Tutorial 1.2
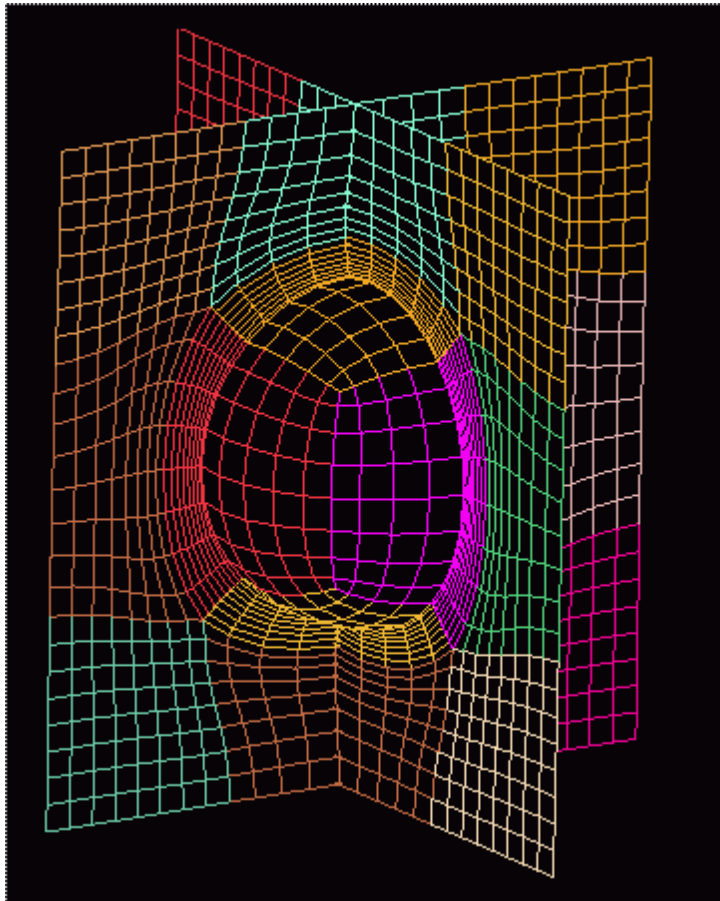
In most cases you will be working in 3-D to accurately simulate the flow around the model of interest. All of the concepts learned in 2- D can be directly applied to 3-D grid generation. In this case a grid of the geometry in Tutorial_1.1 will be created in 3-D.

What You Will Create

What You Will Learn

- Creating geometry in GridPro.
- About various display modes.
- Using a MACRO to automate topology and geometry creation.
- Creating a wrap in 3D.
- Doing and redoing topology commands.
- Topology inheritance.
- Snapping the geometry to the global axis.
- Adding, clearing and subtracting topology from groups.
- Introducing the grid viewer - how to make and manipulate grid view sheets.
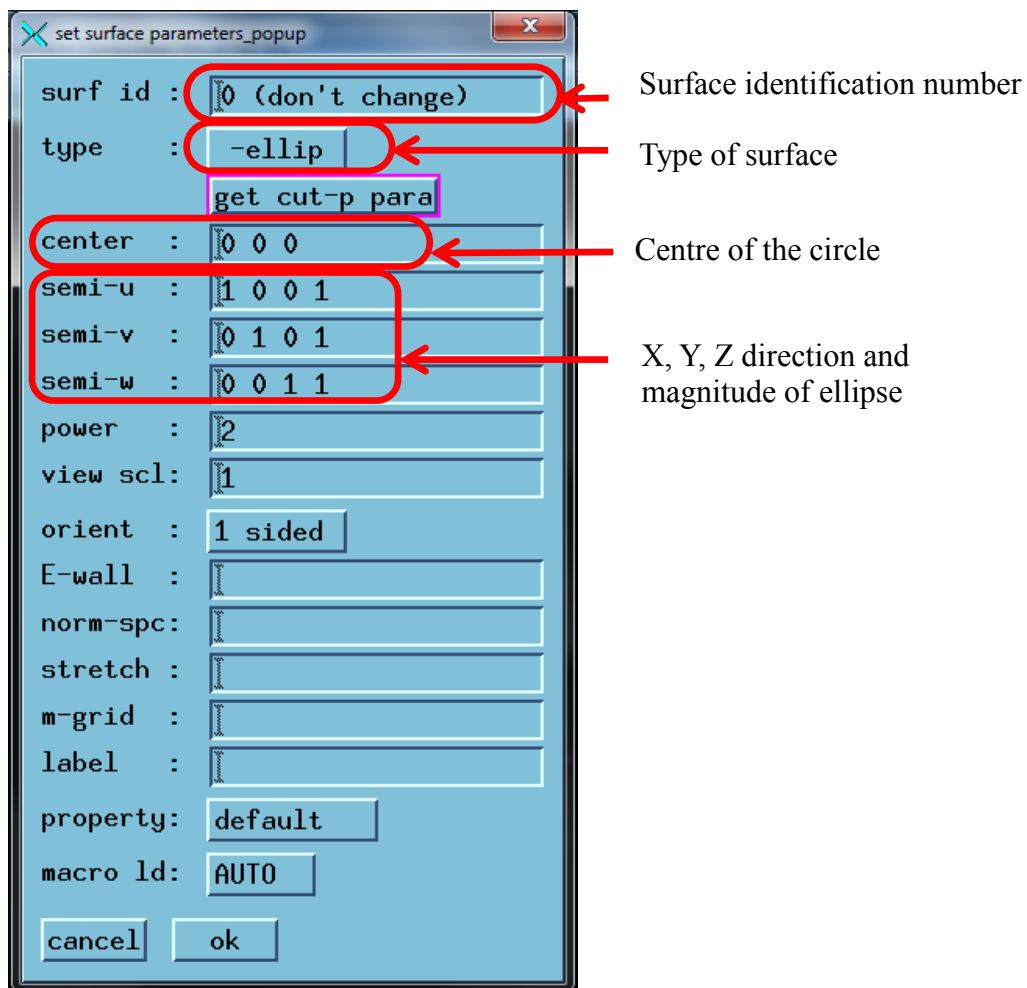
Step 1   Creating Geometry

To aide in grid generation, **GridPro** has functions to create an assortment of surfaces such as planes and ellipses. **GridPro** also allows the user to import a geometry created in an external CAD package. In this case, a sphere surrounded by a box will be created. Go to the **surf** sub-menu on the **Top Pull Down Menu** and click on the **-ellip** button to pull up the **Ellipse Dialog Box.**
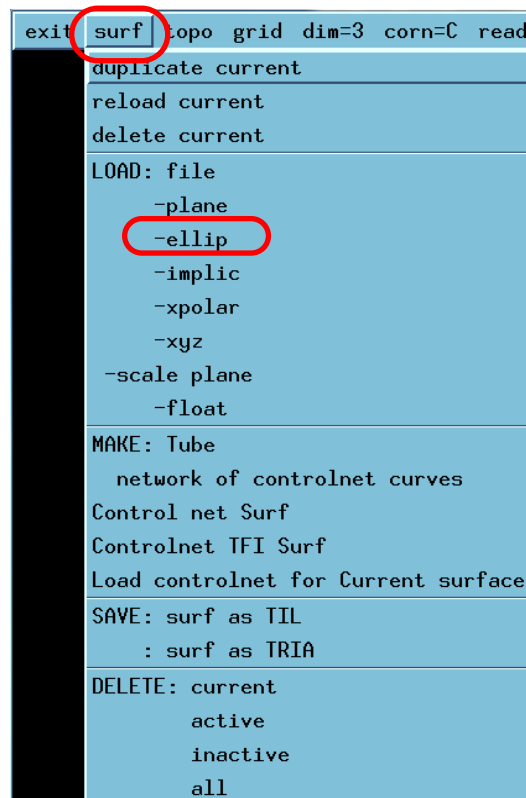
The Ellipse Dialog Box contains many functions to make an ellipse or sphere of any size or shape. The functions are listed in the picture below.

