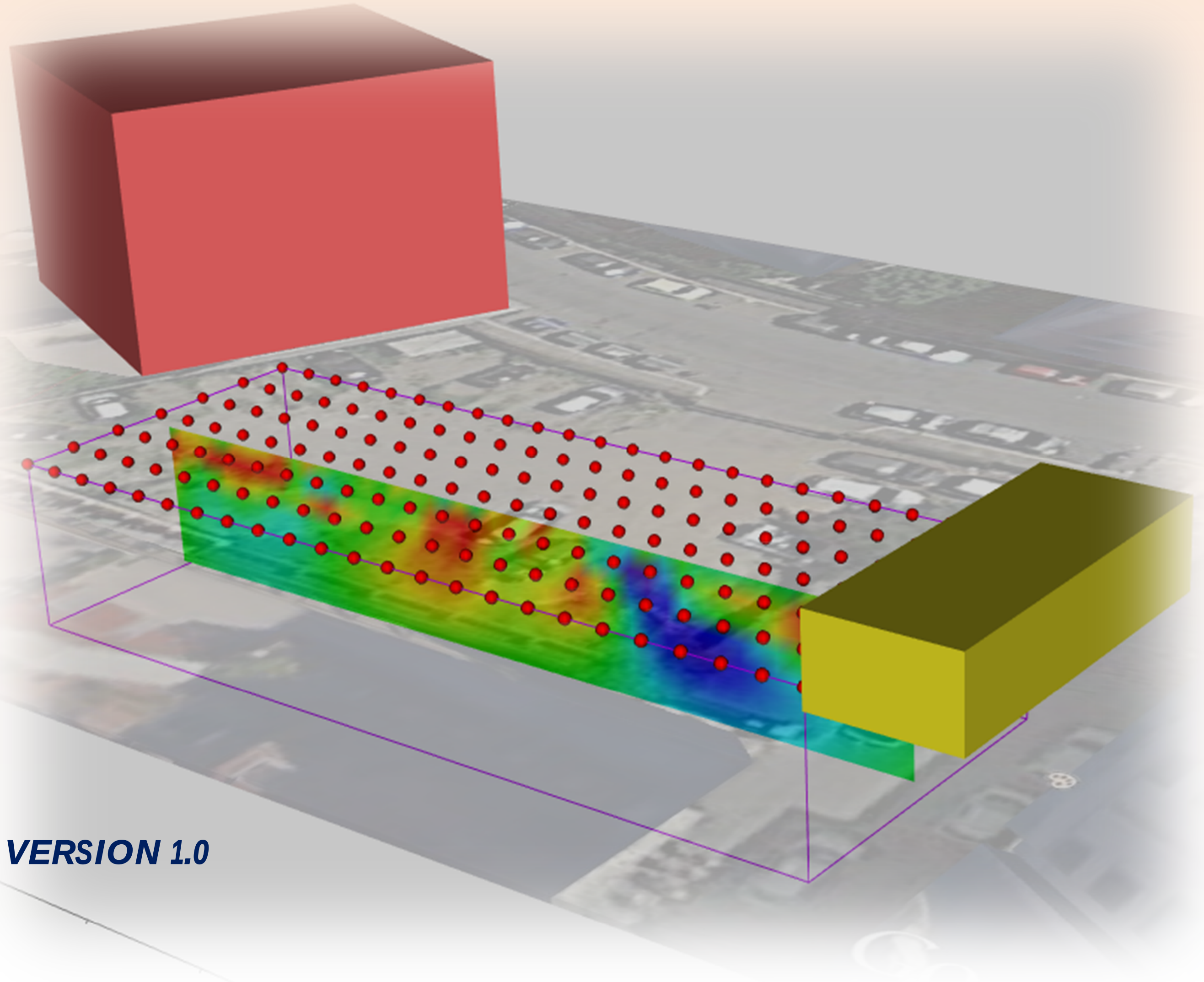
ViewLab3D

DATA VISUALIZATION SOFTWARE

USER MANUAL



VERSION 1.0

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I. INTRODUCTION

This document describes the main features of the software ViewLab3D, produced by Geostudi Astier s.r.l..

It is an useful software to visualize, design and analyze various kind of geophysical data, in particular it is designed to manage seismic and geoelectricalal data. The structural layout of the program is the same for both methodology, but in some cases there are applications dedicated to the two methods that will be treated separately.

This document focuses on the visualization of electric data.

II. USER INTERFACE

When the program starts it shows the following "splash screen":

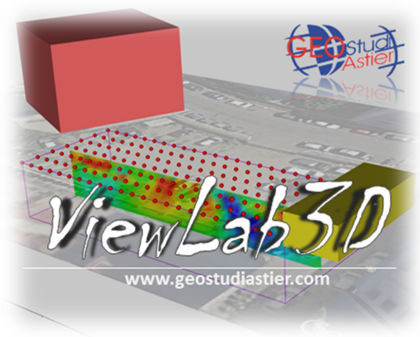


Figure 1: screenshot of the figure that appears at the program launch

Then, after few seconds, the program opens showing the main interface, which is shown in Figure 2:

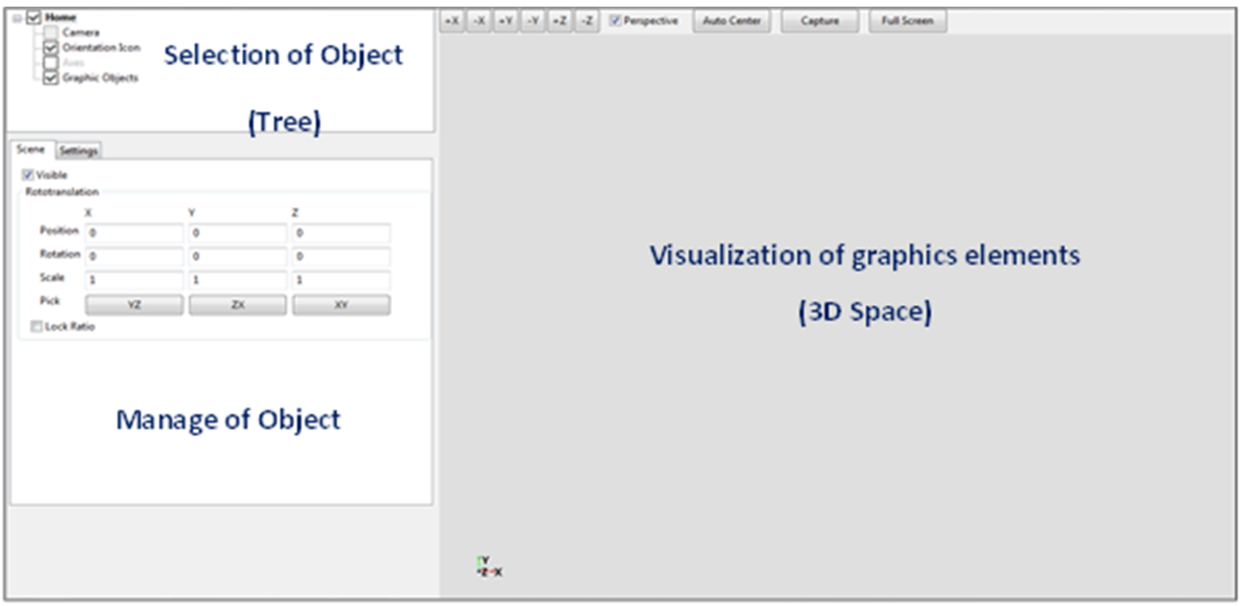


Figure 2: interface at the program startup

This is divided into 3 main areas: the area on the right shows the various object through 3D graphic (at the moment it is empty because no object has been still loaded); the area on the left is the place where the interaction with the application is greater. At the top there is the tree, which allows to select the objects to act on and at the bottom various tools will appears every time one item of the tree is selected; through this tool it is possible to manage the properties of the various graphic elements shown on the right. So contents of this part of the screen varies depending on the selected tree node; at the beginning of the work it is possible that in the lower part of the screen there is a window containing text messages (mainly error messages), in particular "logging" information; this information can be useful for understanding any problems.

The same information are available as text files in the subfolder "Log", which is located in the installation path.

At the beginning of the work the tree on the top left of the screen is not empty but already shows some items which are described in the next part of the document.

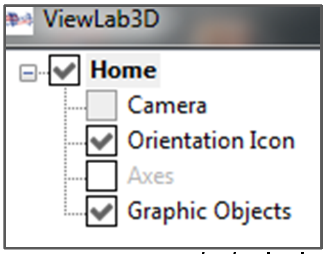


Figure 3: the tree structure at the beginning of the work

III. TREE

This is the main menu, with a tree structure; through it is possible to personalize the 3D scene. Every time one object is selected clicking on the relative node, some dedicated functions will appears on the panel at the bottom of the screen.

Home is the main node of the tree; it contains four secondary nodes, *Camera, Orientation Icon, Axes and Graphic objects*, which are themselves composed by further nodes. In the next paragraph they will be described in detail.

1.0 HOME

Opening the node *Home* it is possible to see that there are 4 voices (*Camera, UCS Icon, Axis* and *Data*) and further items will be added at the insertion of the proper dongle; more information about these will be provided later in this document.

Clicking on *Home* Node, two panels will appears at the bottom of the screen, *Scene* and *Settings*:

- ***Scene Panel:*** it manages the Roto-translation parameters of the entire 3D scene; the relative panel is shown in Figure 4:

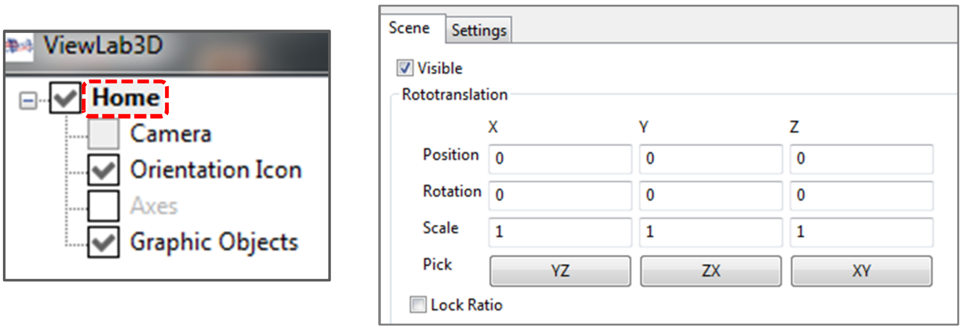


Figure 4: Scene panel

At the moment the panel is empty because no object is still loaded.

To easily understand how the properties described below modify the scene, a cube has been placed in it; the insert mode and the setting of this and other items will be discussed later.

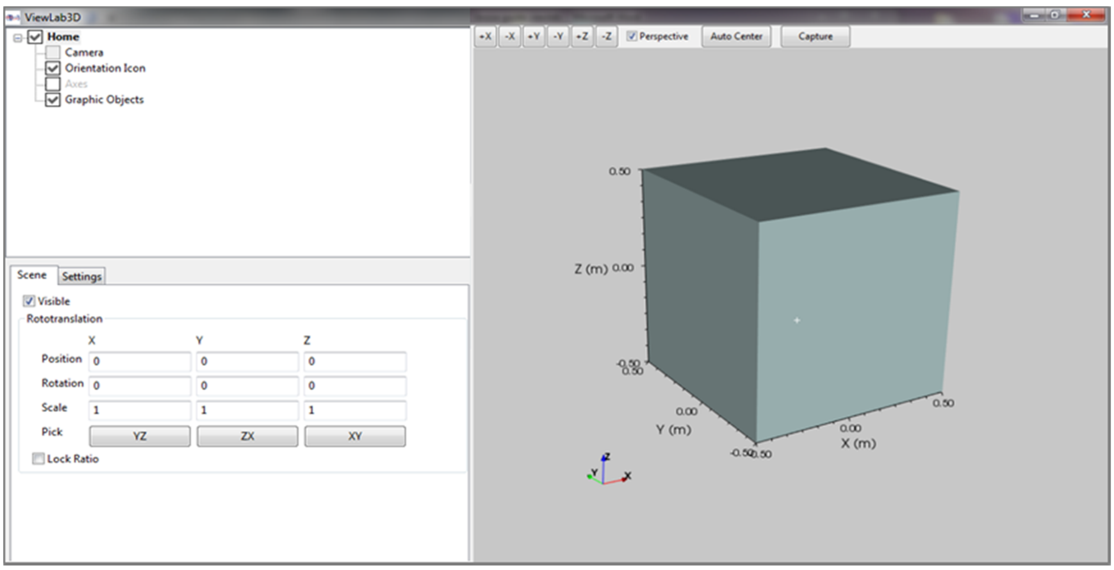


Figure 5: A cube in the scene

It has the following items:

- *Visible:* it make the whole scene visible or not
- *Roto-translation Table:* to set the Position, the Rotation and the Scale of the object (useful if there is the necessity to emphasize one dimension); some example are shown below (Figure 6)

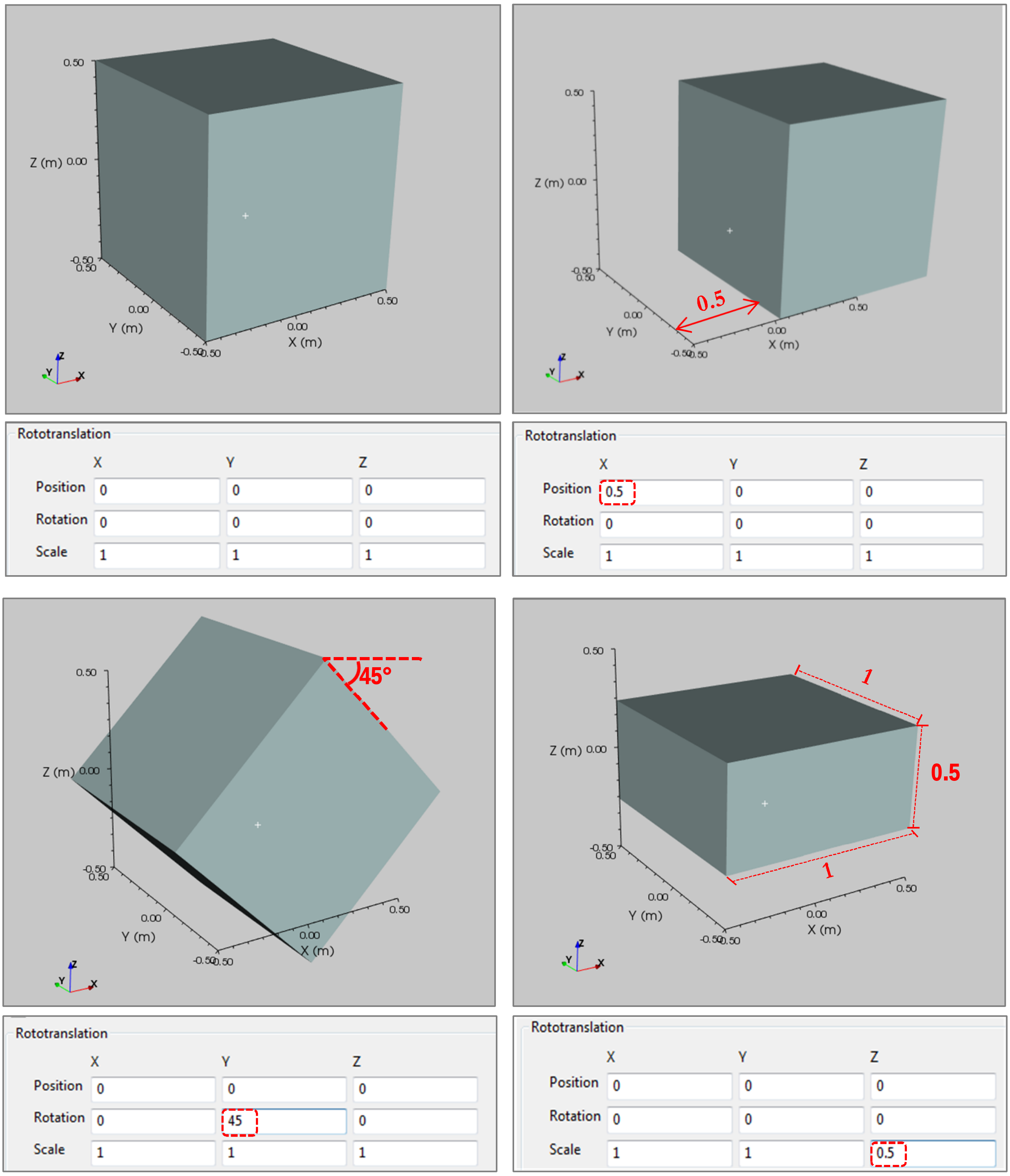


Figure 6: Some example of roto-translation. In A the original position of the cube, with the value in the table of default; in B translation along X axe of 0.5; in C rotation along Y axe of 45° and in D decrease in the scale ratio of 0.5 along Z. This last function is very useful in those case where emphasize one dimension helps to better analyze the value trend.

