pattern, weight, and color of the plot lines.

`display/xy/set/log?` toggles the log scaling on the x- and y-axis.

`display/xy/set/markers` sets parameters for the data markers.

`display/xy/set/numbers` sets the format and precision of the data numbers displayed on the x- and y-axis.

`display/xy/set/rules` sets the visibility, line weight and color of the major and minor rules in the x- and y-axis directions.

14.5 Controlling Display Options

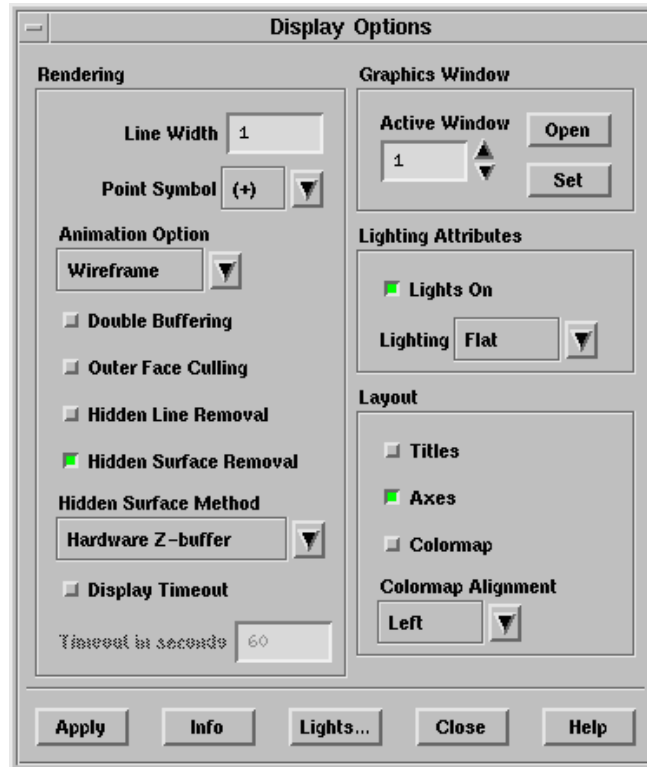
When examining graphics, you may want to change some of the attributes of the display window. For example, you can open a number of windows to look at several different displays simultaneously, control the lighting attributes in a scene, or modify rendering parameters.

These and other options are available in the Display Options panel or with the associated text commands.

14.5.1 The Display Options Panel

The Display Options panel provides an interactive mechanism for setting attributes or options that control how and where a scene is rendered.

Display → Options...



Controls

Rendering allows you to modify characteristics of the display that are related to the way in which scenes are rendered.

Line Width controls the thickness of lines. The default is 1.

Point Symbol sets the symbol used for nodes and data points.

Animation Options contains a list of the animation options available.

All uses a solid-tone shading representation of all geometry during mouse manipulation.

Wireframe uses a wireframe representation of all geometry during mouse manipulation. This option is selected by default. Select an alternative option only if your computer has a graphics accelerator; otherwise the mouse manipulation may be very slow.

Level of Detail uses a simplified representation of the geometry during mouse manipulation by drawing the geometry using fewer elements. You can use this option to enable fast rendering of large models.

Double Buffering allows you to enable/disable double buffering, if it is supported by the driver. Double buffering dramatically reduces screen flicker during graphics updates. If your display hardware does not support double buffering and you enable this option, double buffering will be done in software. Software double buffering uses extra memory.

Outer Face Culling allows you to disable/enable the display of outer faces in wall zones. Outer face culling is useful for displaying both sides of a slit wall. By default, when you display a slit wall, one side will “bleed” through to the other.

When you enable the **Outer Face Culling** option, the display of a slit wall will show each side distinctly as you rotate the display. This option can also be useful for displaying two-sided walls (i.e., walls with fluid or solid cells on both sides).

Hidden Line Removal allows you to enable/disable hidden line removal. If you do not use hidden line removal, TGrid will not try to determine which lines in the display are behind others. It will display all of them resulting a cluttered display.

Disable this option if you are working with a 2D problem or with geometries that do not overlap.

Hidden Surface Removal allows you to enable/disable hidden surface removal. If you do not use hidden surface removal, TGrid will not try to determine which surfaces in the display are behind others. It will display all of them resulting a cluttered display.

Disable this option if you are working with a 2D problem or with geometries that do not overlap.

Hidden Surface Method lists the methods available for hidden surface removal. These options vary in speed and quality, depending on the device you are using. The choices available are as follows:

Hardware Z-buffer is the fastest method if supported by your hardware. The accuracy and speed of this method is hardware dependent.

Painters will show fewer edge-aliasing effects than hardware-z-buffer. This method is often used instead of software-z-buffer when memory is limited.

Software Z-buffer is the fastest of the accurate software methods available (especially for complex scenes), but it is memory intensive.

Z-sort only is a fast software method, but it is not as accurate as software-z-buffer.

Display Timeout enables the setting of a timeout for displaying the geometry.

Timeout in seconds specifies the value for the timeout.



When TGrid fails to display the geometry within the time specified, an error message will be displayed in the TGrid console, indicating that the model could not be displayed within the specified time.

Graphics Window allows you to open and close graphics windows.

Active Window indicates the graphics window to be opened, closed, or set active.

Its title displays the graphics window ID.

Open/Close opens or closes the window with the ID shown in the **Active Window** box. If the indicated window is open, the **Close** button will appear. If the indicated window is not open, the **Open** button will appear.

Set sets the window with the ID shown in the **Active Window** box to be the active graphics window.

Lighting Attributes controls lighting attributes for all lights in the active graphics window.

Lights On allows you to enable/disable *all* lights in the active graphics window.

Lighting specifies the method to be used in lighting interpolation. **Flat**, **Gouraud**, or **Phong**. **Flat** is the most basic method. There is no interpolation within the individual polygonal facets. **Gouraud** and **Phong** have smoother gradations of color because they interpolate on each facet.

Layout controls the display of captions, axes, and the colormap in the graphics display window.

Titles enables/disables the display of captions in the graphics display window.

Axes enables/disables the display of the axis triad.

Colormap enables/disables the display of the colormap.

Colormap Alignment allows you to adjust the alignment of the colormap in the graphics window. Select the side (i.e., **Left**, **Top**, **Right**, **Bottom**) where you want to align the colormap from the drop-down list.