set surface parameters_popup	
surf id : 0 (don't change)	Surface identification number
type : -ellip	Type of surface
get cut-p para	
center : 0 0 0	Centre of the circle
semi-u : 1 0 0 1	
semi-v : 0 1 0 1	X, Y, Z direction and
semi-w : 0 0 1 1	magnitude of ellipse
power : 2	
view scl: 1	
orient : 1 sided	
E-wall :	
norm-spc:	
stretch :	
m-grid :	
label :	
property: default	
macro ld: AUTO	
cancel ok	

Make a sphere by changing the magnitude, the 4th number in the **semi-u**, **semi-v** and **semi-w** input parameter, to 2

| semi-u	:	1 0 0 2
semi-v	:	0 1 0 2
semi-w	:	0 0 1 2
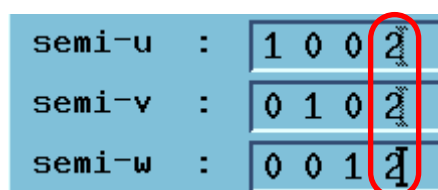
and then click 'ok'.

Step 2   Display Modes

Surfaces can be displayed as lines, points or in shaded mode. Other combinations such as shaded with hidden line removal are also available. Let's remove some of the display clutter by turning the default setting from lines to points. Go to the **STYLE** sub-panel and left click on the center button
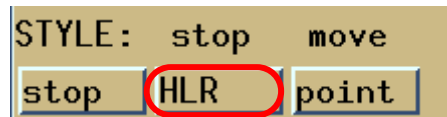

to pull down the display menu and choose points.
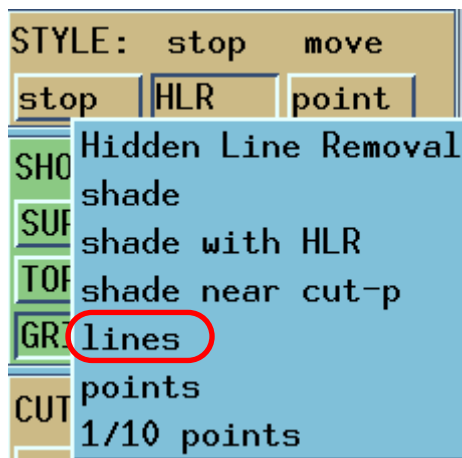
Scroll through the other choices to see the remaining display modes.

Step 3   Introducing Macros

Macros are a powerful tool used to automate **GridPro** functions. Macros reduce tedious and repetitive tasks and significantly improve productivity. They can be edited and used to design topology and speed up the grid generation process. **GridPro** comes with pre-made macros written specifically to reduce the time for grid generation. Place a six surface box with topology around the sphere by going to the topo sub-menu and choosing the read MACRO option.
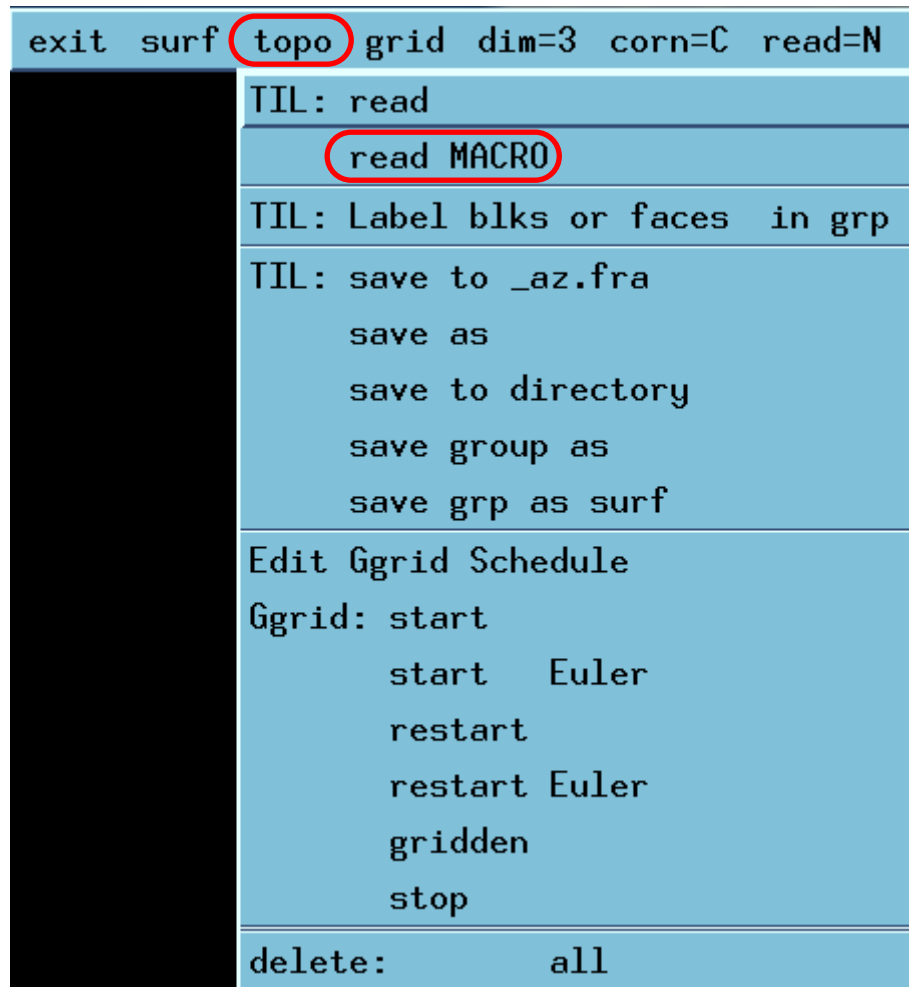
A **Load Topology MACRO** pop-up box will appear.
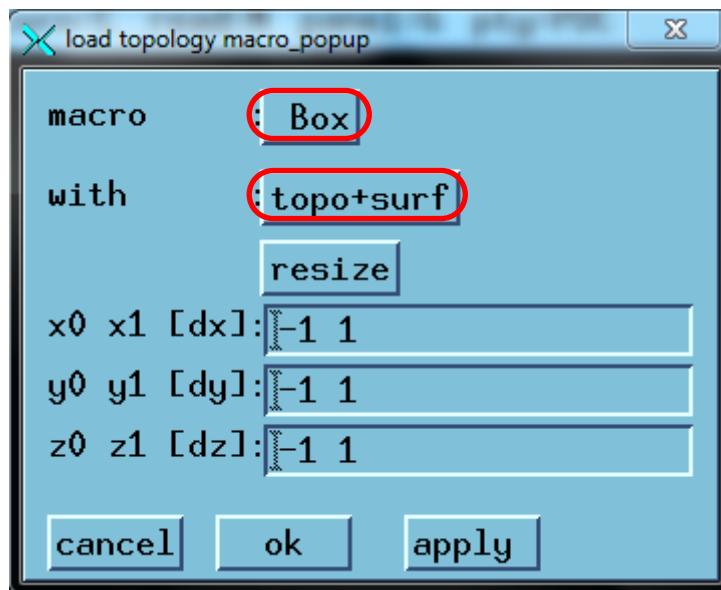
Choose a **Box** macro with a **topology** + **surface**. We want the box and topology to be larger than the sphere, go to the resize sub-menu and choose 100% larger. CLICK ON THIS BUTTON TWICE, so that
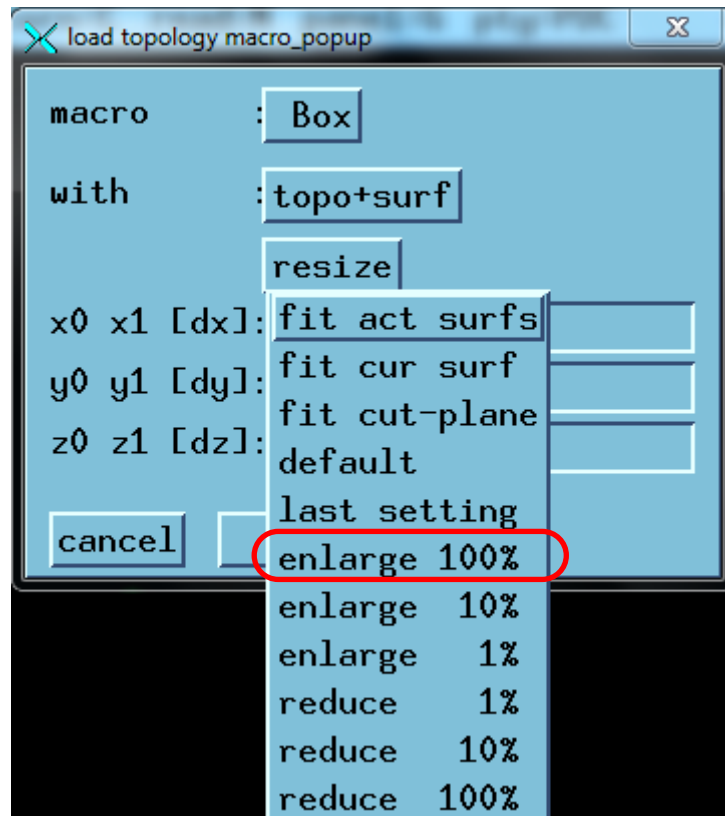