So, through the *Position* X, Y and Z it is possible to choose where to put the object in the scene; through the *Rotation* X, Y and Z it is possible to rotate the object of 360° in the three directions and through the *Scale* X, Y and Z, it is possible to change the scale of the entire 3D scene (sometimes may be useful to change one direction to emphasize the trend of one property, for example an alignment along one direction).

This table is useful in case it is necessary to place the scene in a specific point and rotate it of a defined quantity, expressed by an exact number; otherwise, if it is required to manually shift the scene it is possible to use the proper *Pick* buttons:

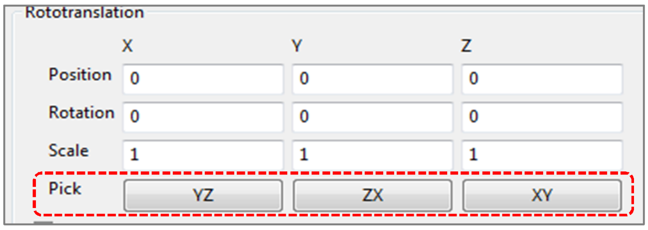


Figure 7: Pick Button in rototranslation panel

Clicking on one of this buttons, it is possible to act along the selected plane; a specific panel appears overlay at the object, shown in the following figure (Fig 8)

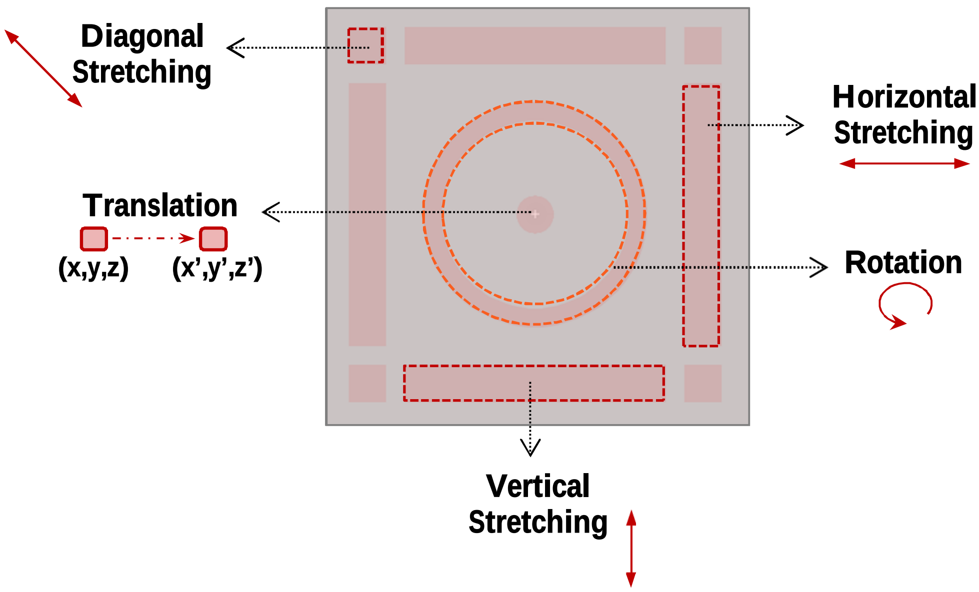


Figure 8: Manually rototranslation panel

For example, to stretch one cube along X axe it is sufficient to press the right mouse button, to drag it until the desired position and to release the button. The X dimension will be changed (from 1 to 2 in this example) and the other two will remain unchanged.

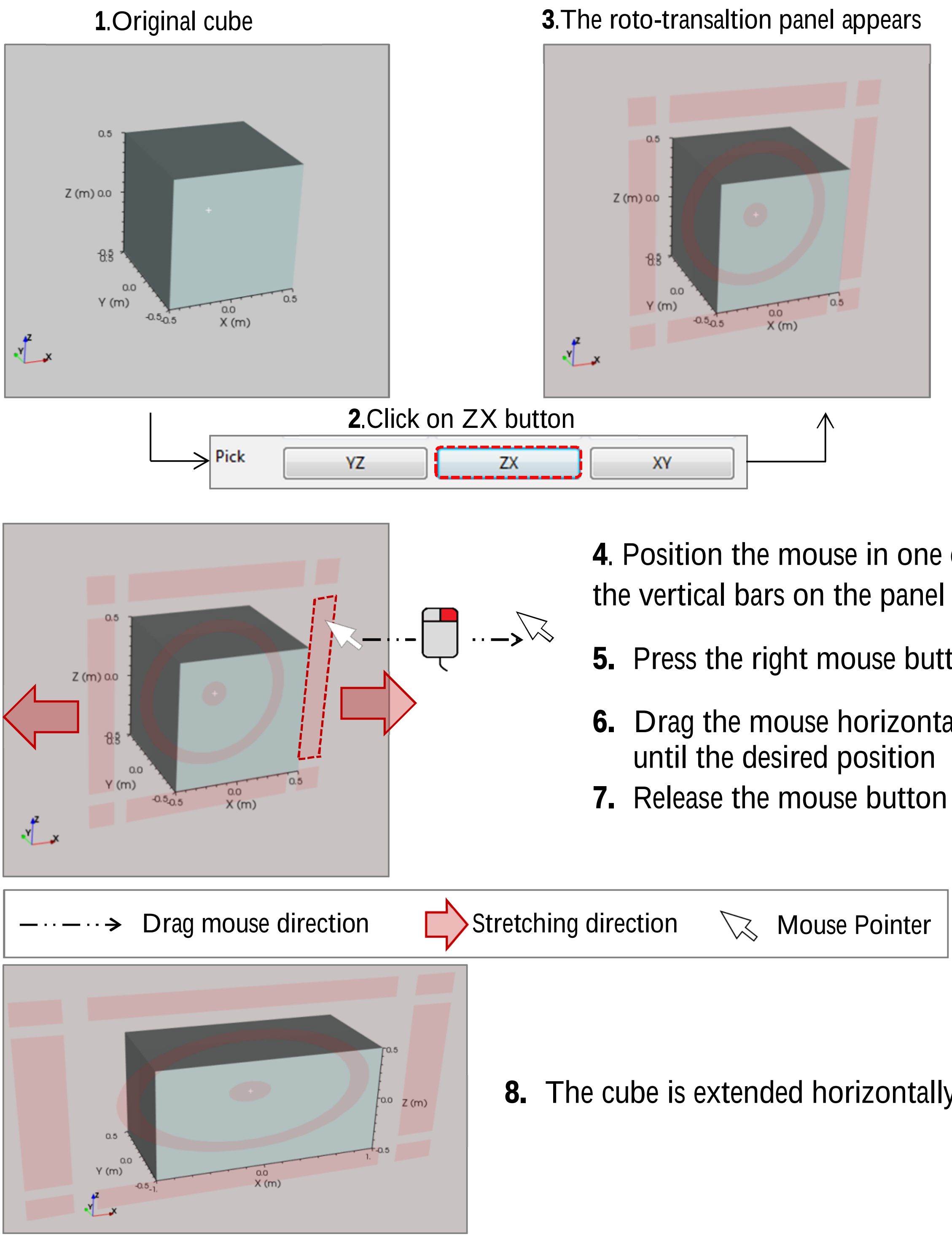


Figure 9: Example of manually stretching of a cube in one direction

If ***Lock Ratio*** is checked, dragging the mouse in one direction even the other dimensions of the same plane are deformed of the same quantity.

In the following example , the cube is deformed vertically through the mouse but it is stretch horizontally too:

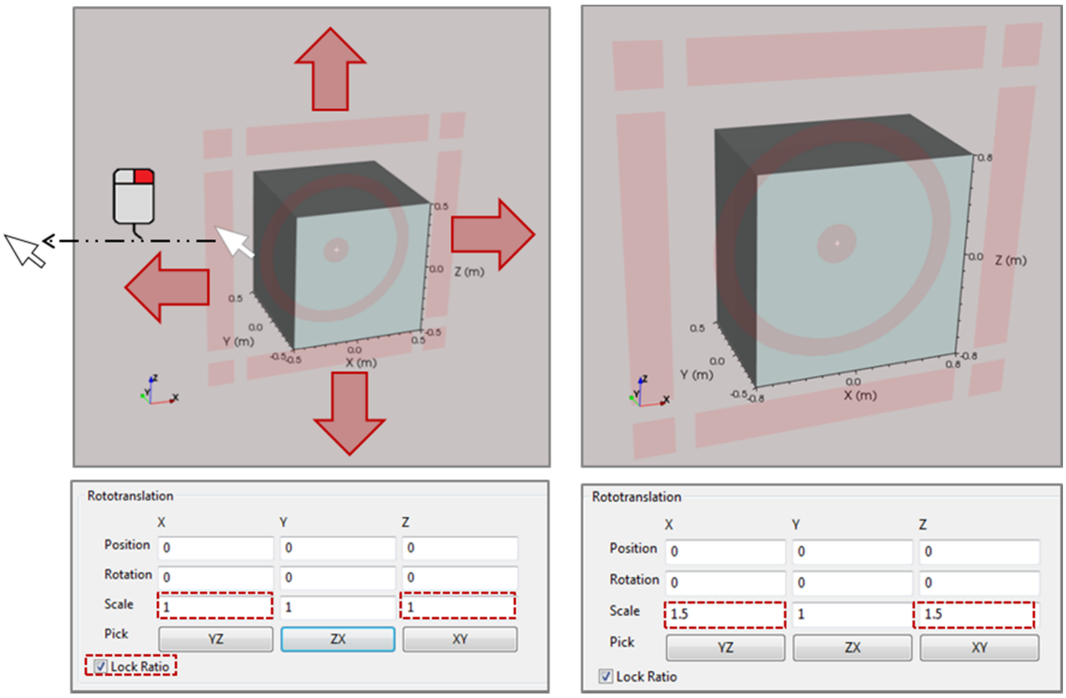


Figure 10: Example of manually stretching of a cube in two dimensions, with Lock Ration active

In the following paragraphs will be treated how to insert the various objects in the scene. Each object will have its position, its rotation and its size, editable independently from other objects. Through the panel just explained, instead, all the objects are treated as a single unit. In this case only one cube is in the scene but if more objects were inserted into the scene everyone would be subjected to the changes made by the table.

In the following example 5 spheres were included in the scene (figure 11)

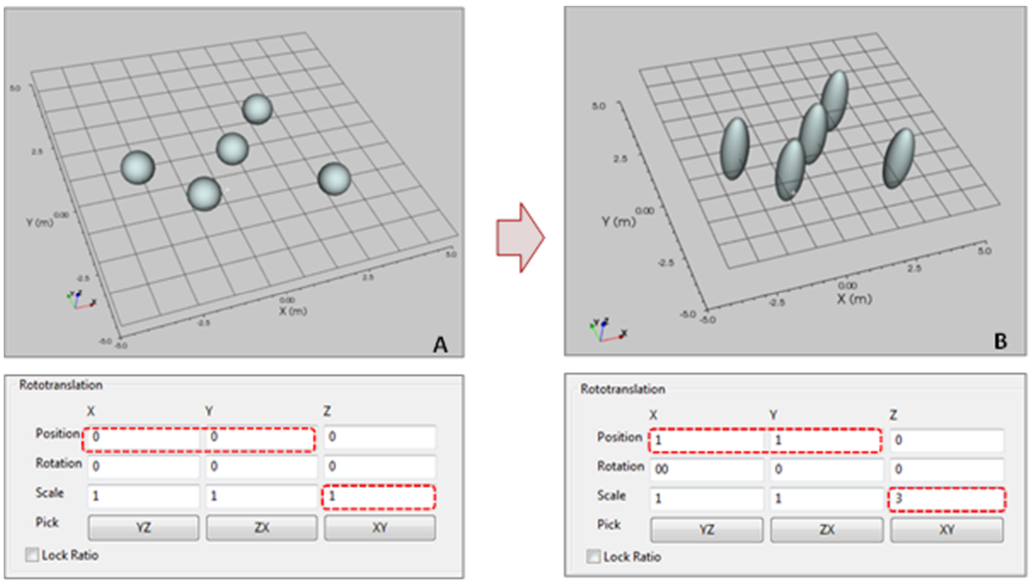


Figure 11: in A objects in original position, in B the same object after a change of position and scale in Scene panel.

From image A to image B the position varies from 0 to 1 for X and Y axes and the Z axe is scaled of a factor of 3; the scene is shifted and the spheres turns into 5 ovoid shape objects, but the relative position between the objects doesn't change.

- ***Setting Panel***

In the Setting panel there are the general information about the software, the version currently installed, the button for any updates and the *Languages* (at the moment are available English and Italian versions).