Apply applies the specified attributes and re-renders the scene in the active graphics window with the new attributes. To see the effect of the new attributes on other graphics windows, redisplay them.

Info prints out information about the graphics driver in the console.

Lights... opens the **Lights** panel (see Section 14.7.1: [The Lights Panel](#)), which allows you to create, delete, and modify directional light sources.

14.5.2 Text Commands for Controlling Display Options

Text commands with functionality similar to the controls in the Display Options panel are listed below:

`display/open-window` opens a graphics window.

`display/close-window` closes a graphics window.

`display/set-window` sets the specified window as the active graphics window.

`display/set/line-weight` sets the line width factor.

`display/set/reset-graphics` resets the graphics system.

`display/set/title` sets the problem title.

`display/set/rendering-options/` contains the commands that allow you to set options that determine how the scene is rendered.

`display/set/rendering-options/animation-option/` allows you to specify the animation option as appropriate.

- `all` uses a solid-tone shading representation of all geometry during mouse manipulation.

- `level-of-detail` uses a simplified representation of the geometry during mouse manipulation by drawing the geometry using fewer elements.

- `wireframe` uses a wireframe representation of all geometry during mouse manipulation. This is the default option.

`display/set/rendering-options/auto-spin?` enables mouse view rotations to continue to spin the display after the button is released.

`display/set/rendering-options/device-info` prints information about the graphics driver in the TGrid console.

`display/set/rendering-options/double-buffering?` allows you to enable/disable double buffering. Double buffering dramatically reduces screen flicker during graphics updates. If your display hardware does not support double buffering and you enable this option, double buffering will be done in software. Software double buffering uses extra memory.

`display/set/rendering-options/driver/` contains commands for changing the current graphics driver.

`/display/set/rendering-options/face-displacement` sets the face displacement (in Z-buffer units along the camera Z-axis) for the displayed geometry when both faces and edges are displayed simultaneously.

Quite often, faces and edges may be displayed at the same location causing bad edges known as edge-stitching. Parts of an edge become invisible due to overlapping portions of the face. Setting the face displacement can help alleviate the problem by pushing the faces back by a small amount so that the complete edge becomes visible. A value of 0 for the `face-displacement` does not displace the faces at all. If the value is set too high, it may cause the hidden edges to show up in front of the displayed faces. You can adjust the display by specifying an appropriate value for the face displacement. The default value of face displacement is set to 8 Z-buffer units.

`display/set/rendering-options/hidden-lines?` allows you to enable/disable hidden line removal.

`display/set/rendering-options/hidden-surfaces?` turns hidden surfaces removal on or off.

`display/set/rendering-options/hidden-surface-method/` allows you to choose from among the hidden surface removal methods that TGrid supports. These options (listed below) are display hardware dependent.

`hardware-z-buffer` is the fastest method if your hardware supports it. The accuracy and speed of this method is hardware dependent.

`painters` will show less edge-aliasing effects than `hardware-z-buffer`. This method is often used instead of `software-z-buffer` when memory is limited.

`software-z-buffer` is the fastest of the accurate software methods available (especially for complex scenes), but it is memory intensive.

`z-sort` is a fast software method, but it is not as accurate as `software-z-buffer`.

`list` lists the current hidden surface method.

`display/set/rendering-options/outer-face-cull?` turns the display of outer faces on and off.

`display/set/rendering-options/surface-edge-visibility` controls whether or not the mesh edges are drawn.

`display/set/rendering-options/wireframe-animation?` turns the use of wireframes during mouse manipulation on or off.

`display/set/windows/` contains commands that allow you to customize the relative positions of subwindows inside the active graphics window. The menu structure for the `axes`, `main`, `scale`, `text`, and `xy` submenus is similar. The * in the following descriptions stands for any one of these submenus.

`display/set/windows/*/` contains commands for changing the location of the subwindow (*).

`display/set/windows/*/border?` draws a border around the subwindow.

`display/set/windows/*/bottom` sets the bottom boundary of the subwindow.

`display/set/windows/*/left` sets the left boundary of the subwindow.

`display/set/windows/*/right` sets the right boundary of the subwindow.

`display/set/windows/*/top` sets the top boundary of the subwindow.

`display/set/windows/*/visible?` sets the visibility of the subwindow.

`display/set/windows/axes/clear?` sets the transparency of the axes window.

`display/set/windows/video/` contains options for modifying a video. This command is not relevant for TGrid.

Text interface commands that control the display and are not found in the GUI are as follows:

`display/clear` clears the active graphics window. This option is useful when you redo an overlay.

`display/set/re-render` re-renders the current window after modifying the variables in the `set` menu.

`display/set/colors/background` sets the background (window) color.

`display/set/colors/foreground` sets the foreground (text and window frame) color.

`display/set/colors/user-color` allows you to change the color for the specified zone.

`display/xy/file` allows you to choose a file from which to create an xy plot.

`display/xy/set/plot-to-file` allows you to write xy plot values to a file.

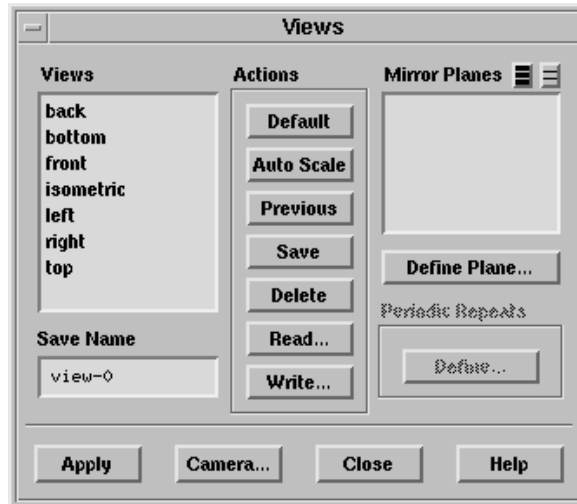
14.6 Modifying the View

TGrid allows you to control the view of the scene that is displayed in the graphics window. You can modify the view by scaling, centering, or rotating the scene. You can also save a view that you have created, or restore or delete a view that you saved earlier. These operations are performed in the **Views** panel or with the associated text commands.

14.6.1 The Views Panel

With the Views panel, you can make various modifications to the view displayed in the active graphics window.

Display → Views...