the dx, dy and dz dimensions change from 1 to 4.
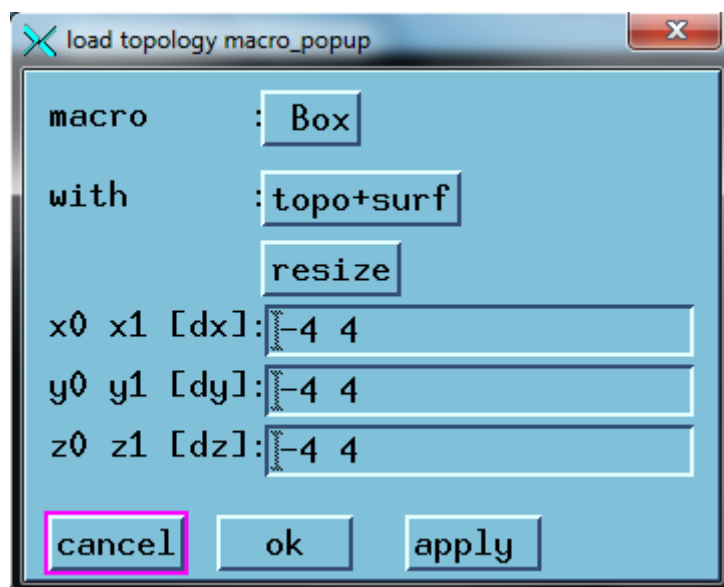
Now press 'ok' and a box with six surfaces and an outer topology is automatically created around the sphere.
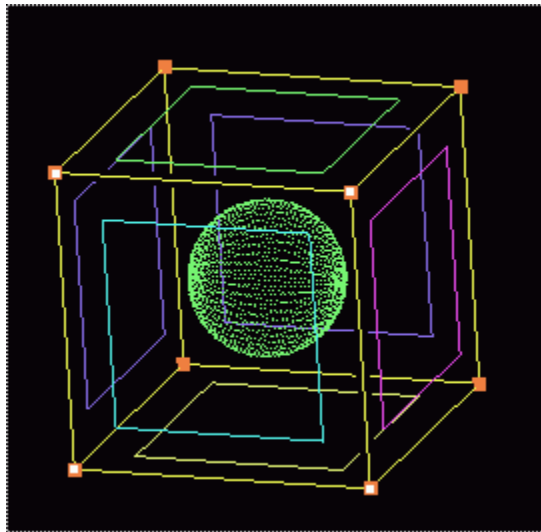
As you can see from the figure, the corners on the selected surface closest to the viewer have been automatically assigned to it. Scroll through these assignments by clicking on the button in the **TOPO** sub-command menu
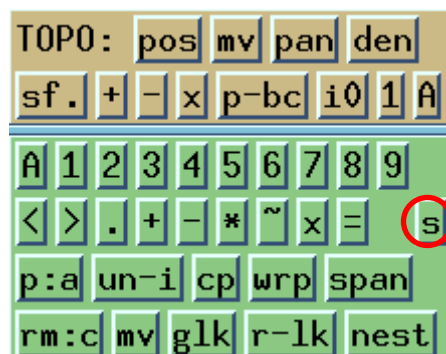
and using the scroll surface function in the **CURRENT** sub-command menu. As can be seen, all of the corners of the outer topology have been assigned to the surfaces of the surrounding box.

Scroll through surfaces to see topology assignments
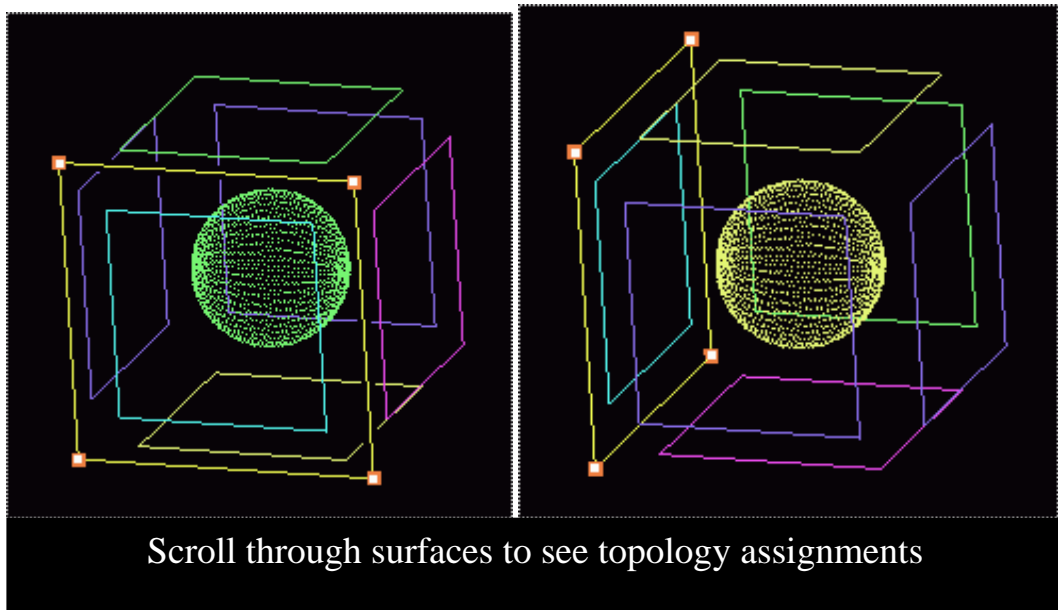
Step 4   Creating the Wrap