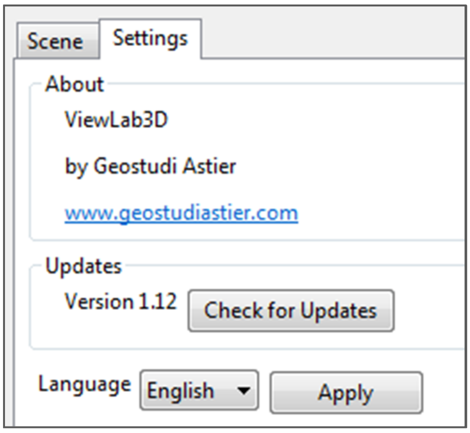


Figure 12: "Setting " panel

2.0 CAMERA

This tool allows to manipulate the mode of representation of the 3D scene shown on the right panel, through some properties which are described below.

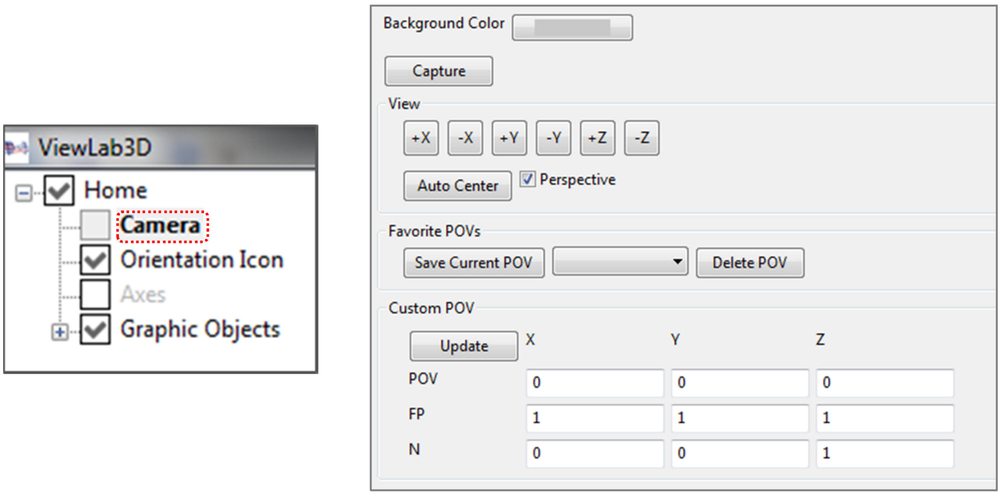


Figure 13: Camera panel

• ***Background Color***: it lets to change the background color, which is white by default. As an example, in the following figure (Fig.14) was set a gray and orange background color.

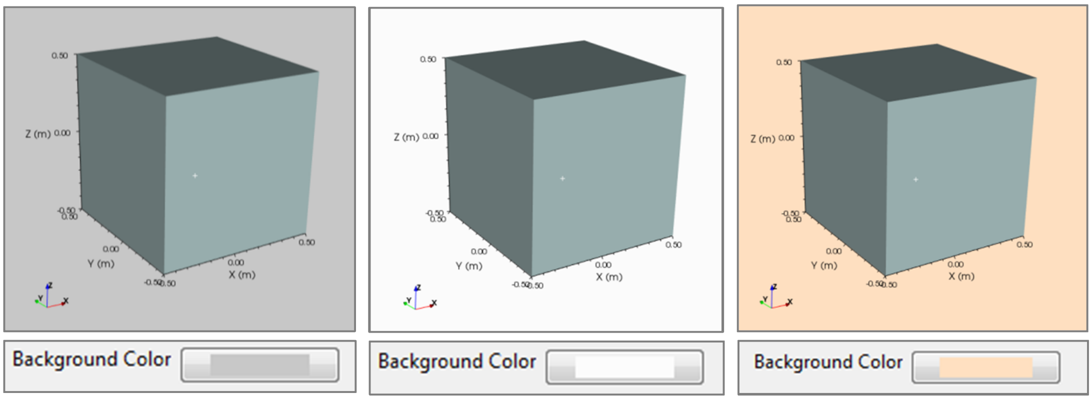


Figure 14: sub-node camera, different choices of background color

- ***Capture***: it allows to export what is currently shown in the 3D scene as an image file; the same button is present in the 3D scene, in the upper right side of the panel.

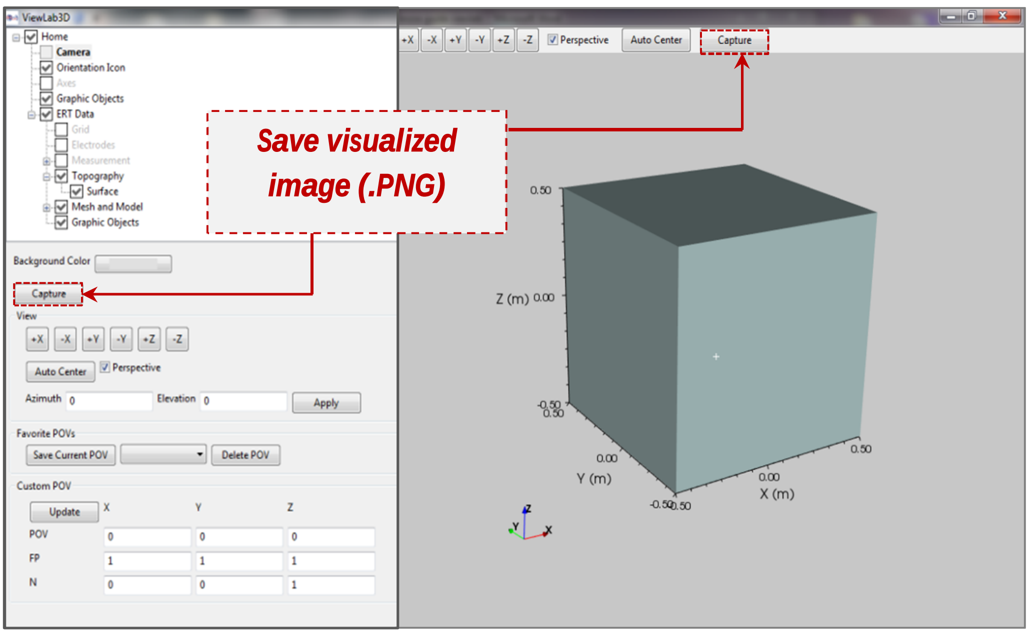


Figure 15: Capture tool to save the current image as a .PNG file

- ***-X, +X, -Y, +Y, -Z, +Z* buttons**: they allow to rotate the view along one of the three axes (X,Y, Z) and also allows to specify from which direction ("-" and "+") to observe the scene. An example with three objects (a cube, a sphere and a pyramid) in different positions is shown in the following figure (Fig.16).

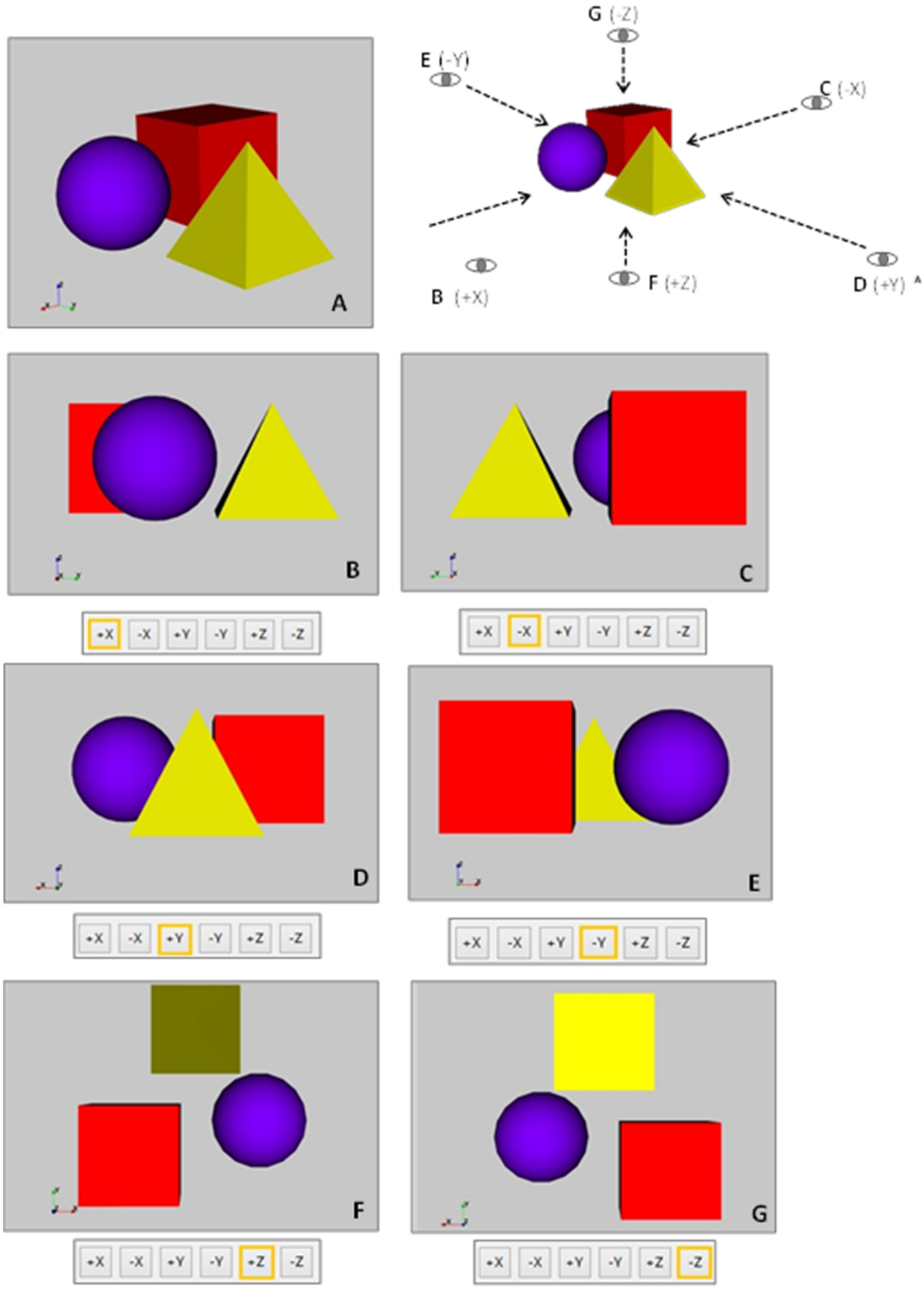


Figure 16*: sub-node “Camera”, different points of view of objects along one of the 3 axes ; in **A** view respect a casual point of view, in **B** view respect positive X axe (+X), in **C** view respect negative X axe (-X), in **D** view respect positive Y axe (+Y), in **E** view respect negative Y axe (-Y), in F view respect positive Z axe (+Z) and in **G** view respect negative Z axe (-Z).*

- ***Auto Center***: it sets automatically the object at the center of the scene, as shown in figure 17.

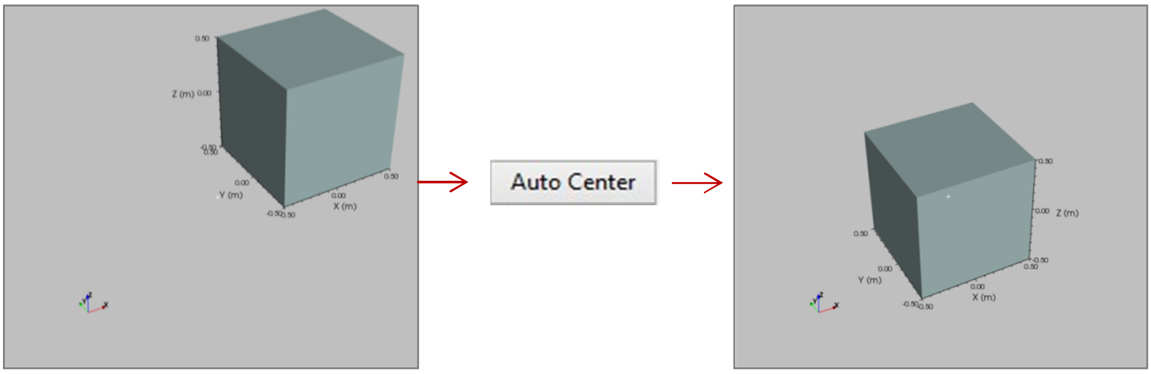


Figure 17: sub-node Camera, in A the object is located in a general position, in B it is at the center of the scene after the application of Auto Center tool.

- ***Perspective***: it switches the perspective view in orthogonal view, as shown below (Fig.18). The red dashed lines helps to value the difference between the two objects.

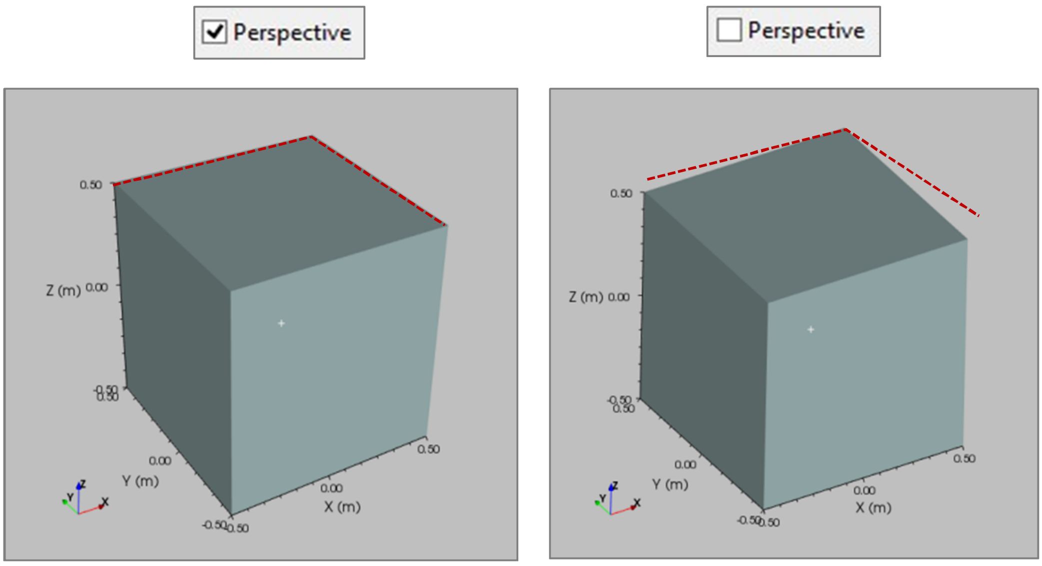
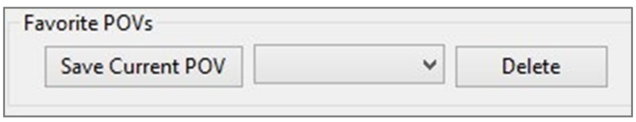


Figure 18: sub-node "Camera", in A prospective view, in B orthogonal view

- ***Favorite POVs***: thanks to this tool it is possible to memorize some specific positions of the object in the 3D scene and to recall them any time after some display modifications.