Controls

Views lists the currently defined views. Clicking on a view name highlights that name and enters it into the **Name** field. Double-clicking on a view name restores that view in the active graphics window.

Save Name specifies the name to use when saving a view.

Actions contains buttons for performing various actions related to the **Views** list and the **Save Name**.

Default restores the “front” view in the active graphics window.

Auto Scale modifies the view in the active graphics window by scaling and centering the current scene without changing its orientation.

Save stores the view in the active graphics window with the name in the **Save Name** box.

Restore sets the view of the active graphics window to be the view selected in the **Views** list.

Delete removes the selected view name from the **Views** list. Be careful not to delete any of the predefined views.

Read... opens the **Select File** dialog box (see Section 3.2.6: [Select File Dialog Box](#)), in which you can specify the name of a view file to be read.

Write... opens the Write Views panel (see Section 14.6.2: The Write Views Panel), in which you can select the views to be saved to a view file.

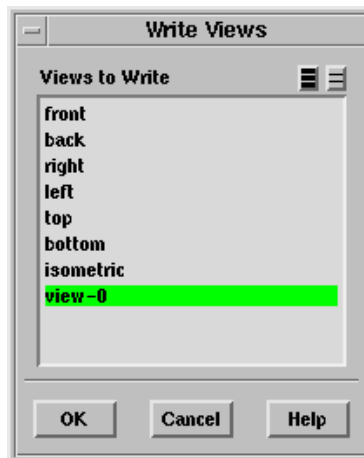
Mirror Planes displays a list of all symmetry planes in the domain. Mirror images are drawn for all selected symmetry planes.

Define Plane... opens the Mirror Planes panel (see Section 14.6.3: The Mirror Planes Panel), in which you can define a mirror plane for a nonsymmetric domain.

Camera... opens the Camera Parameters panel (see Section 14.6.4: The Camera Parameters Panel).

14.6.2 The Write Views Panel

The Write Views panel allows you to save selected views to a view file. This feature allows you to transfer views between mesh files.

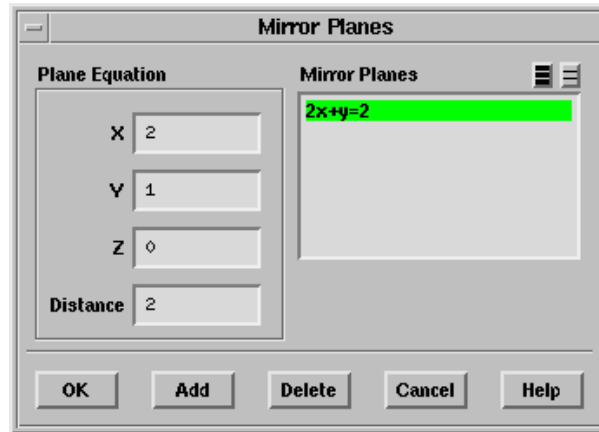


Controls

Views To Save is a selectable list of the defined views. The selected views will be saved to a view file when you click OK.

14.6.3 The Mirror Planes Panel

The Mirror Planes panel allows you to define a symmetry plane for a nonsymmetric domain for use with graphics.



Controls

Plane Equation contains inputs for specifying the equation for the mirror plane:
 $AX + BY + CZ = \text{Distance}$.

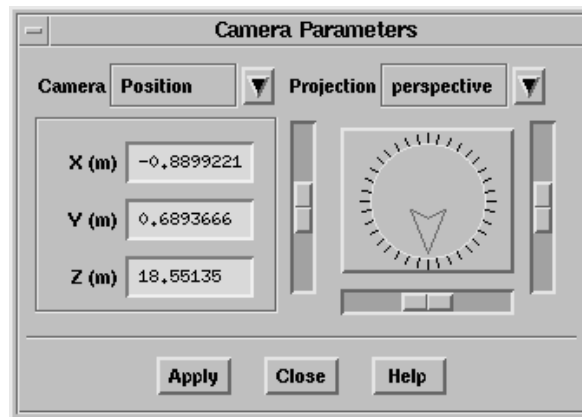
Mirror Planes contains a list of all mirror planes you have defined using this panel. Mirror planes that exist in the domain due to symmetry will not appear in this list, since they cannot be modified.

Add adds the plane defined by the Plane Equation to the Mirror Planes list.

Delete deletes the plane(s) selected in the Mirror Planes list.

14.6.4 The Camera Parameters Panel

The Camera Parameters panel allows you to modify the “camera” through which you are viewing the graphics display.



Controls

Camera contains a drop-down list of the parameters that define the camera (Position, Target, Up Vector, and Field) and X, Y, and Z fields in which you can define the coordinates or field distances for the parameter selected in the drop-down list. Figure 14.6.1 illustrates the definition of the camera by these parameters.

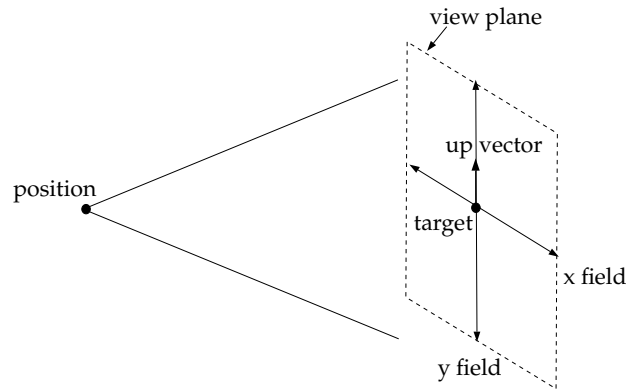


Figure 14.6.1: Camera Definition

Projection contains a drop-down list that allows you to select a Perspective or Orthographic view.

Dial allows you to rotate the graphics display respectively.

- The dial controls rotation about the axis at the center of and perpendicular to the screen.

Sliders allows you to scale the graphics display respectively.

- The slider on the scale to the left of the dial rotates the display about the horizontal axis at the center of the screen.
- The slider on the scale below the dial rotates the display about the vertical axis at the center of the screen.
- The slider on the scale to the right of the dial zooms in or out in the display.

i When using the sliders and dial to manipulate the view, select All in the Display Options panel (see Section 14.5.1: The Display Options Panel), so that you can watch the display move interactively while you move the slider or the dial indicator.