The same technique for creating the wrap in 2D of Part I will be used to create a 3D wrap around the sphere. Turn off the ⬛ button so the whole topology is displayed and, as in the 2D case; insert **Edge Sheets** around the sphere by pressing and holding down ⬛ on the keyboard and clicking on the topology edges. Put the first **Edge Sheet** at about 20% of the distance from the left most wall as in the picture below.
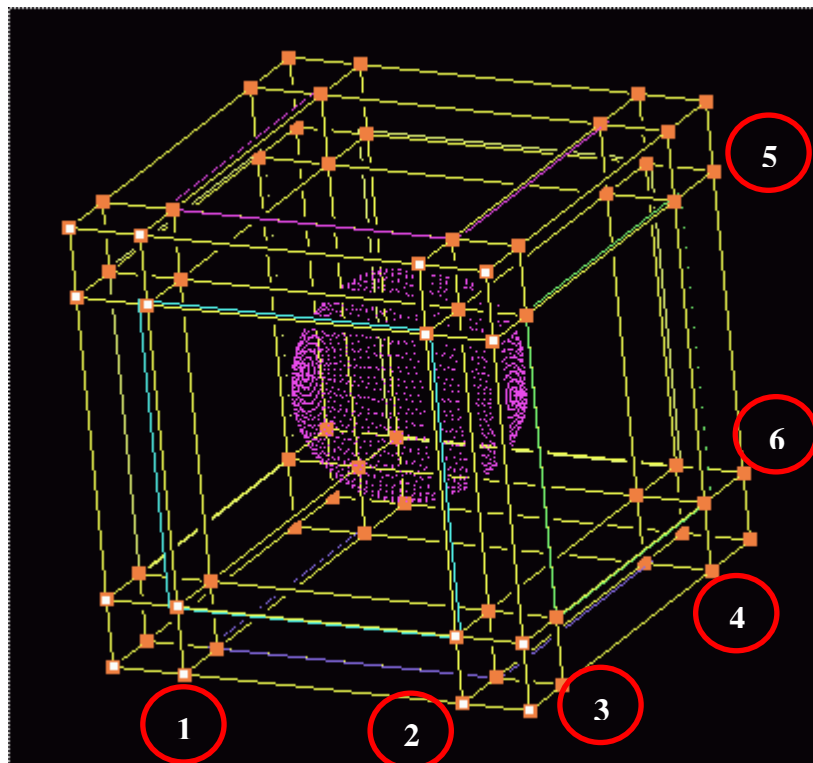

Insert first edge sheet
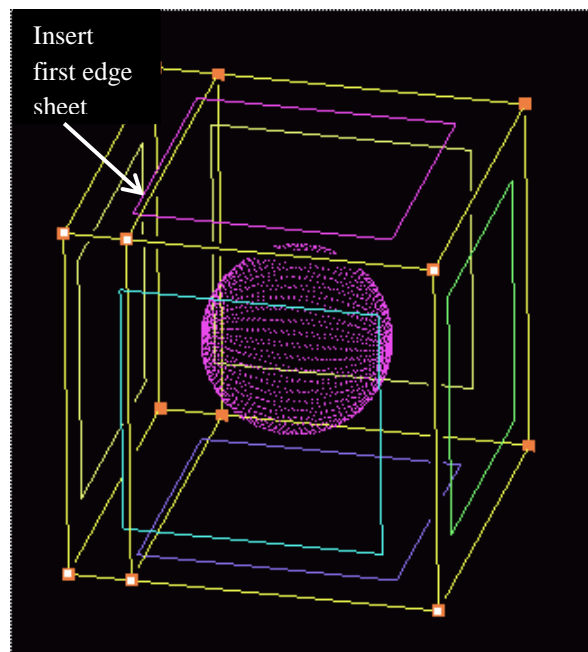
Undo Topology

One of the most useful topology design tools inside **GridPro** is the undo button. If you insert, move or place topology in the wrong location simply go to the ▢topo ◀ ▶ button in the **UN-REDO** sub-command panel. The ◀ scrolls back while the ▶ scrolls forward.

```
UN-REDO:  unzoom  4.0
topo ◀ ▶       view ◀ ▶
view grp              rec
```
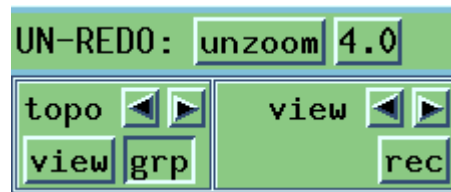
Do the same for the remaining 5 edges such that an inner box surrounds the sphere with enough room such that when we create the wrap the corners remain outside of the sphere. A total of six edges should be inserted into the outer topology.

Now that we have created an inner box around the sphere we will group and wrap it. Make sure the **axis** button in the **SHOW** sub-command panel is turned on so the **Global XYZ** axis is showing. Zoom-in on the model and snap the grid to the XY plane by clicking on the **snap** in the **ROTATE** sub-command panel. Pull down the snap menu and choose the **world: xyz** option.
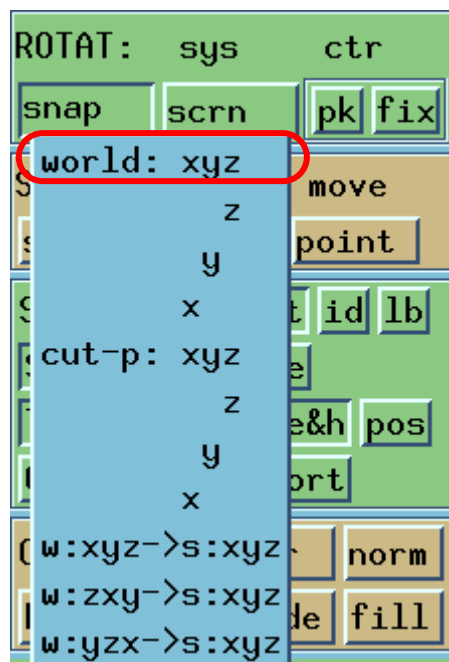

The model should look like the picture below.