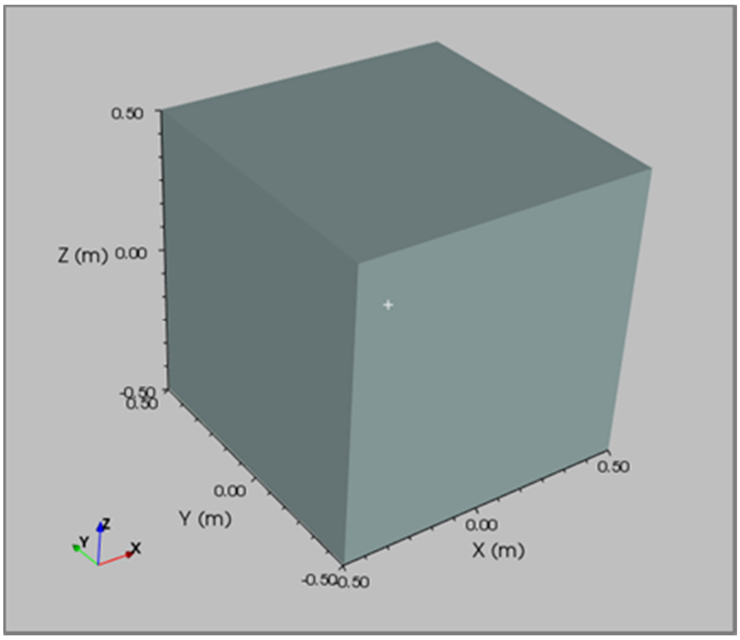


To save the current view press "*Save Current Point of View*" button; it is possible to give a name to this setting using the proper space nearby (it is empty in the figure).

If "*Delete*" button is pressed, the selected POV is deleted.

- ***Custom POV***: it is possible to set a specific POV by inserting the desired coordinates X, Y, Z of POV (Point of view), FP (Focal Point) and N (Normal) in the proper table.

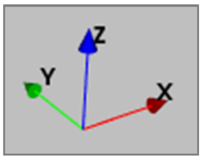
The "***Update***" button updates the table to the values currently used in the 3D scene; it is possible to edit them to set the desired view mode. (Fig. 19).



Update	X	Y	Z
POV	-2.53191342667487	-3.2859515845672	2.60293665218517
FP	-0.02643252706850	-0.01614628418503	-0.04864510361046
N	0.281328713451996	0.4650997408632	0.839366657686871

Figure19: auto-fill of table POV-FP-N in function of the set position of the cube.

3.0 ORIENTATION ICON



Through this panel it is possible to set the properties of the object shown in the near figure, which displays the orientation of the 3 axes (X, Y and Z) in the 3D space.

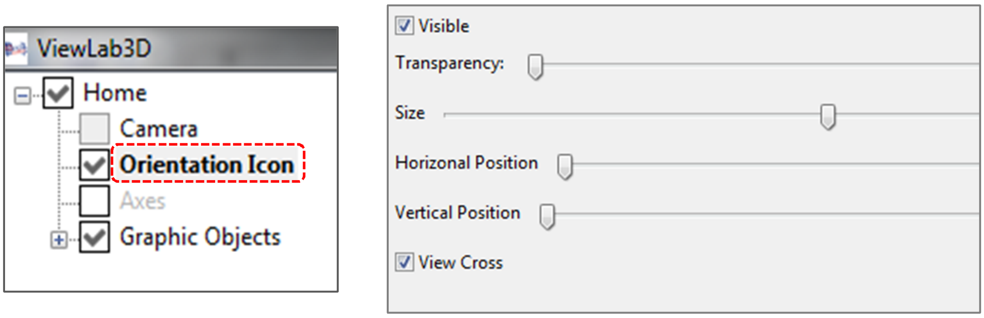


Figure 20: UCS-Icon panel

- ***Visible***: it allows to visualize or not the object, clicking or not the checkbox.
- ***Transparency***: it allows to set the transparency of the object; when the slide is totally at left the object is completely visible; when it is on the right it is not visible at all and at the intermediate positions it is more transparent as the slide goes towards the right, as shown in figure below (Fig.21)

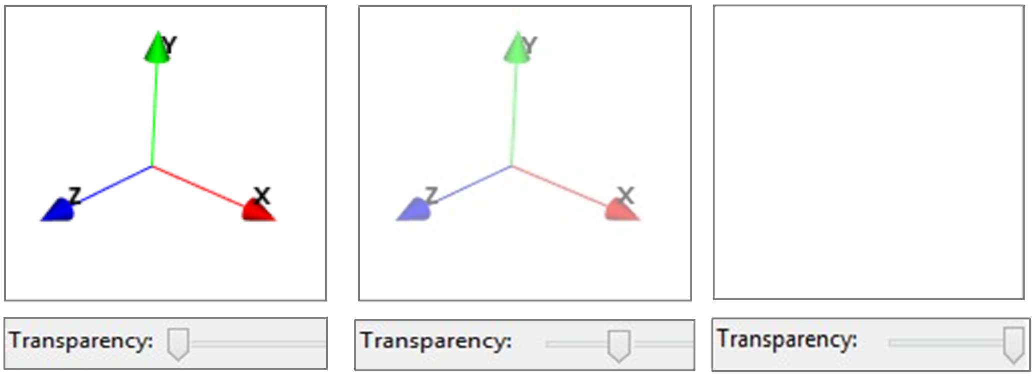


*Figure 21: sub-node "UCS-Icon", different level of transparency of the object. In **A** the transparency is set at the minimum (in the detail the axes are completely visible), in **B** the transparency is set at an intermediate level (in the detail the axes are semi-transparent) and in **C** the transparency is set at the minimum (in the detail the axes are not visible at all)*

• ***Size***: it allows to set up the size of the object, between a maximum (slide at right) and a minimum (slide at left) (Fig. 22).

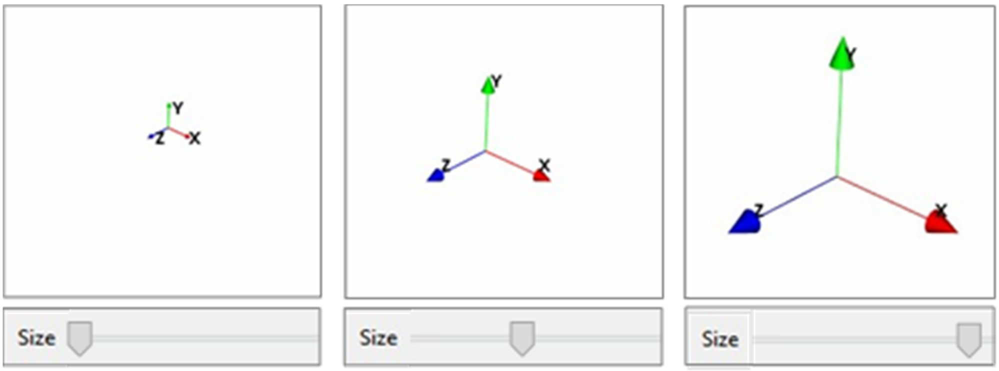


*Figure 22: sub-node "UCS-Icon", different size of the object relative to the orientation of the three axes; in **A** minimum size, in **B** an intermediate size and in **C** maximum size.*

• ***Horizontal Position***: it allows to set up the horizontal position of the object, between a maximum left side (slide at left) and a maximum right side (slide at right), with all the intermediate positions available, as is shown in the following figure (Fig.23)

• ***Vertical Position***: it allows to set up the vertical position of the object, between a maximum lower side (slide at left) and a maximum upper side (slide at right), with all the intermediate positions available, as is shown in the following figure (Fig.23)

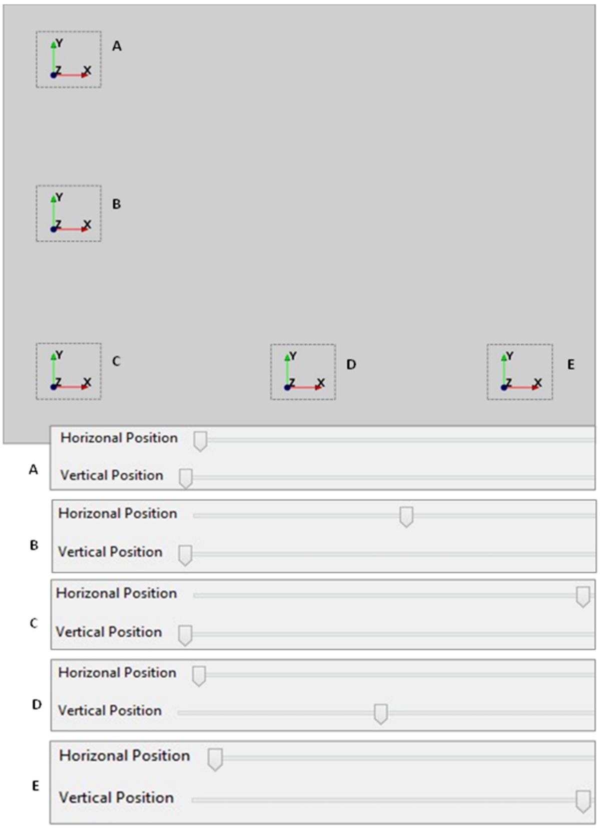


Figure 23: different position of the UCS-Icon in the 3D scene panel

- ***View Cross:*** if it is checked, the little white cross at the center of the scene is visible, otherwise it is not.

3.1 AXES REFERENCE SYSTEM

Through this panel it's possible to set the property of the axes shown in 3D figure (Fig. 24).

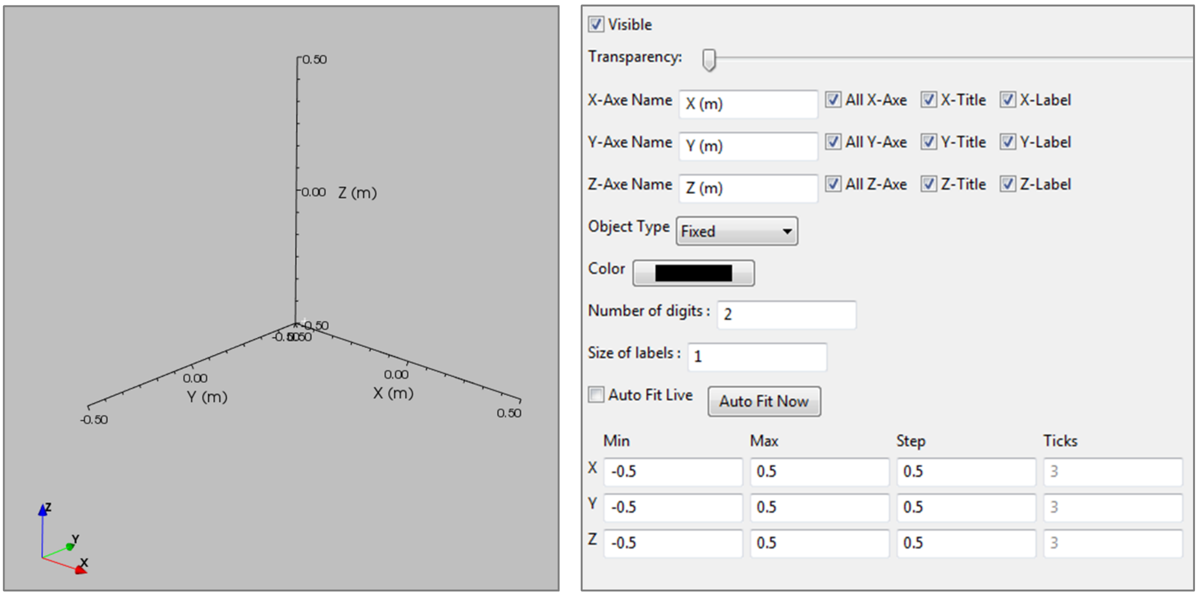


Figure 24: Screenshot of sub-node "Axes" panel

- ***Visible* :** it allows to visualize or not the axes, ticking or not the checkbox.
- ***Transparency***: it allows to set the transparency of the axes; when the slide is totally at left the object is completely visible, when it is on the right it is not visible at all and at the intermediate positions it is more transparent as the slide goes towards the right, (in the same way described in paragraph 3_Orientation Icon).
- ***X,Y,Z-Axe name***: it allows to give a name at every axe (X, Y, Z are the default name)

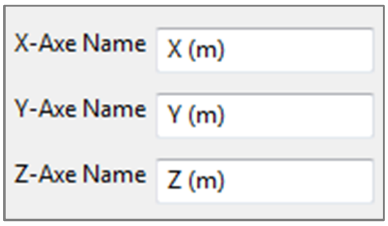


Figure25 : detail of sub-node "Axes" panel

• ***All X,Y,Z Axe***: it allows to show or not every single axe independently from the other two; for example in the figure below the Z axe is visible in the first case (Fig 26_A) and not visible in the second case (Fig.26_B).

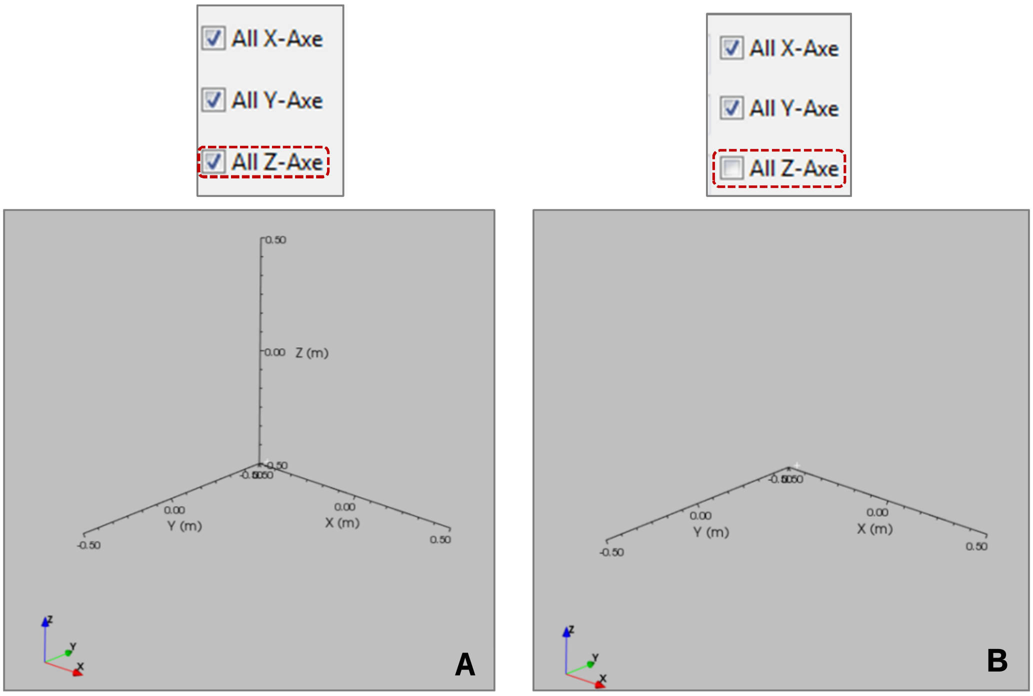


Figure 26: sub-node Axes, in A all the three axes are visible, in B the Z axe is not visible.