14.6.5 Text Commands for Modifying the View

Text interface commands with the same functionality as the controls in the Views panel are:

`display/view/auto-scale` scales and centers the current scene without changing its orientation.

`display/view/default-view` resets the view to front and center.

`display/view/delete-view` deletes a named view from the list of stored views.

`display/view/last-view` returns to the camera position before the last manipulation.

`display/view/list-views` lists all predefined and saved views.

`display/view/restore-view` sets the current view to one of the stored views.

`display/view/read-views` reads views from an external view file.

`display/view/save-view` saves the currently displayed view into the list of stored views.

`display/view/write-views` writes views to an external view file.

`display/view/camera/dolly-camera` allows you to move the camera left, right, up, down, in, and out.

`display/view/camera/field` allows you to set the field of view (width and height) of the scene.

`display/view/camera/orbit-camera` allows you to move the camera around the target. Gives the effect of circling around the target.

`display/view/camera/pan-camera` gives you the effect of sweeping the camera across the scene. The camera remains at its position but its target changes.

`display/view/camera/position` sets the camera position.

`display/view/camera/projection` lets you switch between perspective and orthographic views.

`display/view/camera/roll-camera` lets you adjust the camera up-vector.

`display/view/camera/target` sets the point the camera will look at.

`display/view/camera/up-vector` sets the camera up-vector.

`display/view/camera/zoom-camera` adjusts the camera's field of view. This operation is similar to dollying the camera in or out of the scene. Dollying causes objects in front to move past you. Zooming changes the perspective effect in the scene (and can be disconcerting).

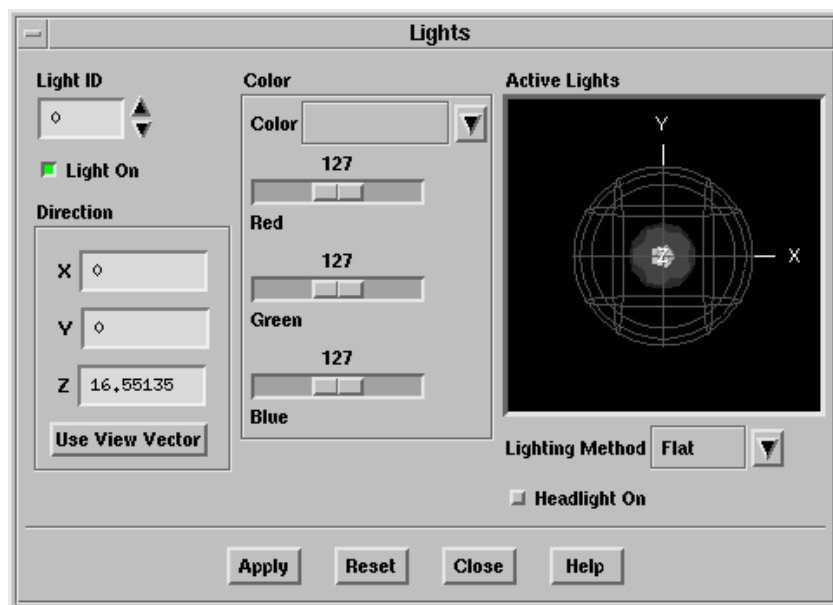
14.7 Adding Lights

In TGrid you can add lights with a specified color and direction to your display. These lights can enhance the appearance of the display, especially when it contains 3D geometries.

14.7.1 The Lights Panel

The Lights panel provides an interactive mechanism for placing colored, directional lights in a scene.

Display → Lights...



Controls

Light ID indicates the light that is being added, deleted, or modified. By default, light 1 is defined to be dark gray with a direction of (1,1,1).

Light On indicates whether or not the light specified in **Light ID** is on or off. By turning off the **Light On** option for a particular light, you can remove this light from the display, while still retaining its definition. To add it to the display again, simply turn on the **Light On** button.

Direction allows you to specify the direction of the light (the position on the unit sphere from which the light emanates) by entering the X, Y, and Z coordinates or by computing the coordinates based on the current view in the graphics window.

X,Y,Z specify the direction of the light. For example, the direction (1,1,1) means that the rays from the light will be parallel to the vector from (1,1,1) to the origin.

Use View Vector updates the **X,Y,Z** fields with the appropriate values for the current view in the active graphics window, and shines a light in that direction.

Instead of entering the **X,Y,Z** values for a light's direction vector, use the mouse to change the view in the graphics window so that the position in reference to the geometry is the position from which you would like a light to shine. Then click on the **Use View Vector** button to update the **X,Y,Z** fields with the appropriate values for the current position and update the graphics display with the new light direction.

This method is convenient if you know where you want a light to be, but you are not sure of the exact direction vector.

Color allows you to specify the light color with sliders. You can create your desired color by increasing and decreasing the slider values for the colors **Red**, **Green**, and **Blue**. You can also enter a descriptive string (e.g., lavender) in the **Color** field.

Active Lights shows the position and color of all defined directional lights, and allows you to change the position of a light.

All directional lights in **TGrid** are assumed to be at infinity and pass through the unit sphere at the position shown. All light rays arriving at the scene from one light are parallel.

The colored markers on the surface of the sphere represent the color and direction of these *distant* lights. These lights point towards the center of the sphere (the origin, which is usually where the geometry is).

Lighting Method specifies the method to be used in lighting interpolation: **Off**, **Flat**, **Gouraud**, or **Phong**.

Flat is the most basic method. There is no interpolation within the individual polygonal facets. **Gouraud** and **Phong** have smoother gradations of color because they interpolate on each facet. When **Off** is selected, lighting effects are disabled.

Headlight On turns on a light that moves with the camera. This option is not especially relevant for **TGrid**.

Reset resets the light definitions to their last saved state (i.e., the lighting that was in effect the last time you opened the panel or clicked on **Apply**).

14.7.2 Text Commands for Adding Lights

Text interface commands with the same functionality as the controls in the **Lights** panel are:

`display/set/lights/headlight-on?` turns the light that moves with the camera on/off.

`display/set/lights/lights-on?` turns all lights on/off.

`display/set/lights/lighting-interpolation` sets the lighting interpolation method to be used. You can choose `flat`, `gouraud`, or `phong`. The first one is the most basic method, and the others are more sophisticated and provide smoother gradations of color.

`display/set/lights/set-ambient-color` sets the ambient color for the scene. The ambient color is the background light color in a scene.