Snap the model to XY plane

Y

Axis

X
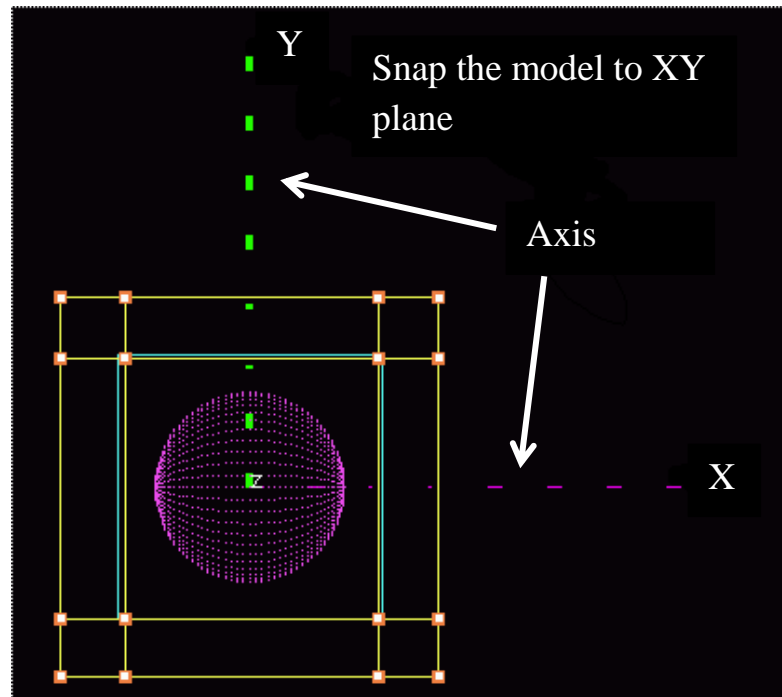
If the model was snapped to the YZ plane rotate it so that it is nearly close to the XY plane and snap again. Let's add topology to **Group 2** in the **TOPO** sub-command panel.
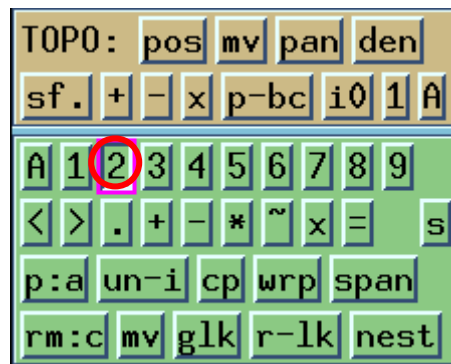
Make sure that the group is clear of any topology by clicking on in the **TOPO** menu. This function clears all topology from any chosen group, but the group must first be turned on, and then cleared.
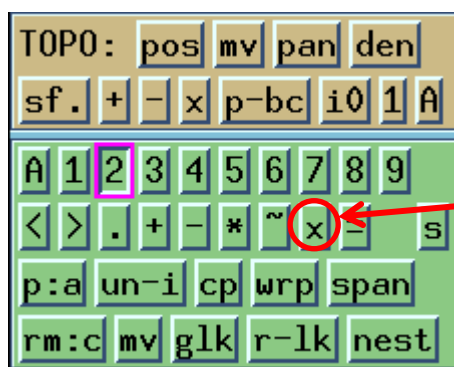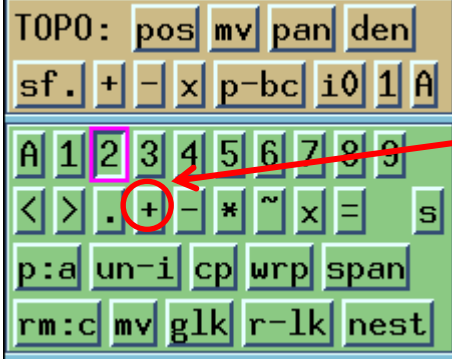

Clears chosen group

Add the inner topology to the group by clicking on the [+] button in the **TOPO** subcommand panel.

Choosing the [+] Button!
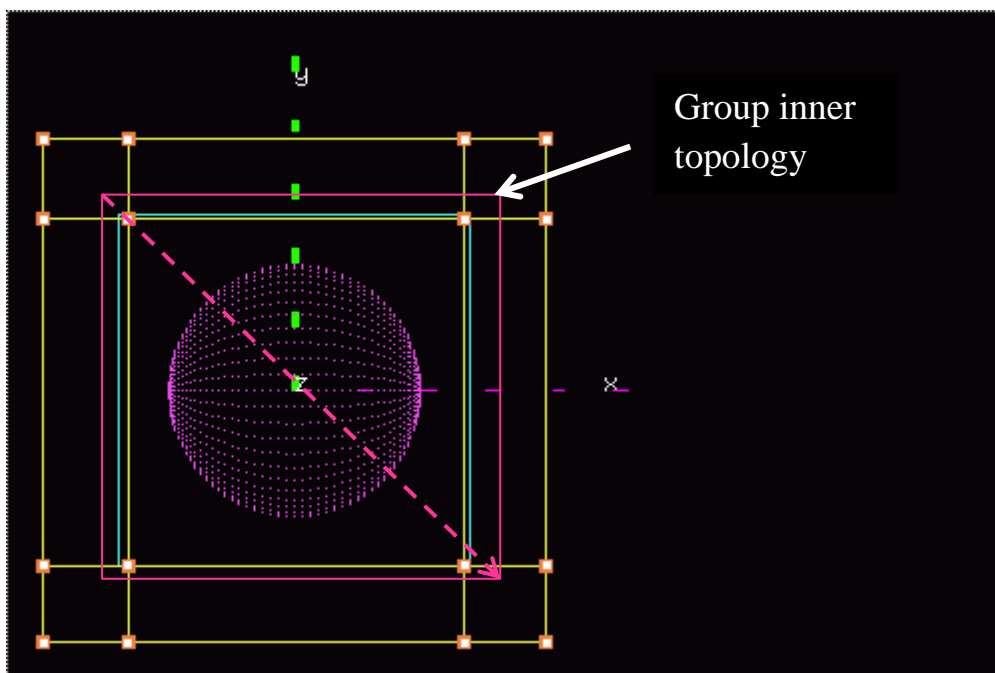
When grouping topology make sure you pick on the [+] in the 4th row, NOT the [+] in the 2nd row.

```
TOPO: pos mv pan den
sf. + - x p-bc i0 1 A
A 1 2 3 4 5 6 7 8 9
< > . + - * ~ x =    s
p:a un-i cp wrp span
rm:c mv glk r-lk nest
```

Correct group assignment button

When the button is pressed, add the inner topology to **Group 2** by right clicking and dragging a box around it.
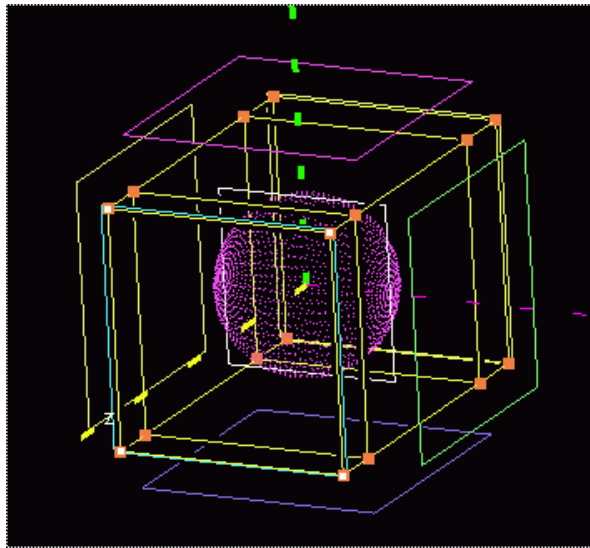