• ***X, Y, Z-Title***: it allows to show or not every single axe title independently from the other two; as example in the figure below the title of X axe is visible in the first case (Fig 27_A) and not in the second case (Fig.27_B).

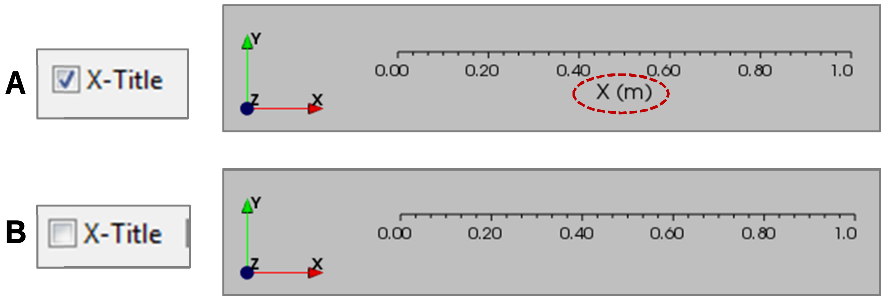


Figure 26: sub-node Axes, in A all the X axe value (labels) are visible, in B they are not visible

•***X, Y, Z- Label***: it allows to show or not every axe labels independently from the other two; as example in the figure below the labels of X axe are visible in the first case (Fig 28_A) and not in the second case (Fig.28_B).

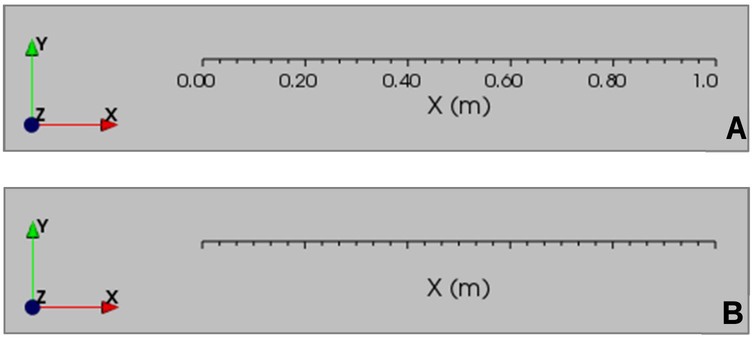


Figure 28: sub-node Axes, in A all the X axe value (labels) are visible, in B they are not visible

- ***Object Type***: in the box with a drop down menu it is possible to choose between three options:
  - o *Outer Edges*: it puts the axes along the edges of the object of the scene (the cube in the example) and they maintain this position even if the object is rotate, as shown in Fig.29-A1, 29-A2.
  - o *Closest Triad*: it puts the axes along the nearest triad from the point of view of the observer, and they maintain this position even if the object is rotated (Fig.29-B1, 29-B2).
  - o *Fixed:* it puts the axes in a fixed triad (starting from the Xmin, Ymin, Xmin) which is hooked to the object; if the object is rotated the axes rotates with it. (Fig 29-C1, 29-C2).

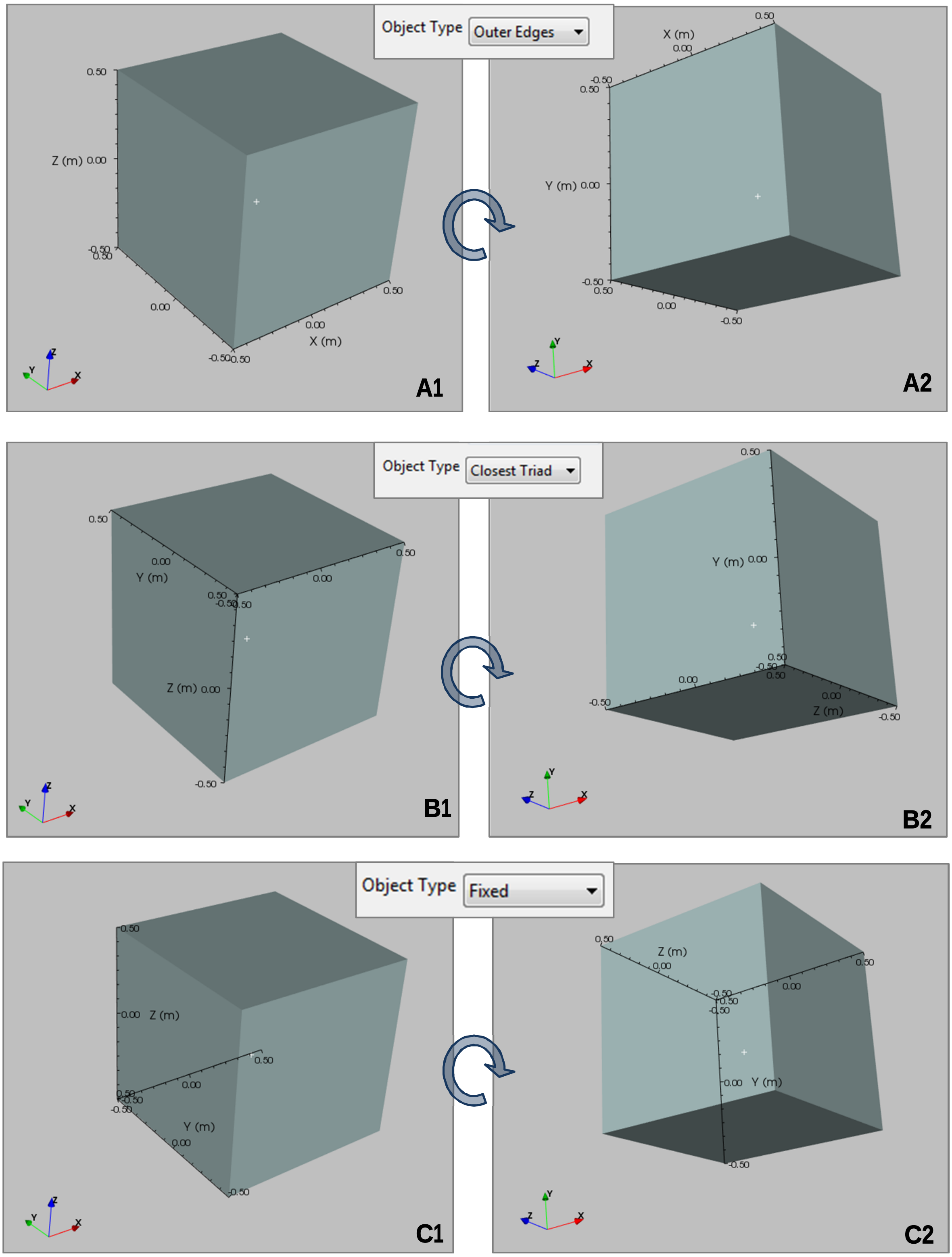


*Figure 29: sub-node Axes, before (left column, **A1,B1,C1**) and after (right column, **A2, B2, C2**) a rotation of the object. Just in the "closest Triad" case the axes doesn't follow the cube.*

- ***Color:*** it allows to change color to the axes; some examples are shown below (Fig. 30)

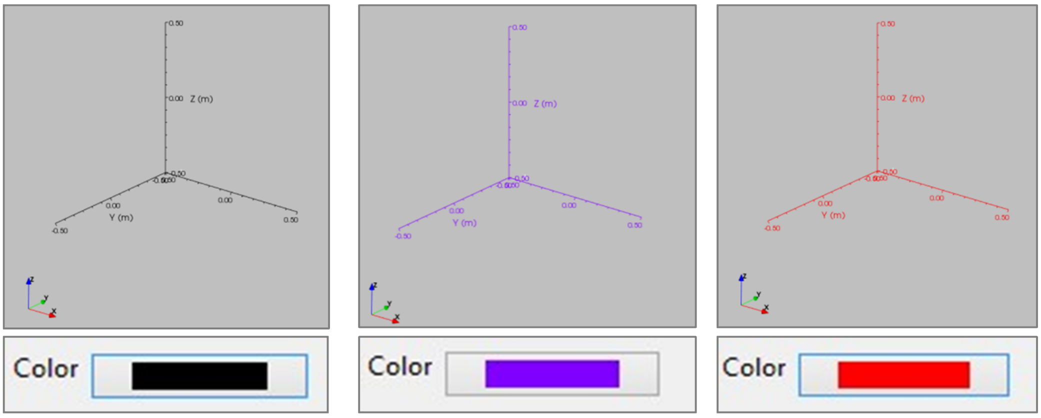


Figure 30: sub-node Axes, different choices for axes color

- ***Number of digits***: it allows to set the decimal used for numbers at axes side. It is possible to specify the value both graphically with the "slider" that numerically using the text box.

As an example, in the following figure (Fig.31) is set the number of digit at 2 and 4.

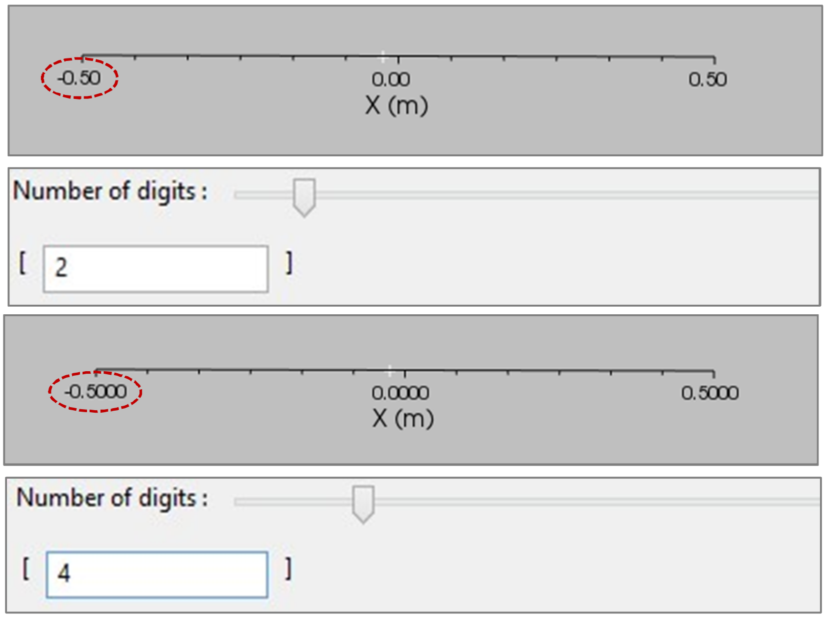


Figure 31: sub-node Axes, example of different number of digits

• ***Size of labels***: it is possible to choose the size of the numbers at axes side, specifying the value graphically with the "slider" or numerically editing the text box.

Figure 32: sub-node Axes, example of different size of labels.

- ***Auto Fit Live:*** if it is selected, there is an automatic and continuous control of the program, which adjust the size of the axes according to the size of object shown in the 3D figure (Fig 33)
- ***Auto Fit now***: it has the same function of the *Auto Fit Live* checkbox just exposed but it works when activated and not in continuous during all the work (Fig. 33)

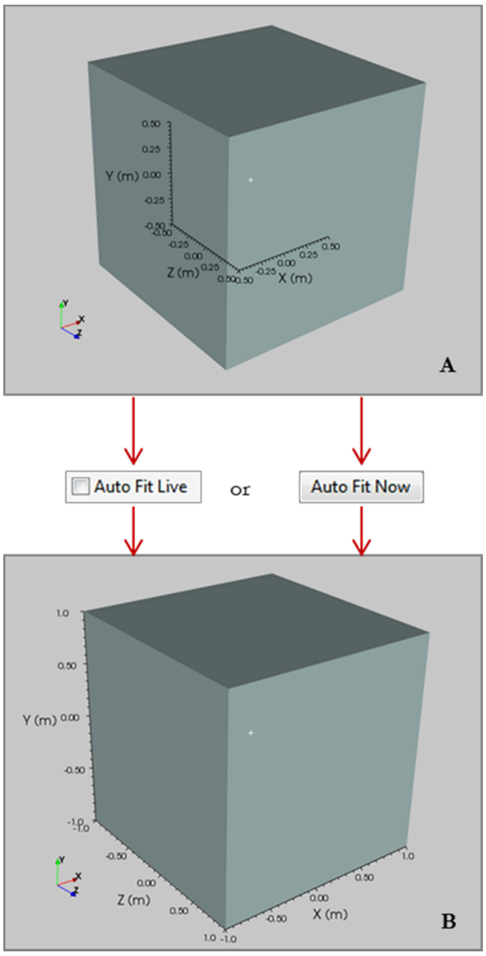
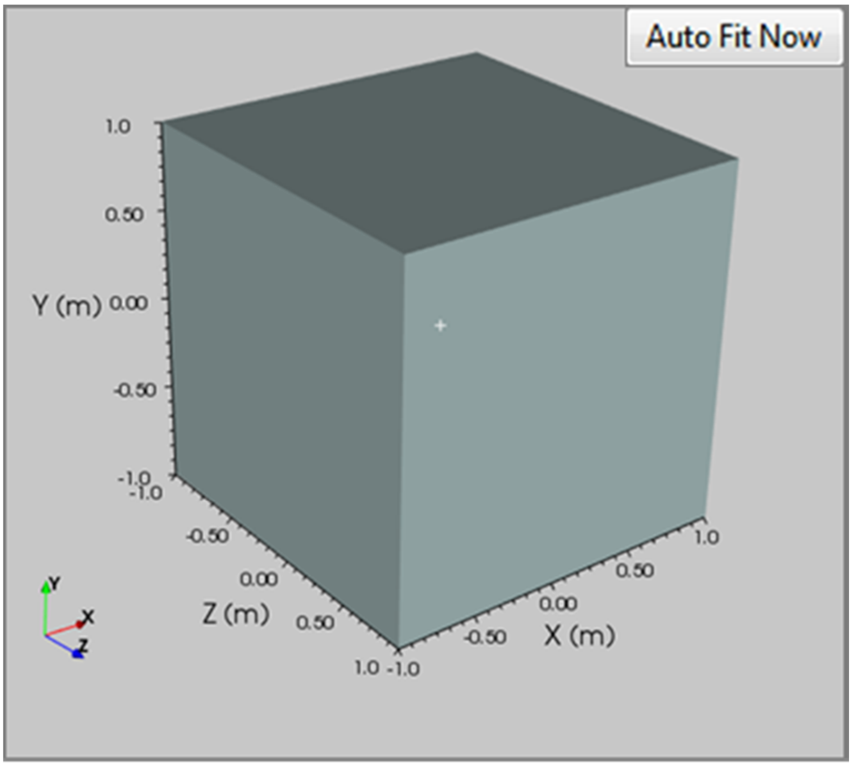


Figure 33*: Sub-node Axes, in A the axes doesn't fit the object, in B they follow the object through Anti Fit live or Auto Fit Now tool*

- The ***table*** in the lower part of the screen: it allows to set the dimensions of the 3 axes and the way to display them. The following examples are shown to explain the various customization possibilities.