`display/set/lights/set-light` adds or modifies a directional, colored light.

14.8 Describing a Scene

After displaying a grid or parts of a grid in your graphics window, you may want to overlay an additional display or move objects around and change their characteristics to increase the effectiveness of the scene displayed.

You can use the **Scene Description** panel, the **Display Properties** and **Transformations** panels, which are opened from within it, to rotate, translate, and scale each object individually, as well as change the color and visibility of each object. You can make geometric objects visible and invisible, thereby adding or deleting objects from the scene one at a time.

14.8.1 The Scene Description Panel

The **Scene Description** panel allows you to turn overlays on and off, select geometric objects in the display for modification or deletion, and open panels that control various characteristics of the selected object(s).

 `Display` → Scene...

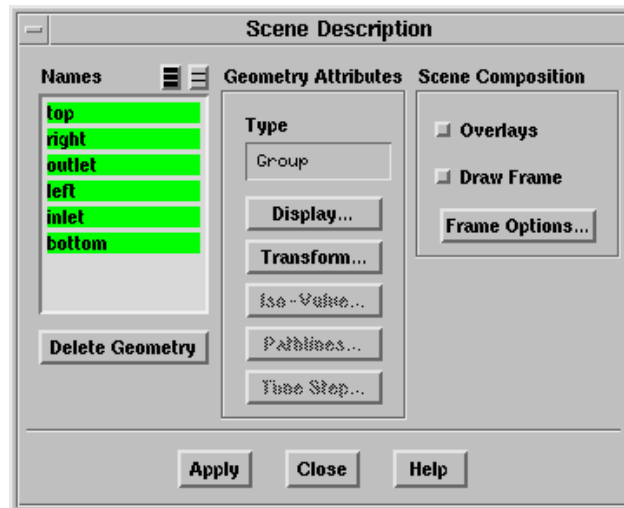
This menu item becomes available after you display a grid in the graphics window. You cannot use the **Scene Description** panel to control XY plot and histogram displays.

Controls

Names contains a list of the geometric objects that currently exist in the scene (including those that are presently invisible).

You can specify the object or objects to be manipulated by selecting names in this list. If you select more than one object at a time, any operation (transformation, color specification, etc.) will apply to all the selected objects.

You can also select objects by clicking on them in the graphics display using the mouse probe button. The default is the right mouse button. For information about mouse button functions, see Section 14.9: [Controlling the Mouse Buttons](#). To deselect a selected object, click on its name in the Names list.



Geometry Attributes contains information about the type of the selected geometric object and push buttons which open panels for modifying the object.

Type reports the type of the selected object. Possible types include grid and Group. This information is especially helpful when you need to distinguish two or more objects with the same name. When more than one object is selected, the type displayed is Group.

Display... opens the Display Properties panel (see Section 14.8.4: [The Display Properties Panel](#)), which allows you to change the color, visibility, and other properties for the selected object.

Transform... opens the Transformations panel (see Section 14.8.5: [The Transformations Panel](#)), which allows you to translate, rotate, and scale the selected object.

IsoValue... is not available in TGrid.

Pathlines... is not available in TGrid.

Time Step... is not available in TGrid.

Scene Composition contains controls for enabling overlays and bounding frames.

Overlays activates the superimposition of a new geometry onto a currently displayed geometry.

Draw Frame activates the display of a bounding frame in the graphics display.

Frame Options... opens the **Bounding Frame** panel (see Section 14.8.6: [The Bounding Frame Panel](#)), in which you can define properties of the bounding frame.

Delete Geometry deletes the geometric object that is currently selected in the **Names** list. The ability to delete individual objects is especially useful if you have overlays on and you generate an unwanted object (e.g., if you generate contours of the wrong variable). You can simply delete the unwanted object and continue your scene composition, instead of starting over from the beginning.

Apply saves the status of **Overlays** and **Draw Frame**. When you turn **Overlays** or **Draw Frame** on or off, click **Apply** to see the effect of the change on subsequent display operations.

14.8.2 Text Commands for Scene Description

The following text commands are related to scene description:

`/display/update-scene/draw-frame?` enables/disables the drawing of the bounding frame.

`/display/update-scene/overlays?` enables/disables the overlays option.

`/display/update-scene/select-geometry` allows you to select the geometry to be updated.

`/display/update-scene/set-frame` allows you to change the frame options.

14.8.3 Changing the Display Properties

To enhance the scene in the graphics window, you can change the color, visibility, and other display properties of each geometric object in the scene.

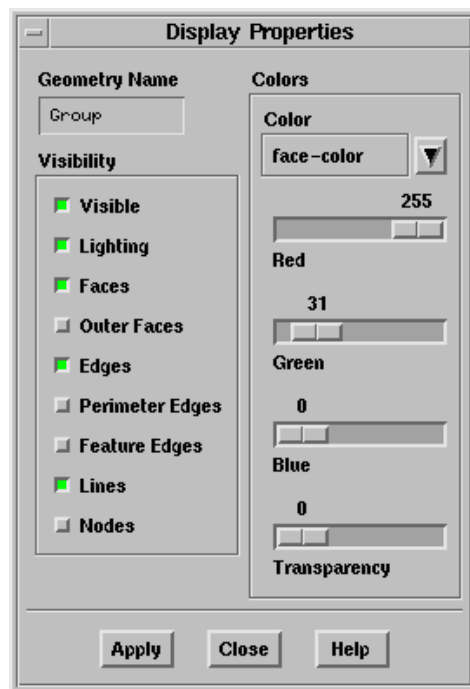
- You can specify different colors for displaying the edges and faces of a grid object to show the underlying mesh (edges) when the faces of the grid are filled and shaded.
- You can also make a selected object temporarily invisible. If, for example, you are displaying the entire grid for a complicated problem, you can make objects visible or invisible to display only certain boundary zones of the grid without regenerating the grid display using the **Display Grid** panel.

- You can also use the visibility controls to manipulate geometric objects for efficient graphics display.

These features along with several others are available in the Display Properties panel.

14.8.4 The Display Properties Panel

To modify the color, visibility, and other display properties for individual geometric objects in the graphics display, use the Display Properties panel. Click **Display...** in the Scene Description panel (see Section 14.8.1: [The Scene Description Panel](#)) to open this panel.



Controls

Geometry Name displays the name of the object you selected for modification in the Scene Description panel (see Section 14.8.1: [The Scene Description Panel](#)).