Group inner topology

The chosen topology will be highlighted in bright yellow, rotate the geometry to get a better view as in the picture below.
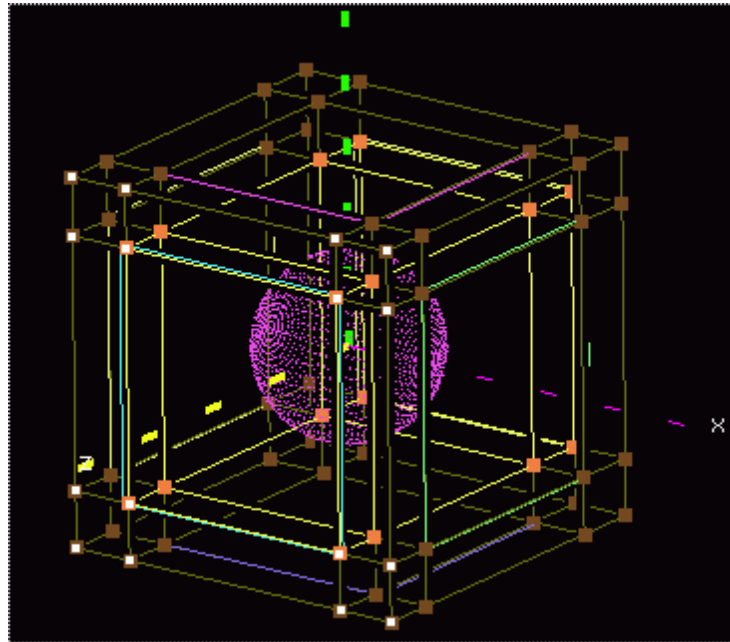

Now, let's get rid of some clutter. Go to the **TOPO** menu and click on the button and switch it to display selected group.
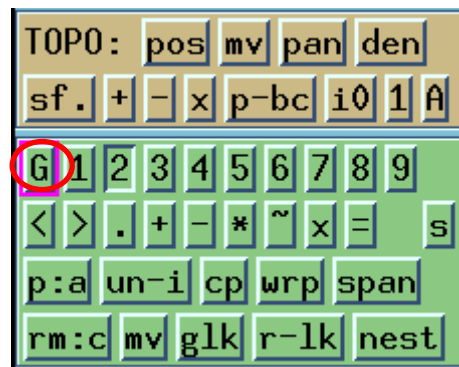

Only the group will be displayed as in the picture below.

As can be seen in the picture above, part of the outer topology was also chosen. We need to eliminate the outer topology by subtracting it from the group. **Snap** the geometry along the YZ plane and subtract the unwanted geometry from the group by pressing on the ![-] in the **TOPO** sub-command menu while the **Group 2** button is still on.
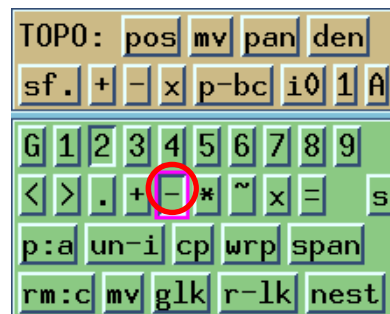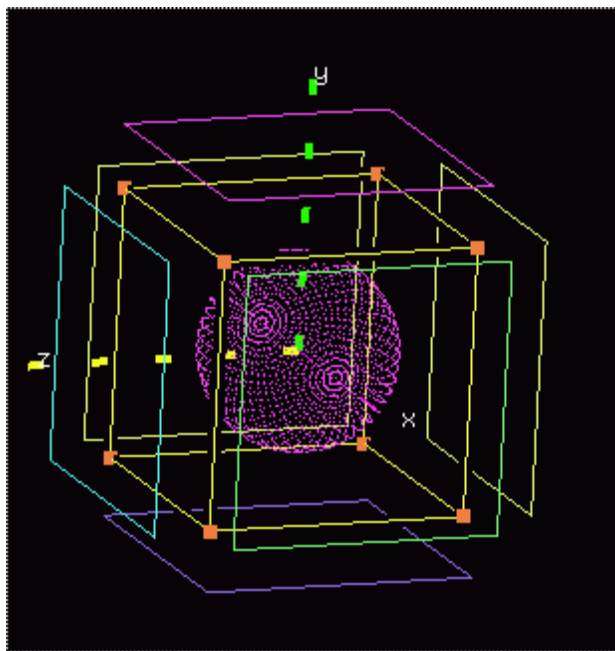

Now click on the right mouse button and drag a box around the topology that you would like to delete from the group as in the picture below.

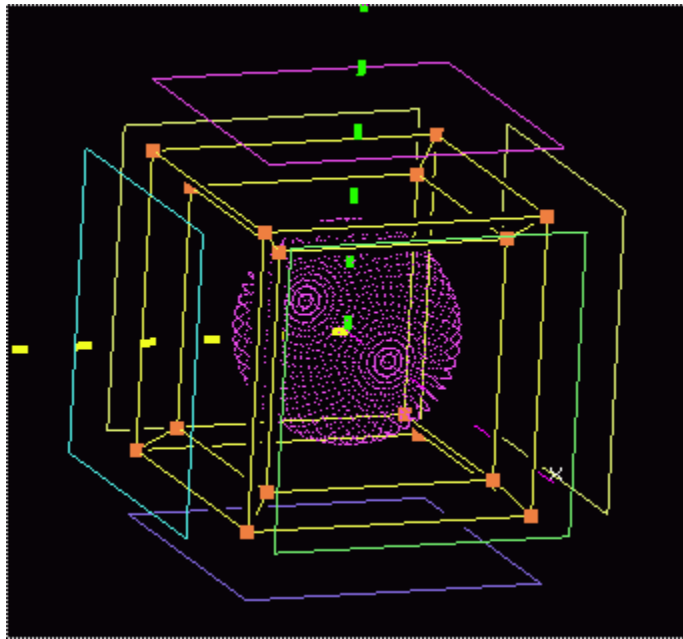Choose the topology you want to delete from group 2
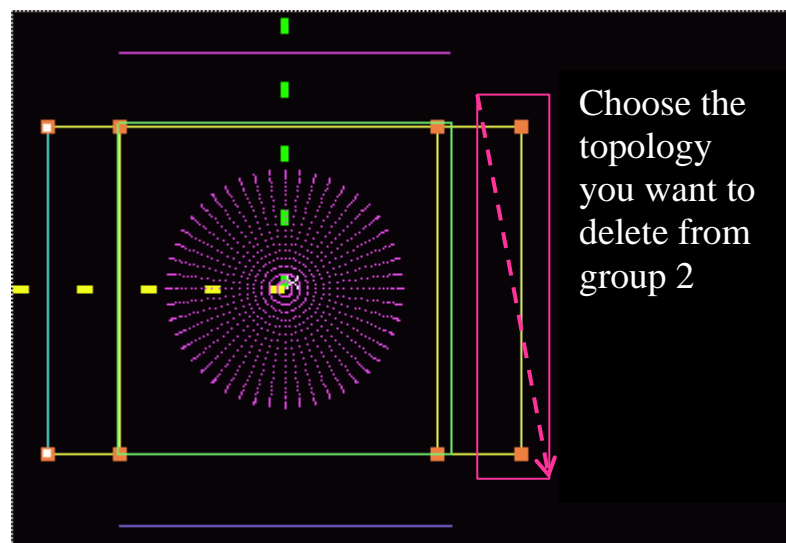
The result is that the topology that was chosen is deleted from the group as in the picture below.
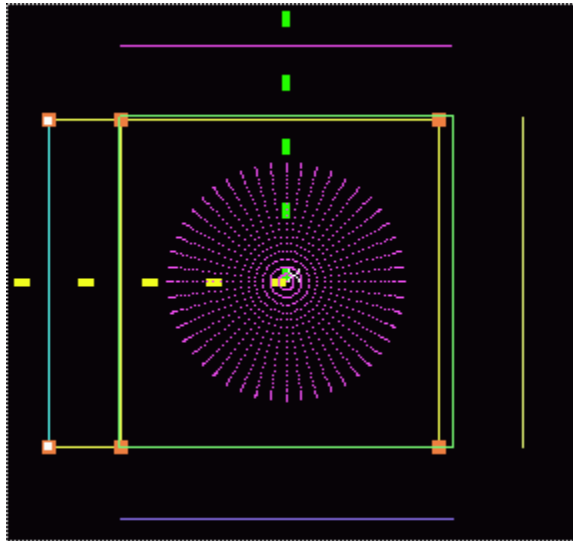

Delete the left topology so that only the center remains as in the picture below.