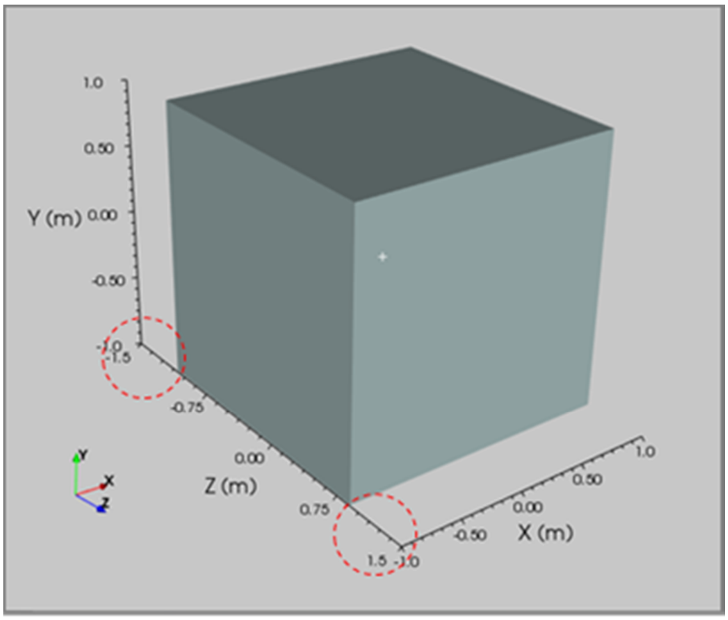
In this case (Fig. 34), the axes are setting in automatic way, through the Auto Fit live tool, in fact the minimum and maximum dimensions of the axes are the same of the object.



	Min	Max	Step	Ticks
X	-1	1	0.5	5
Y	-1	1	0.5	5
Z	-1	1	0.5	5

Figure 34: Example of axes with Auto fit Live tool activated.

It is possible to change the length of the axes; in the following example (Fig 35) the X axe starts from -1.5 and ends at +1.5, while the object size is still between -1 and +1.



	Min	Max	Step	Ticks
X	-1	1	0.5	5
Y	-1	1	0.5	5
Z	-1.5	1.5	0.75	5

Figure 35: Example of axes longer than the object

It is possible to change the features of axes label, as well; in particular it is possible to set the *Step* (how many digits jump between a label and the other) or the *Ticks* (how many label to display); the two quantities are dependent on each other and then setting one the software will calculate automatically the other (grey numbers in the table)

In the following example (Fig. 36) in A the step of X axe is set at 0.25 and the step of Y and Z axes are not modified (they are still at step 0.5, as the table shows); the thick is automatically calculated, and it is 9.

In B the ticks of X label is set at 3 instead that 5, as Y and Z axes; the Step is automatically calculated and it is 1.

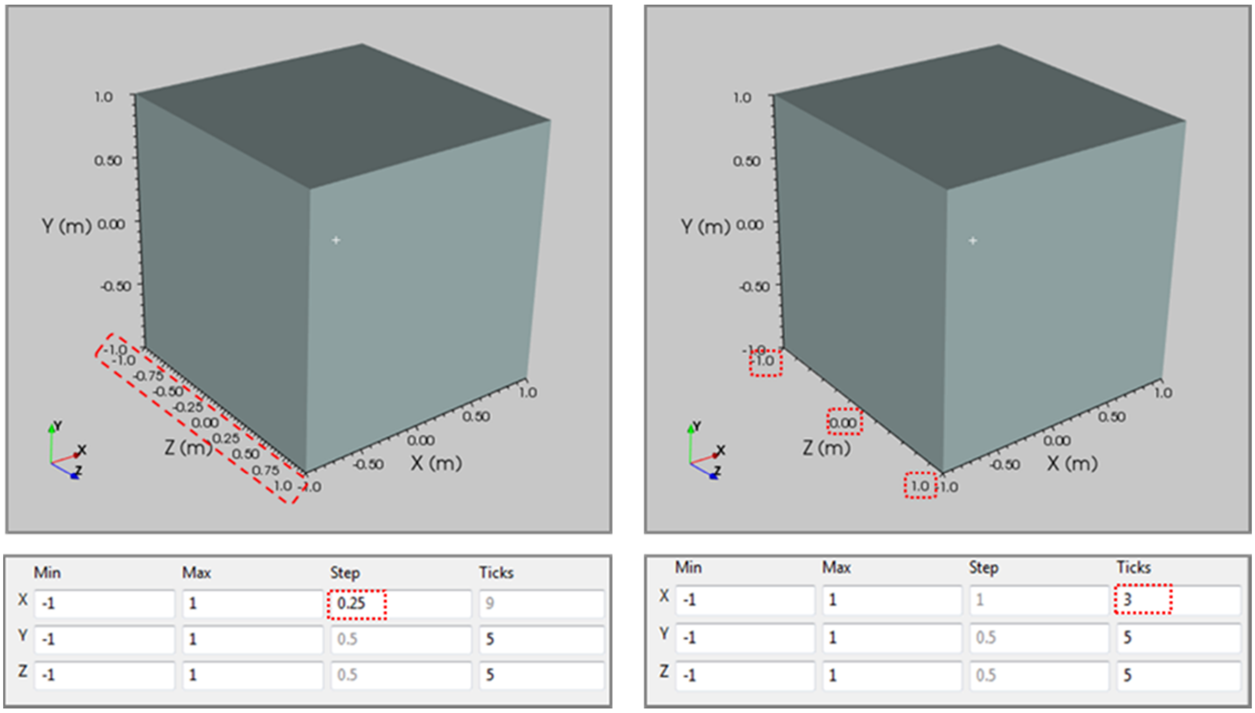


Figure 36: Examples of different step (A) and tick (B) of the X axe.

4.0 GRAPHIC OBJECTS

This node allows to insert in the scene objects of various types.

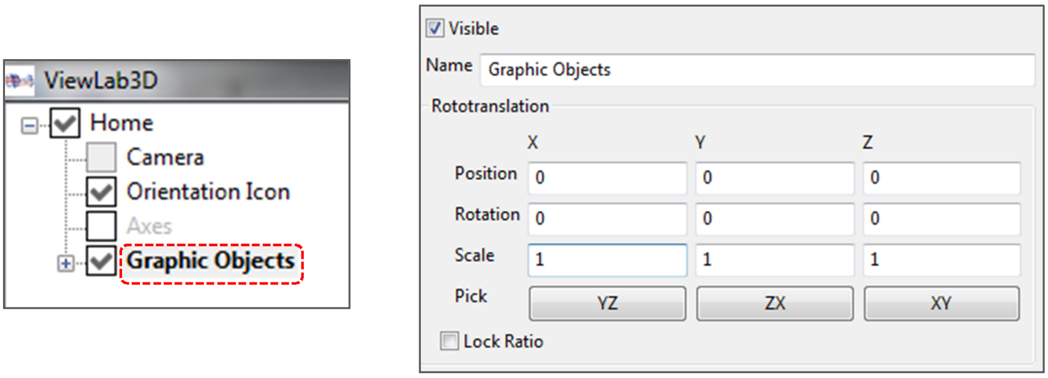


Figure 37: Data panel

Using the "Visible" property, it is possible to display or not all objects placed at that time, in the same way explained in *Orientation icon* Paragraph.

Through the table X-Y-Z it is possible to set the Position (to translate the origin to a point in space other than 0 0 0) the Rotation (rotation in degrees on each axe to move away from a starting plan) and the Scale of the object (useful if there is the necessity to emphasize one dimension or to manage many object of different dimension in the same grid).

Clicking with the right mouse button on *Graphic Objects* node, it is possible to load an object saved in some personal folder, using Load button, or to insert one of the available object through *Insert Object* button; in this case a panel with a list of tools will appears, as shown in Figure 38:

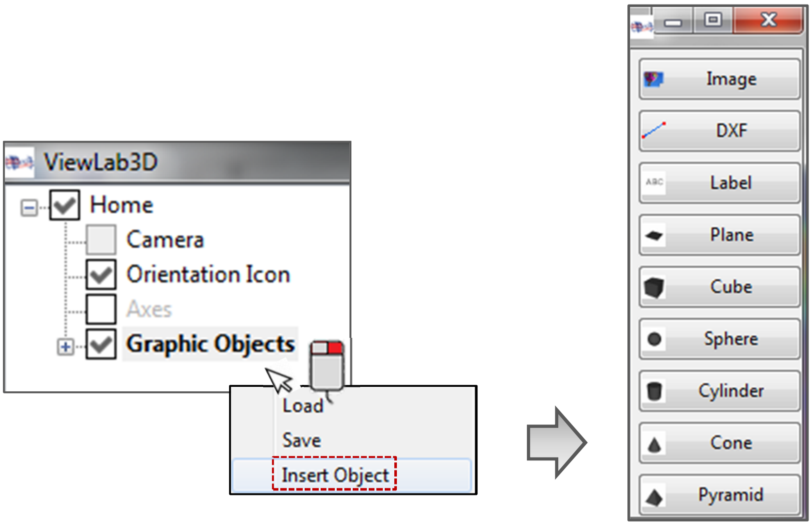


Figure 38: Objects available for the insertion in 3D scene

4.1 IMAGE

In this case, the object is created importing it from a file (an image, in common formats ' bmp ', ' jpg ', ' png ', …). A new node will be added at the tree (one new node for every object created).

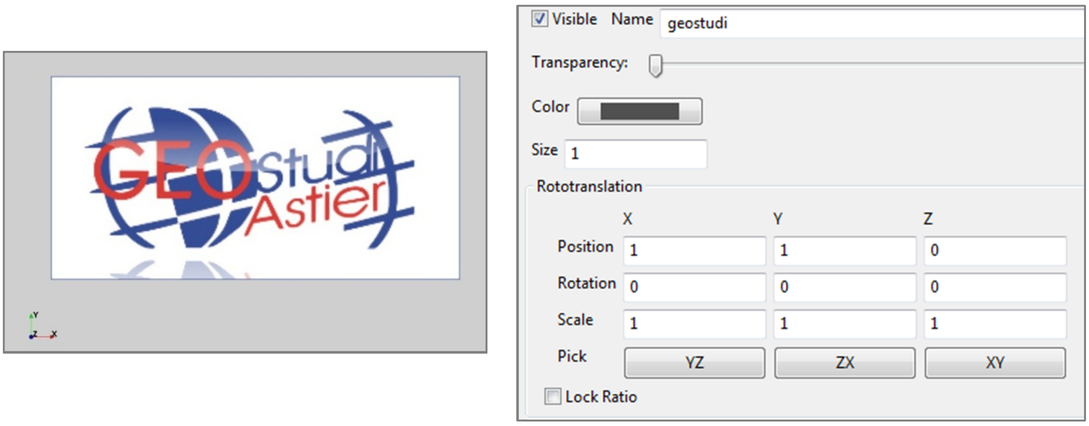


Figure 39: detail of sub-node "Data" panel, property of "image"

Through the box "Name" it is possible to give a name to the object ("Geostudi" in this example). The transparency of the image is editable through the "Transparency" property (shifting the slide at the desired point, in the same way exposed in *Orientation Icon* paragraph); it is possible to rototranslate the image through the proper table (setting the Position, the Rotation and the Scale of the displayed object) or manually through *Pick* button, as explained in paragraph 1_*Home.*

4.2 DXF

It is possible to import a CAD file (*.DXF format) selecting the proper voice in *Object type* menu. This format is very complex and constantly improving, so it possible to import just the basic elements as points, lines, poly-lines, arcs, circles, and text (and blocks made from these items); more complex objects are not imported nor represented. However this tool is very powerful and can be used for many situations.

4.3 LABEL

It is possible to insert in the scene some labels as words, text or numbers (Figure 44):

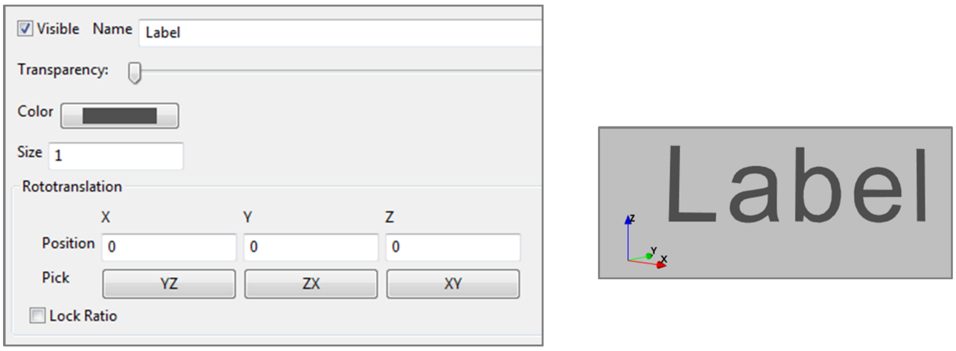


Figure 44: detail of sub-node "Data" panel, property of "Label"

As for the other object exposed before, it is possible to set the transparency of the object, the color, the size (writing the desired number in the box o through the use of the slide), the position X,Y and Z, to make the label visible or not and to give it a name ("Label" in the example) writing it in the proper space. It is also possible to roto-translate the label manually through *Pick* button, as explained in 1_*Home* paragraph.

4.4 PLANE

It is possible to insert a plane in the scene through the proper voice in *Insert Object* menu.

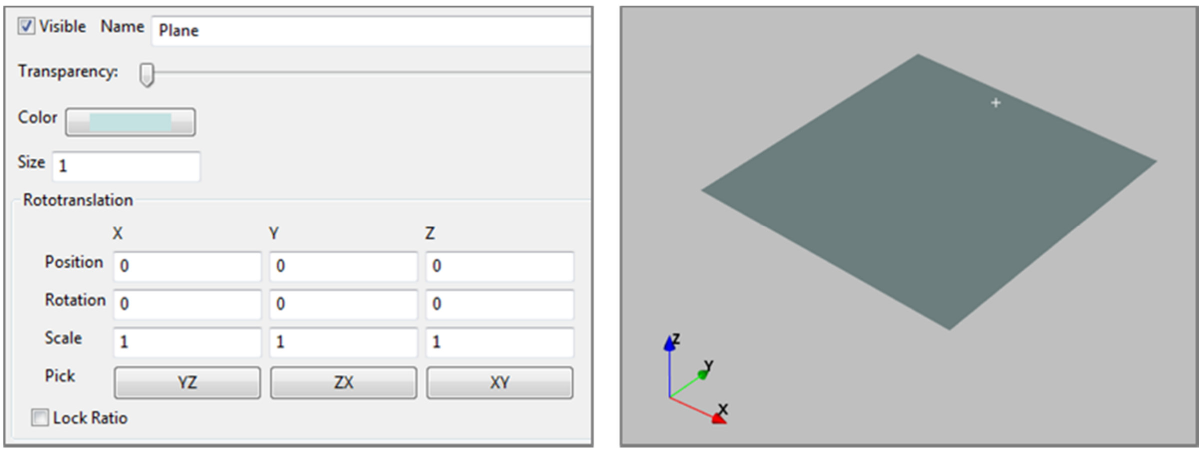


Figure 45: Plane Panel

As for the other object exposed before, it is possible to set the transparency of the plane, the color, the size (writing the desired number in the box o through the use of the slide), to make the label visible or not and to give it a name (“Plane” 1 in the example) writing it in the proper space. It is possible to roto-translate the plane through the proper table (setting the Position, the Rotation and the Scale of the displayed object) or manually through *Pick* button, as explained in 1_*Home* paragraph.