Visibility contains check buttons that control options related to the visibility of the selected object.

Visible toggles the visibility of the selected object.

- If the option is enabled, the object will be visible in the display.
- If the option is disabled, the object will be invisible.

Lighting turns the effect of lighting for the selected object on or off. You can choose to have lighting affect only certain objects instead of all of them.

Faces toggles the filled display of faces for the selected grid or surface object.

Enabling **Faces** on has the same effect as enabling the **Filled** option in the **Display Grid** panel (see Section 14.1.3: [The Display Grid Panel](#)).

Outer Faces toggles the display of outer faces.

Edges toggles the display of interior and exterior edges of the geometric object.

Perimeter Edges toggles the display of the outline of the geometric object. This option has no effect on the display of grids.

Feature Edges (not applicable for TGrid)

Lines toggles the display of the lines (if any) in the geometric object.

Nodes toggles the display of the nodes (if any) in the geometric object.

Colors contains controls for setting face, edge, line, and node colors, and transparency for faces.

Color specifies the face, edge, line, or node color for modification. When you turn on this button, the color scales below will show the current color specification, which you can modify by moving the sliders on the color scales.

Red, Green, Blue are color scales with which you can specify the RGB components of the face, edge or line color.

Transparency sets the relative transparency of the selected object. An object with a transparency of 0 is opaque. An object with a transparency of 100 is transparent.

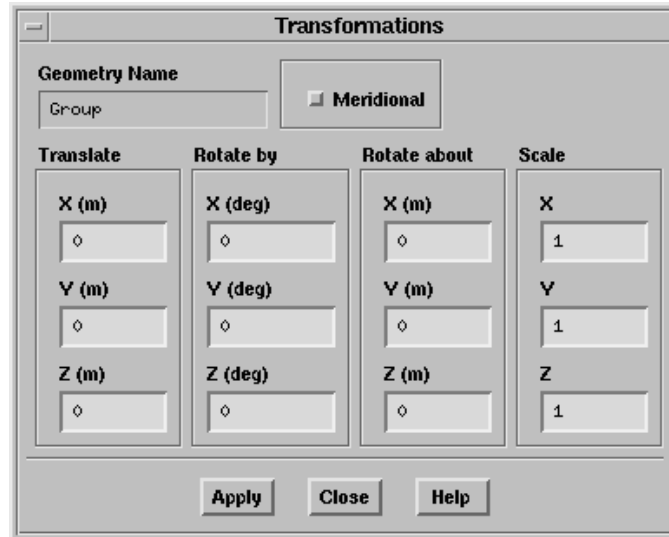
14.8.5 Transforming Geometric Objects in a Scene

When composing a scene in your graphics window, it is helpful to move a particular object from its original position or to increase or decrease its size. For example, you may want to temporarily move an interior portion of the grid outside the grid boundaries where it can be seen and interpreted more easily.

You can also move an object by rotating it about a specified point. If you want to display one object more prominently than the others, scale its size. All these capabilities are available in the **Transformations** panel.

The Transformations Panel

You can use the Transformations panel to translate, rotate, or scale individual objects in the graphics display. To open this panel, click on the Transform... push button in the Scene Description panel (see Section 14.8.1: [The Scene Description Panel](#)).



Controls

Geometry Name displays the name of the object you selected for modification in the Scene Description panel (see Section 14.8.1: [The Scene Description Panel](#)).

Meridional enables the display of the meridional view. This option is especially useful in turbomachinery applications.

Translate contains X, Y, and Z real number fields in which you can enter the distance by which to translate the selected object in each direction. Translations are not cumulative, so you can easily return to a known state. To return to the original position, enter 0 in all three real number fields.

Rotate By contains X, Y, and Z integer number fields in which you can enter the number of degrees by which to rotate the selected object about each axis. You can enter any value between -360 and 360 .

Rotations are not cumulative, so you can easily return to a known state. To return to the original position, enter 0 in all three integer number fields.

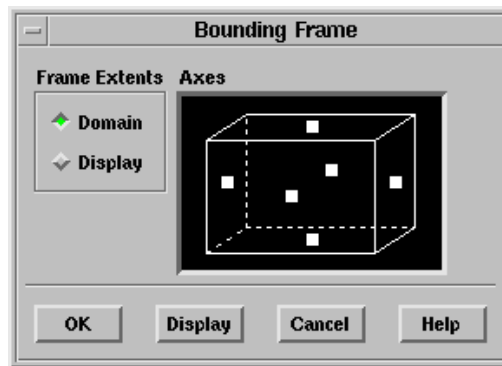
Rotate About specifies the point about which to rotate the object.

Scale contains X, Y, and Z real number fields in which you can enter the amount by which to scale the selected object in each direction.

- To avoid distortion of the shape of the object, be sure to specify the same value for all three entries. Scaling is not cumulative, so you can easily return to a known state.
- To return the object to its original size, enter 1 in all three real number fields.

14.8.6 The Bounding Frame Panel

To open this panel, click on the Frame Options... push button in the Scene Description panel (see Section 14.8.1: The Scene Description Panel).



The Bounding Frame panel allows you to add a bounding frame with optional measure markings to the display of the domain (e.g., Figure 14.8.1).

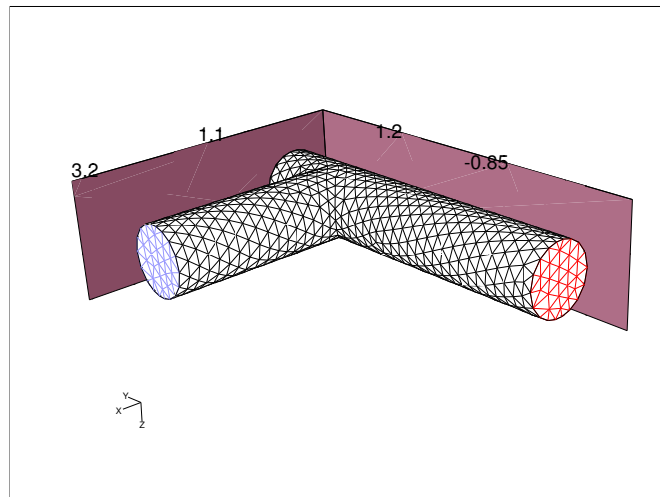


Figure 14.8.1: Graphics Display with Bounding Frame

Controls

Frame Extents indicates the extents of the bounding frame.