Now that the inner topology is grouped all we need to do is wrap it, click on the **wrp** button and choose a wrap that is 10% smaller.

Now that we have the wrap, and all of the outer topology has been assigned from inheritance, all we need to do is assign the inner topology to the sphere. A quick way to isolate the topology for this surface assignment is to scroll through the groups by clicking on ◁ in the **TOPO** sub-command panel.
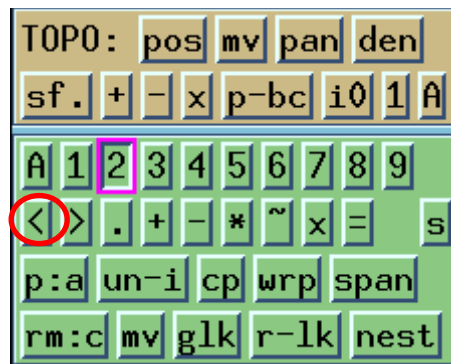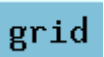

Since only the wrap is now visible, it is easier to assign the topology to the surface. Click on the ⊞ in the TOPO sub-command panel and right click and drag a box around the highlighted topology as in the picture below.
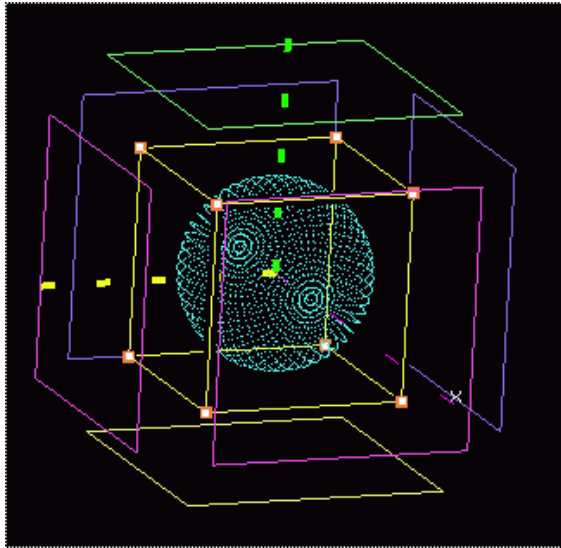
Click on the ⬛ **S** button in the TOPO sub-command panel and scroll through the current surfaces as in **Step 3** to view the surface assignments. As can be seen, all of the corners have been assigned to their proper surfaces. We are now ready to build the mesh.

Step 5   Mesh Generation

As in **Part I**, go to the **topo** sub-menu and click on **Ggrid:Start** to begin the mesh generation process. Allow the mesh to run for a few minutes and load it up by going to the **grid** sub-menu to choose **load new** and click on the **blk.tmp** file.

## Step 6   Introducing the Grid Viewer

One of the most useful tools inside **GridPro** is the **Grid Viewer**. **GridPro** incorporates the most advanced viewing technologies on the market. Go into the **Grid Viewer** panel and the blocks of the grid are displayed as in the picture below.
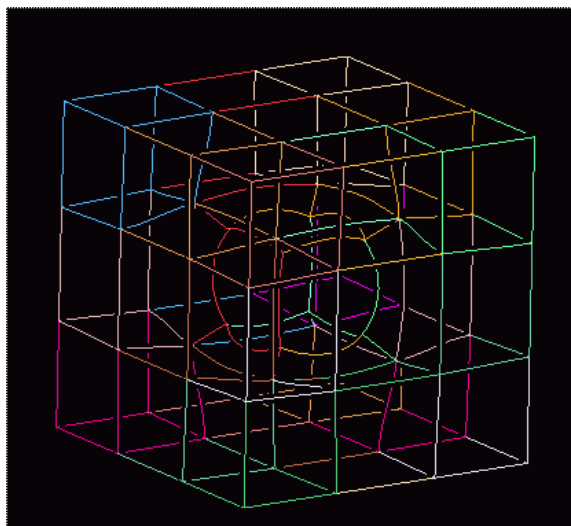
Let's cut a few sheets through the mesh volume. Go to the **MAKE SHEET** sub-command panel and click on the edge button.

MK SHEET: shell edge
surf ◀ ▶ all del
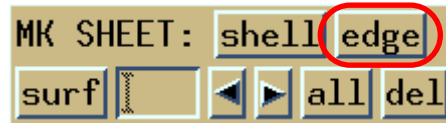
Now place the cursor on the left, center block at the bottom and click with the left mouse button. A sheet will be automatically made as in the picture below.
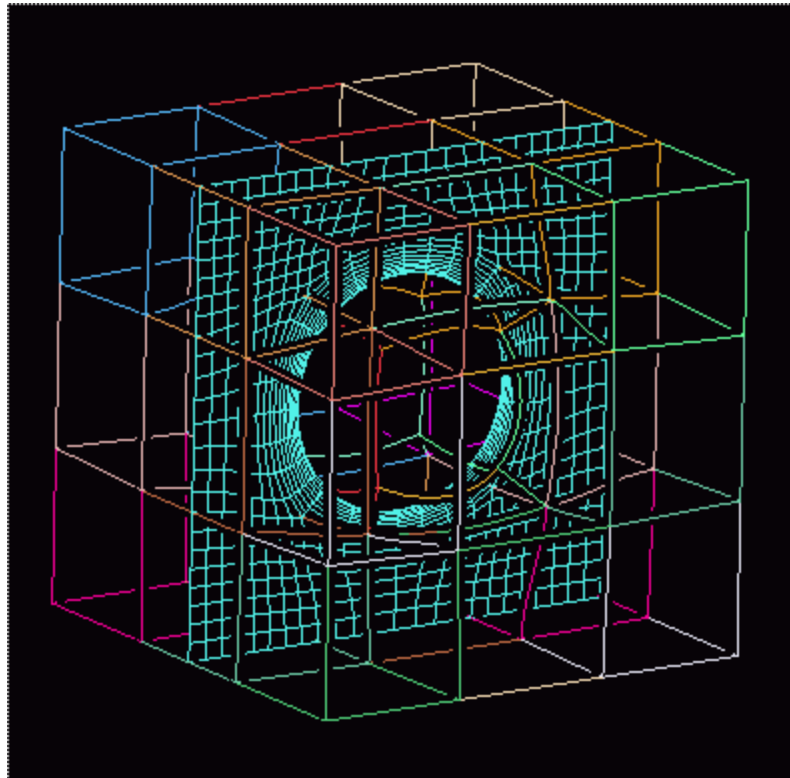