4.5 CUBE

It is possible to insert a cube in the scene through the proper voice *Insert Object* menu, as was done at the beginning of this document.

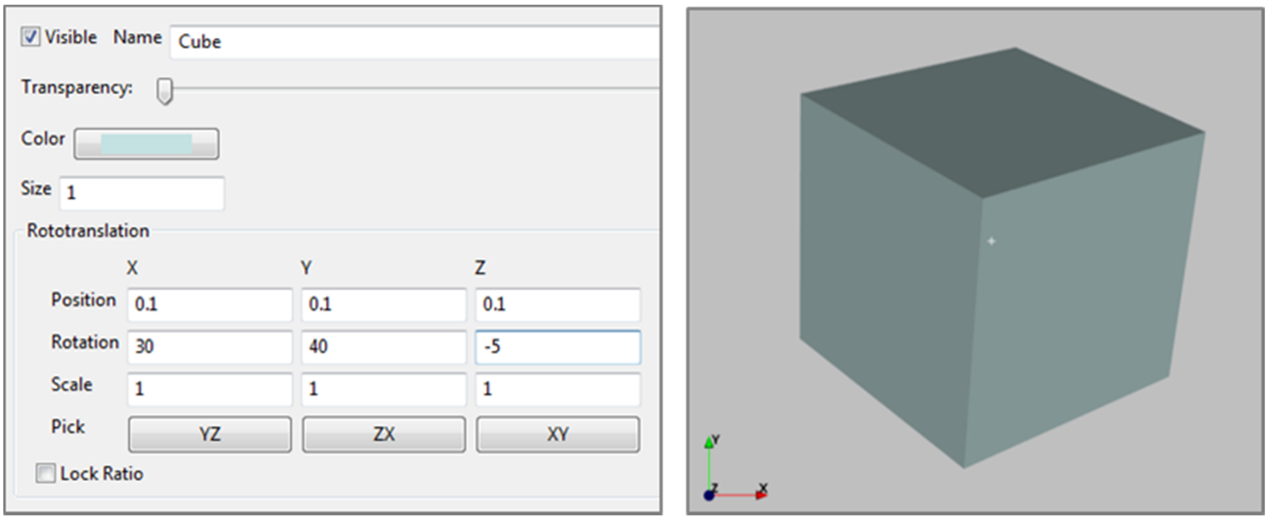


Figure 46: Cube panel

Even in this case it is possible to set the transparency of the cube, the color, the size (writing the desired number in the box o through the use of the slide), to make the cube visible or not and to give it a name (“Cube” in the example) writing it in the proper space. It is possible to roto-translate the cube through the proper table (setting the Position, the Rotation and the Scale of the displayed object) or manually through *Pick* button, as explained in 1_*Home* paragraph.

4.6 SPHERE

It is possible to insert a sphere in the scene through the proper voice *Insert Object* menu.

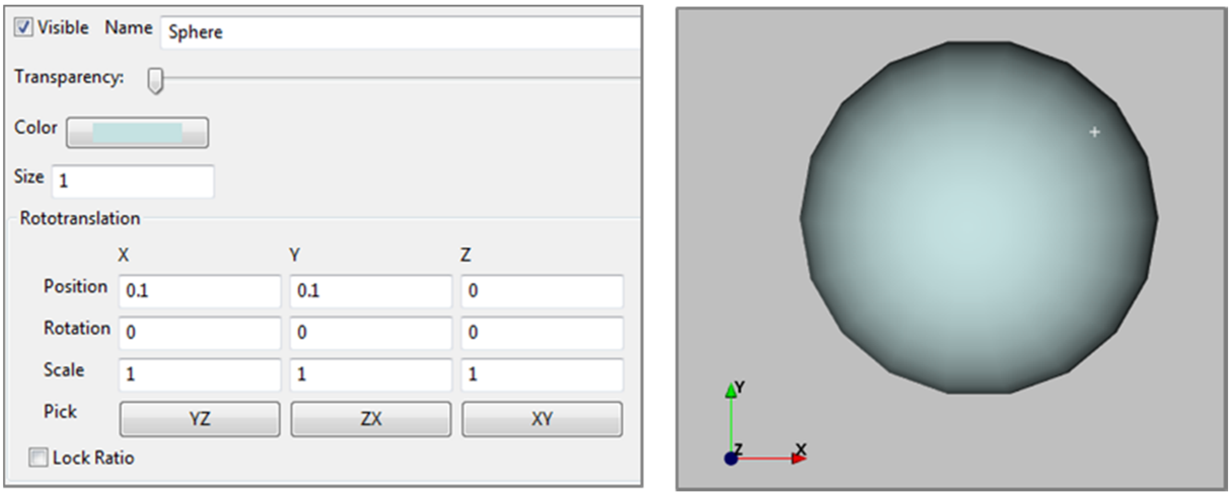


Figure 47: Sphere Panel

As for the other object exposed before, it is possible to set the *Transparency* of the sphere, the *Color*, the *Size* (writing the desired number in the box o through the use of the slide), to make the sphere visible or not and to give it a name (“Sphere” in the example) writing it in the proper space. It is possible to roto-translate the sphere through the proper table (setting the Position, the Rotation and the Scale of the displayed object) or manually through *Pick* button, as explained in 1_*Home* paragraph.

4.7 CYLINDER

It is possible to insert a cylinder in the scene through the proper voice *Insert Object* menu.

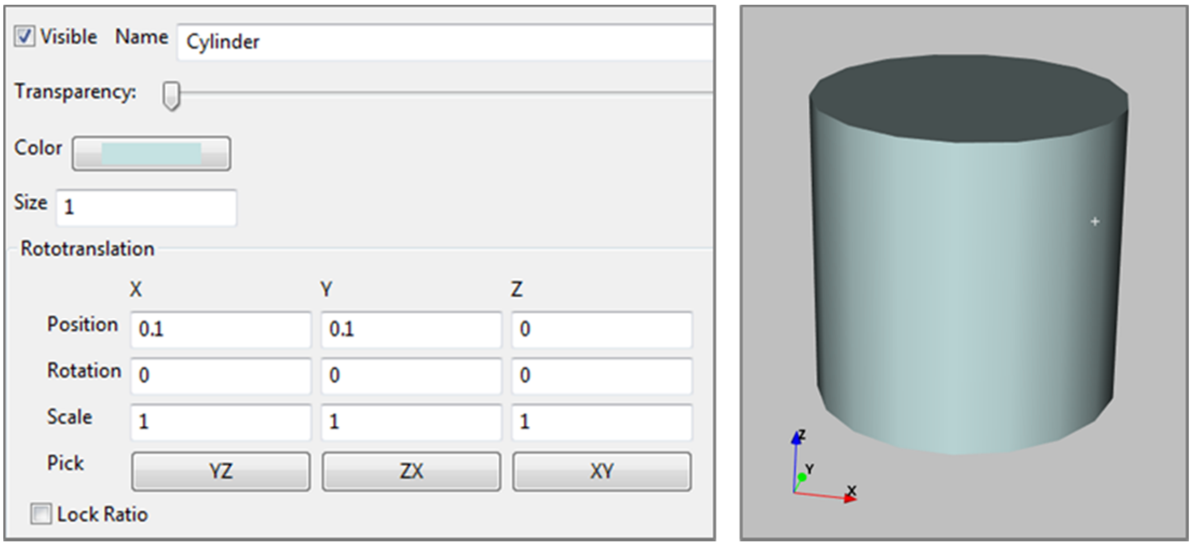


Figure 48: Cylinder Plane

As for the other object exposed before, it is possible to set the transparency of the cylinder, the color, the size (writing the desired number in the box o through the use of the slide, to make the cylinder visible or not and to give it a name ("Cylinder in the example) writing it in the proper space. It is possible to roto-translate the cylinder through the proper table (setting the Position, the Rotation and the Scale of the displayed object) or manually through *Pick* button, as explained in 1_*Home* paragraph.

4.8 CONE

It is possible to insert a cone in the scene through the proper voice *Insert Object* menu:

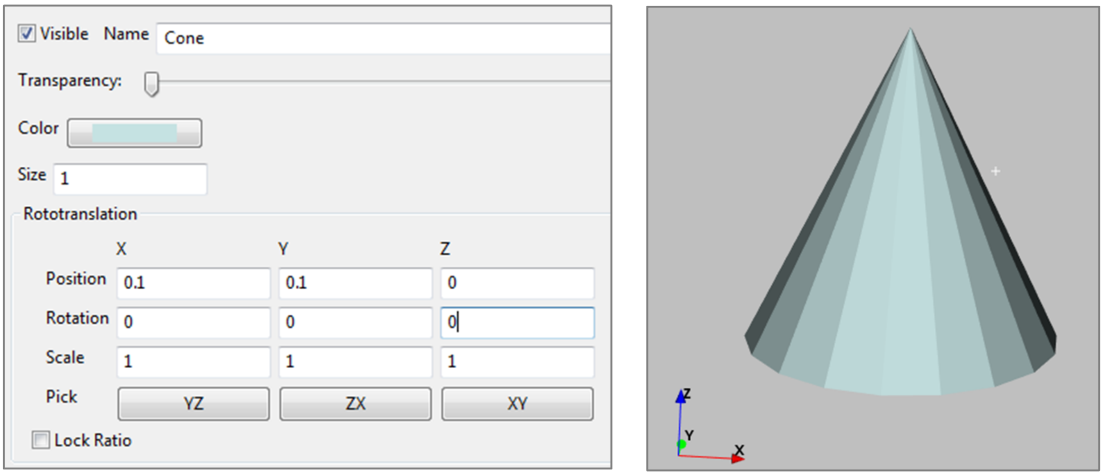


Figure 49: Cone Panel

As for the other object exposed before, it is possible to set the transparency of the cone, the color, the size (writing the desired number in the box o through the use of the slide), to make the cone visible or not and to give it a name ("Cone" in the example) writing it in the proper space. It is possible to rototranslate the cone through the proper table (setting the Position, the Rotation and the Scale of the displayed object) or manually through *Pick* button, as explained in 1_*Home* paragraph.

4.9 PYRAMID

It is possible to insert a cone in the scene through the proper voice *Insert Object* menu.

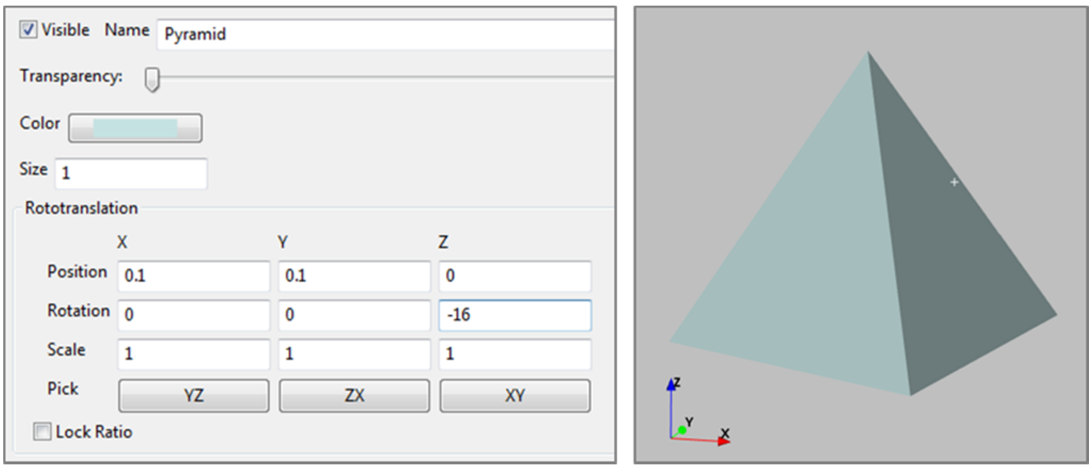


Figure 50: Pyramid panel

As for the other object exposed before, it is possible to set the *Transparency* of the pyramid, the *Color*, the *Size* (writing the desired number in the box o through the use of the slide), to make the cone visible or not and to give it a name ("Pyramid" in the example) writing it in the proper space. It is possible to rototranslate the pyramid through the proper table (setting the Position, the Rotation and the Scale of the displayed object) or manually through *Pick* button, as explained in 1_*Home* paragraph.

4.10 GRID

It is possible to insert a grid, it is useful to have a reference for the other objects, similar to the "Axes"

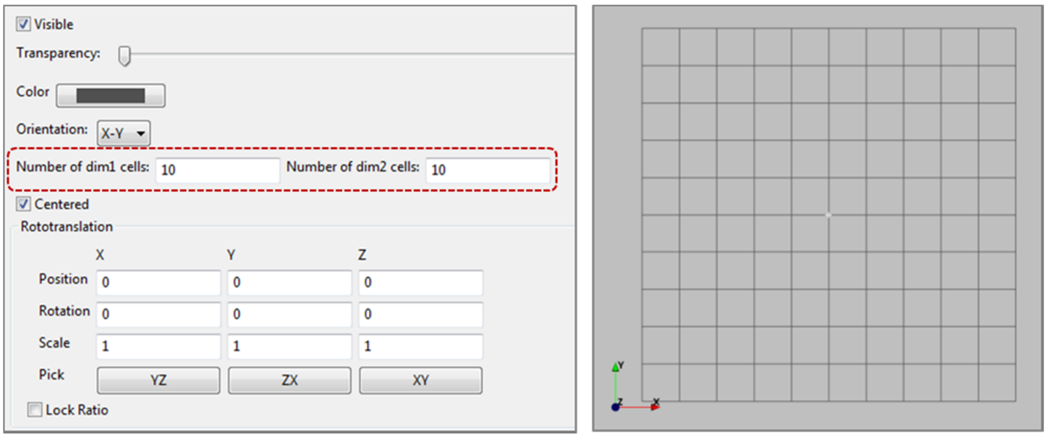


Figure 51: grid panel

In addition to the usual setting of *Visibility, Transparency, Color* and *Rototranslation*, in this case there is the possibility to set the *Orientation* of the grid and *Number of cell* to insert in two dimensions (inside the dashed red line in Fig 51).