Domain specifies that the frame should encompass the domain extents.

Display specifies that the frame should encompass the portion of the domain that is shown in the display.

Axes contains controls for specifying the frame boundaries and measurements.

Display updates the active graphics window with the current frame settings.

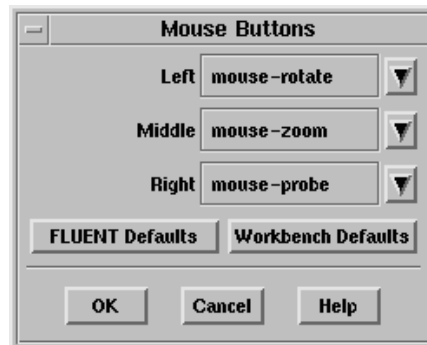
14.9 Controlling the Mouse Buttons

A convenient feature of TGrid is that it allows you to assign a specific function to each of the mouse buttons. According to your specifications, clicking a mouse button in the graphics window will cause the appropriate action to be taken.

14.9.1 The Mouse Buttons Panel

The mouse button is used to set the actions taken when you click the mouse button in a graphics window. Clicking any mouse button in a graphics window will make that window the active window.

Display → Mouse Buttons...



Each mouse button can be associated with a different function. The predefined functions include mouse-rotate, mouse-dolly, mouse-zoom, mouse-probe, and mouse-annotate. These functions apply only to the graphics windows; they are not active when an XY plot or histogram is displayed.

Clicking any mouse button in a graphics window will make that window the active window.

Controls

Left sets the function associated with the left button. In 2D, the default setting is **mouse-dolly**, and in 3D it is **mouse-rotate**.

Middle sets the function associated with the middle button. The default setting for both 2D and 3D is **mouse-zoom**.

Right sets the function associated with the right button. This is not used on a two button mouse. The default setting for both 2D and 3D is **mouse-probe**.

FLUENT Defaults sets the mouse button functions according to FLUENT defaults.

Workbench Defaults sets the mouse button functions according to Workbench defaults.

The predefined button functions available are follows:

mouse-rotate allows you to rotate the view by dragging the mouse across the screen. Dragging horizontally rotates the object about the y axis of the screen, vertical mouse movement rotates the object about the x axis of the screen. The function completes when the mouse button is released or the cursor leaves the graphics window.

mouse-dolly allows you to translate the view by dragging the mouse while holding down the button. The function completes when the mouse button is released or the cursor leaves the graphics window.

mouse-zoom allows you to draw a zoom box, anchored at the point at which the button is pressed, by dragging the mouse with the button held down. When you release the button:

- If the dragging was from left to right, a magnified view of the area within the zoom box will fill the window.
- If the dragging was from right to left, the area of the window shrinks to fit into the zoom box, resulting in a “zoomed out” view.
- If the mouse button is clicked (not dragged), the selected point becomes the center of the window.

mouse-roll-zoom allows you to zoom in or out of the view by rolling the mouse while the button is pressed.

mouse-probe allows you to perform the specified mouse probe function. The mouse probe function can be set in the **Mouse Probe** panel (see Section 14.10.1: [The Mouse Probe Panel](#)).

`mouse-annotate` allows you to insert text into the graphics window. If you drag the mouse button an attachment line is drawn. When you release the button (after dragging or clicking), a cursor is displayed in the graphics window, and you can enter the text. Press `<RETURN>` or move the cursor out of the graphics window.

To remove annotated text and attachment lines, use the `Clear` push button in the `Annotate` panel or the `display/clear-annotation` command, as described below in [Section 14.11: Annotating the Display](#).

These commands will delete all annotated text from the window.

`OK` saves the current settings and closes the panel. The appropriate function will be executed when a mouse button is subsequently clicked in a graphics window. You do not have to redraw the graphics window for the new button functions to take effect.

14.9.2 Text Commands for Selecting Mouse Buttons

Text interface commands with the same functionality as the controls in the `Mouse Buttons` panel are:

`display/set/mouse-buttons` prompts you to select a function for each of the mouse buttons. The options available are:

`mouse-rotate` allows you to rotate the view by dragging the mouse across the screen.

`mouse-dolly` allows you to translate the view by dragging the mouse across the screen.

`mouse-zoom` allows you to zoom in or out on the display.

`mouse-roll-zoom` allows you to zoom in or out of the view by rolling the mouse while the button is pressed.

`mouse-probe` allows you to perform the specified mouse probe function. The mouse probe function can be set to one of the values described for the `boundary/modify/select-probe` command in [Section 7.3.4: Text Commands for Boundary Modification](#).

`mouse-annotate` allows you to insert text into the graphics window.

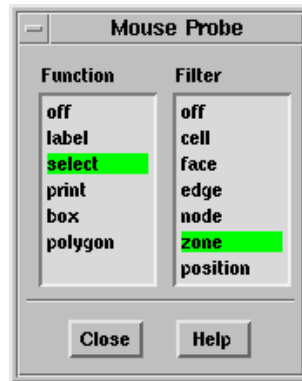
14.10 Controlling the Mouse Probe Functions

TGrid allows you to assign a specific function to the mouse probe button. Click the mouse probe in the graphics window for the appropriate action to take.

14.10.1 The Mouse Probe Panel

The Mouse Probe panel is used to set the actions taken when the mouse probe button is clicked in a graphics window.

Display → Mouse Probe...



Controls

Function selects the function to be performed when the mouse probe is clicked in the graphics window. The available functions are:

off disables the mouse probe.

label displays the label for the selected entity in the graphics window.

select saves the selected entity in a list that can be used in conjunction with the boundary modification functions (see Section 7.3: [Modifying the Boundary Mesh](#)).

print prints information about the selected entity in the text window (see Section 15.6: [Printing Grid Information](#)).

box enables the selection of a group of entities within a box, to be used in conjunction with the boundary modification functions (see Section 7.3: [Modifying the Boundary Mesh](#)). To define the selection box, click the mouse probe button at one corner of the region to be selected, drag the mouse to the opposite corner, and release the mouse probe button.

polygon enables the selection of a group of entities within a polygonal region, to be used in conjunction with the boundary modification functions (see Section 7.3: [Modifying the Boundary Mesh](#)). To define the selection polygon, click the mouse probe button at one vertex of the polygonal region to be selected, and use the left mouse button to successively select each of the remaining vertices.