The sheet can be scrolled through the volume to highlight the important features of the grid. Go to the **CUR** sub-command panel and click on the ◀ step ▶ buttons to scroll.
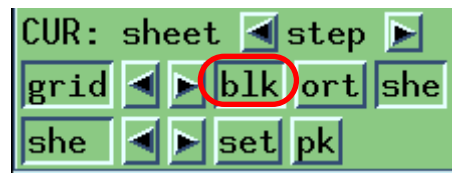
CUR: sheet ◀ step ▶
grid ◀ ▶ blk ort she
she ◀ ▶ set pk
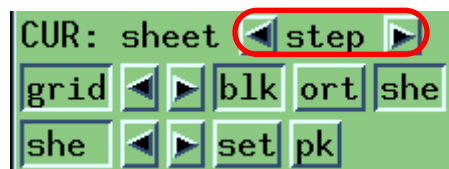
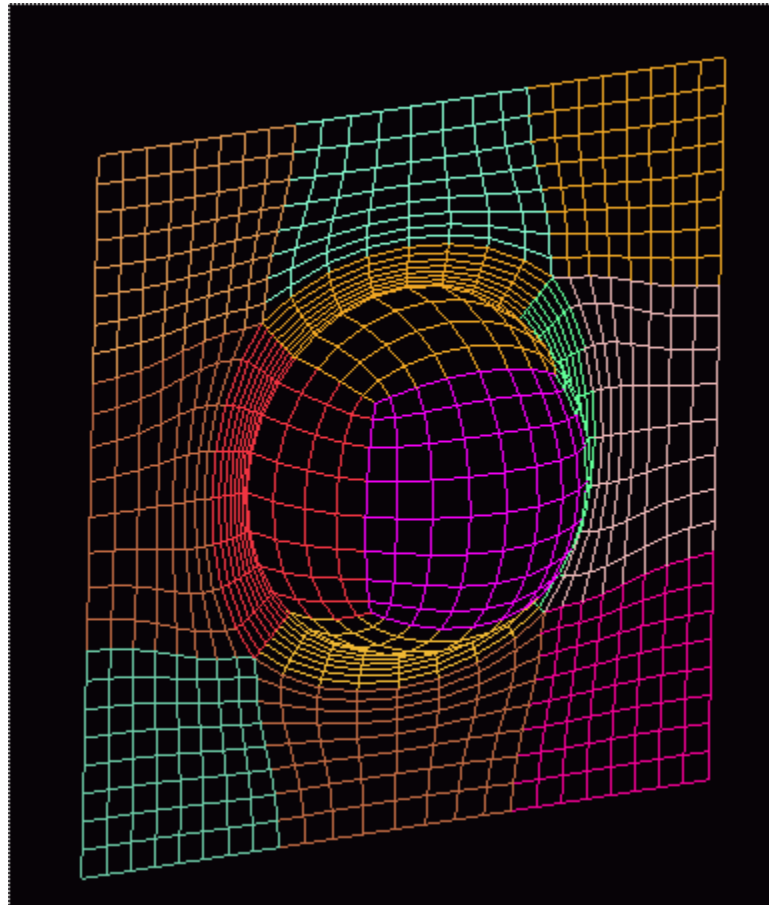Now zoom-in on blocks close to the sphere as in the picture below.
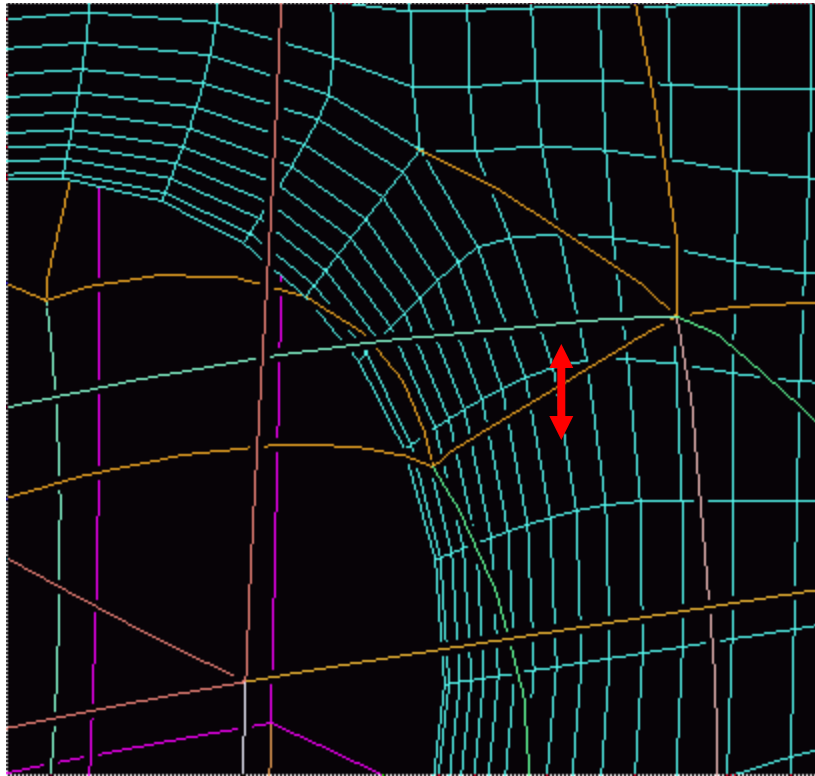
By clicking on the ⌈edge⌉ button and then the block that surrounds the sphere, a sheet is created around the sphere as in the picture below.
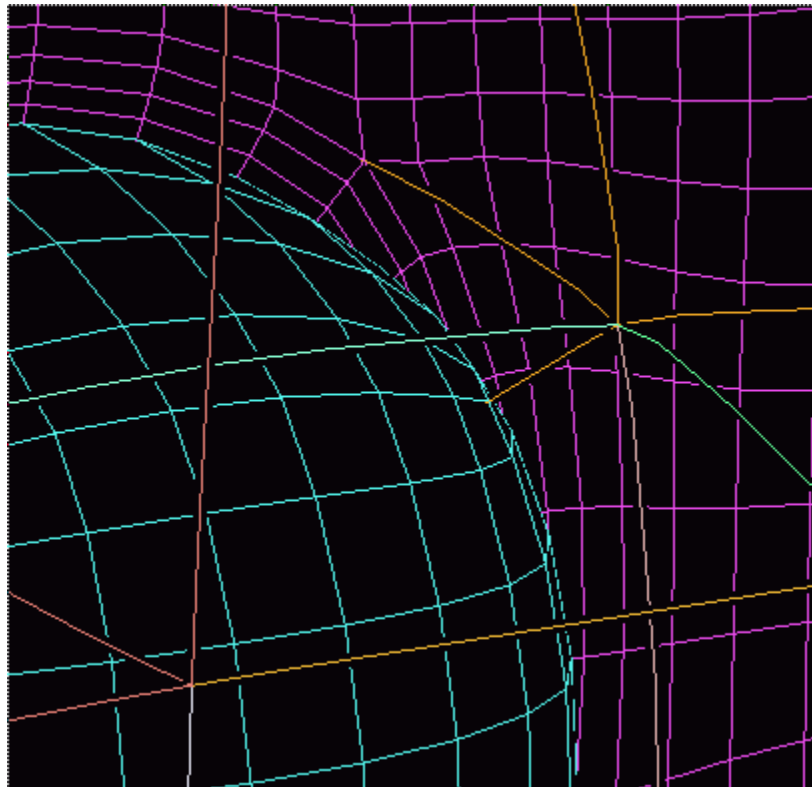
Zoom-out and turn off the blocks in the **CUR** sub-command panel by clicking on the **blk** button

and turning on colour by blocks.

Continue to scroll the sheets and make new ones to get to know the grid viewer functions.