Click the mouse probe button again (anywhere in the graphics window) to complete the polygon definition.

Filter indicates what the mouse probe button is to select. The available filters are **off**, **cell**, **face**, **edge**, **node**, **zone**, and **position**. If **off** is chosen, when a selection is made it is first checked to see if it is a cell, then a face, an edge, and so on. When the **node** filter is used, if a cell or face is selected the node closest to the selection point is picked. Thus nodes do not have to be displayed to be picked.

14.10.2 Text Commands for Mouse Probe Selection

Text interface commands with the same functionality as the controls in the Mouse Probe panel are `boundary/modify/select-probe` and `boundary/modify/select-filter`.

14.11 Annotating the Display

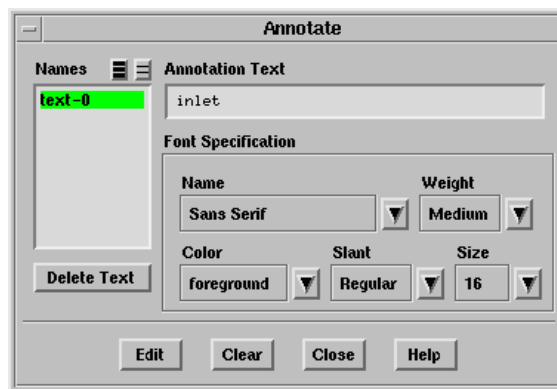
Text annotations with optional attachment lines may be added to the TGrid graphics windows. The text is added to the window at a location chosen with the mouse, using the mouse-probe button (see Section 14.9: [Controlling the Mouse Buttons](#) for information on setting the mouse buttons). Dragging with the mouse-probe button pressed will draw an attachment line from the point where the mouse was first clicked to the point where it was released. The annotation text will be placed at the point where the mouse button was released.

The annotation text is associated with the active graphics window; it is removed only when the annotations are explicitly cleared. You can edit the text in the graphics window's caption block by the left mouse button in the desired location. When a cursor appears, you can type the new text or delete the existing text. Text in the caption block will *not* be deleted when you clear annotations.

14.11.1 The Annotate Panel

You can use the **Annotate** panel to add text with optional attachment lines to the graphics windows. It can also be used to remove all annotations from the active graphics window.

Display → Annotate...



Names contains a selectable list of all annotation text strings that have been defined. You can choose a text string to be deleted or edited.

Delete Text deletes the text strings selected in the **Names** list from the display.

Annotation Text contains the annotation text string you wish to add, or the annotation text string for the item selected in the **Names** list.

Font Specification contains controls for defining or modifying the font in the annotation text string.

Name contains a drop-down list of various font styles.

Weight contains a drop-down list from which you can select **Medium** or **Bold**.

Size contains a drop-down list of font sizes (in points).

Color contains a drop-down list of colors that can be used for the text.

Slant contains a drop-down list from which you can select **Regular**, **Italic**, or **Oblique** as the slant type.

Add adds the current **Annotation Text** to the active graphics window. A dialog will prompt you to select a screen location using the mouse-probe button. For more information on setting the mouse buttons see [Section 14.9: Controlling the Mouse Buttons](#).

Edit updates the edited text in the active graphics window. This button will replace the **Add** button when you are editing an existing text string from the **Names** list.

Clear removes all annotation text and attachment lines from the active graphics window.

14.11.2 Text Commands for Text Annotation

Text commands related to annotation are:

`/display/annotate` adds annotation text to a graphics window. It will prompt you for a string to use as the annotation text. A dialog will prompt you to select a screen location using the mouse-probe button on your mouse. For more information on setting the mouse buttons see [Section 14.9.2: Text Commands for Selecting Mouse Buttons](#).

`/display/clear-annotations` removes all annotations and attachment lines from the active graphics window.

14.12 Shortcuts for Selecting Zones

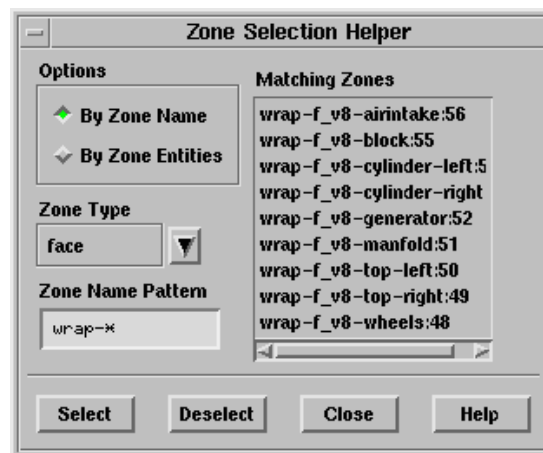
The panels opened from the **Display** menu and some other panels contain lists of zones present in the model. You can choose one or more face, cell, node, or edge zones from these lists. If a large number of zones are present in the model, it becomes difficult to find and select the required zone.

The **Zone Selection Helper** panel allows you to easily find and select the zone(s) you want. You can either select the required zones by their naming pattern or by number of entities present in them. Although the panel is opened from the **Display** menu, it can be used with *all* panels that contain zone lists (e.g., **Cell Zones** and **Boundary Zones** panels).

14.12.1 The Zone Selection Helper Panel

The **Zone Selection Helper** panel allows you to find and select zones with a certain pattern in their names or with the number of zone entities present in them.

Display → Selection Helper...



Controls

Options contains options to choose zone selection criteria.

By Zone Name specifies the use of zone selection criteria based on zone name pattern.

By Zone Entities specifies the use of zone selection criteria based on the number of selected zone entities present in them.

Zone Type contains a drop-down list of types of zones (face, node, edge, cell).

Zone Name Pattern specifies the pattern to look for in the names of zones of the selected **Zone Type**. Press <RETURN> after you enter the pattern.

Max. Zone Entities specifies the maximum number of zone entities to look for in the zones of the selected **Zone Type**. Press <RETURN> after you enter the number.

Matching Zones contains a list of the zones of the specified **Zone Type** that match the specified **Zone Name Pattern** or **Max. Zone Entities**.

Select selects the zones in the **Matching Zones** list (in all open panels).

Deselect deselects the zones in the **Matching Zones** list (in all open panels).