By selecting one of the 3 option available in "Orientation" (3 primary plans "XY", "XZ" or "YZ") it is possible to choose the plan on which to draw the grid, as is shown in the following figure (Figure 52).

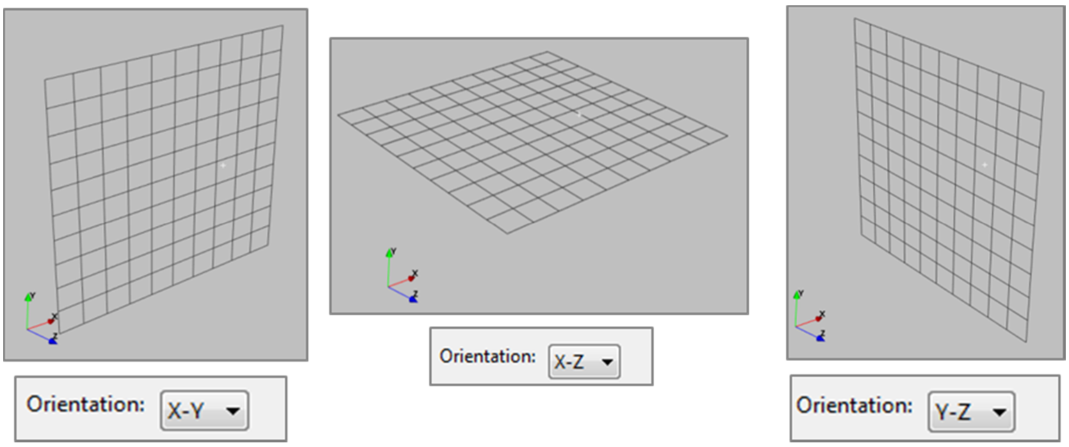


Figure 52: different orientation of the grid in the 3D space

To set the size of the grid it is possible to use the slide or to insert manually the number of grid boxes (10 by default) between a minimum dimension of 1 box and a maximum dimension of 100 boxes. Within this interval, it is possible to set a relative minimum and maximum value (in orange in Fig. 53), writing the corresponding number in the dedicated boxes; in this way the extreme value of the slider change from 1-100 to the new selected values.

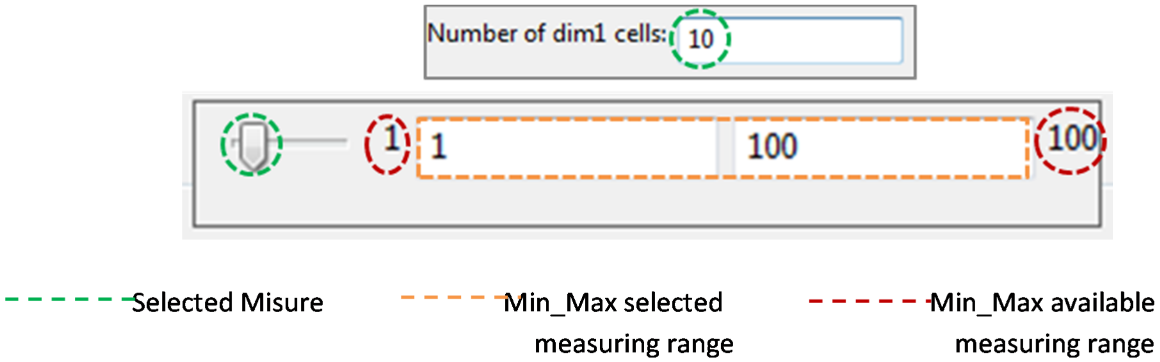


Figure 53: Setting of Number of cell in one dimension

For example, if the minimum size should be 15 and the maximum 60, writing this numbers in the boxes the slide will have 15 as value when it is totally at left, 60 when it is totally at right, and intermediate value in any other point of the sliding bar (Fig 54).

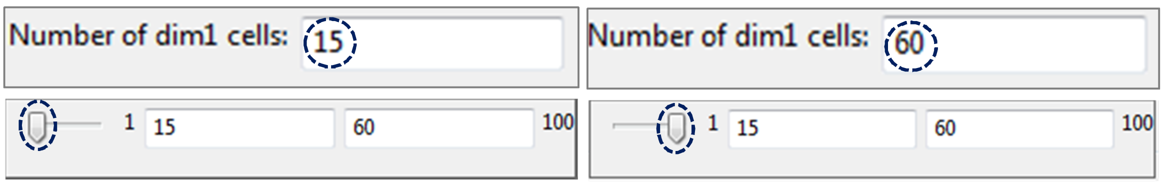


Figure 54: Modification of max and min value

The two dimension are editable separately (Number of dim1-dim2 cells in Fig 55).

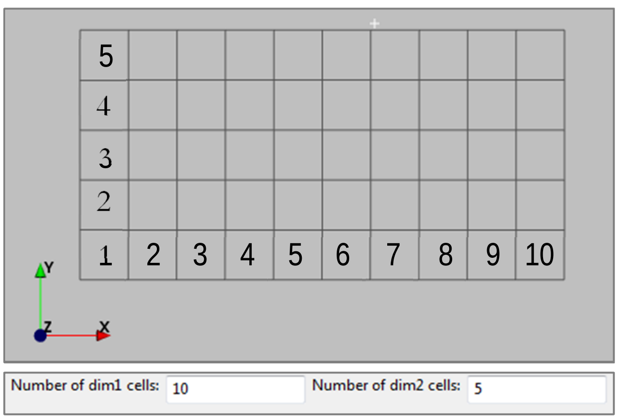


Figure 55: example of setting on number of cells in the two dimensions

5.0 INTERACTION WITH 3D VISUALIZATION

It is possible to interact with objects in the 3D scene by acting directly on it with the mouse. For example, it is possible to keep still the object and turn around the camera or to turn the object around its axe. Clicking in different areas of the panel, it is possible to carry out different actions, as is shown in the following figure (Fig. 56) and in detail below.

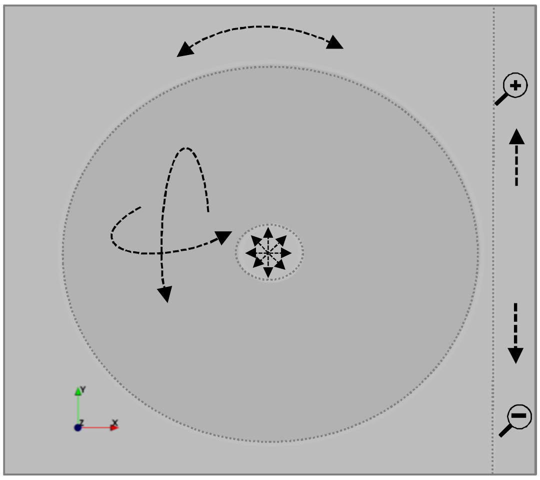


Figure 56: 3D scene empty; each area causes a different movement of the object, as is suggested by the arrows.

The area is divided into three main parts; the inner is a little circle of light gray; clicking and holding it the object on the scene will shift stiffly because the focal point changes, as is shown in the following figure (the dashed arrow suggests the direction of drag effected).

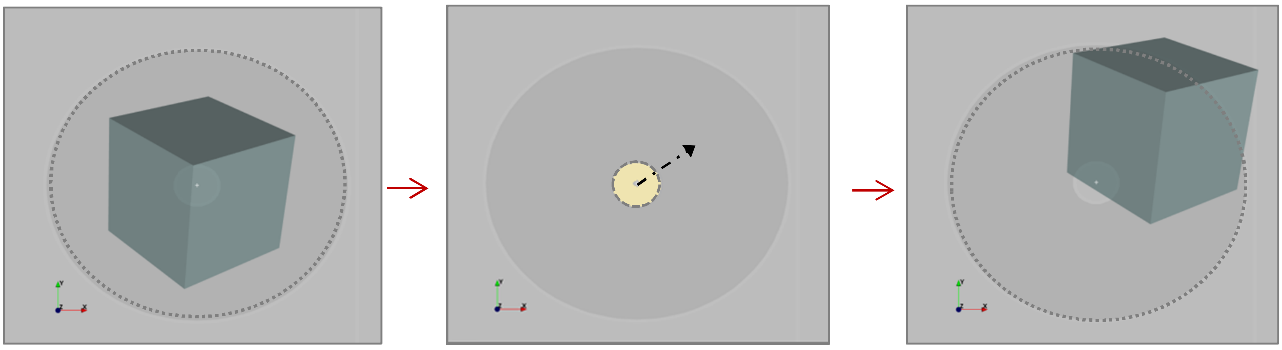


Figure 57: Shifting of the object, acting on the yellow area of the panel

Outside this circle there is another bigger circle; through it the 3D scene can be rotated pressing and dragging the left button of the mouse so that the scene will rotate around its center; when the button is released the rotation stops. The directions of rotation is suggested by the arrows in the following figures (Fig 58):

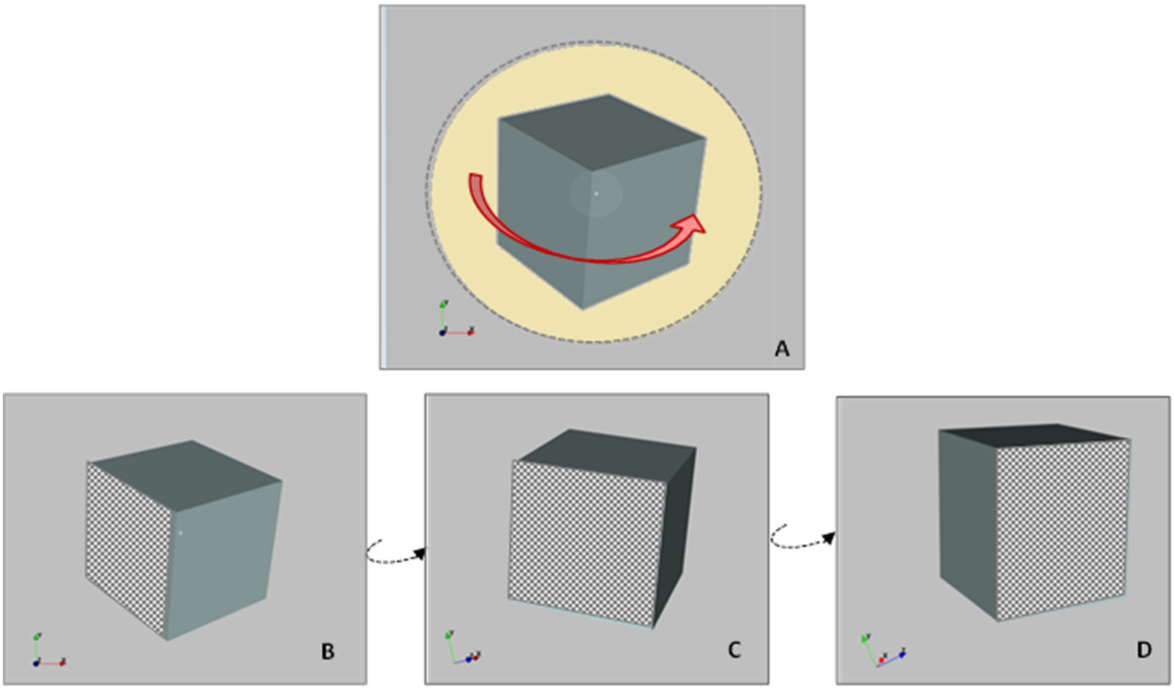


Figure 58: in A the object in original position with the direction of rotation suggested; in B, C and D rotation of the cube in counterclockwise in horizontal direction perpendicular at the panel.

The same applies to vertical rotation (Figure 59):

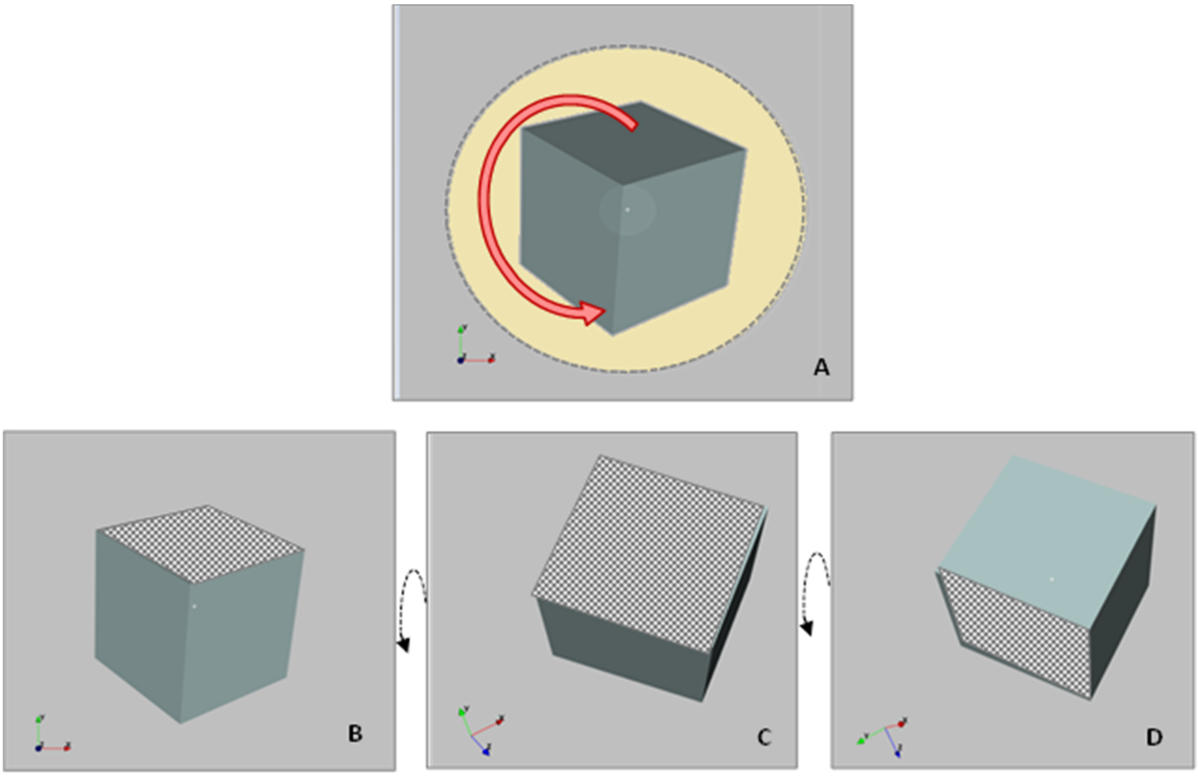


Figure 59: in A the object in the original position with the direction of rotation suggested; in B, C and D rotation of the cube in counterclockwise, in vertical direction perpendicular at the panel

The outer part of the panel makes the object rotates through right and through left, as is shown in the following features.

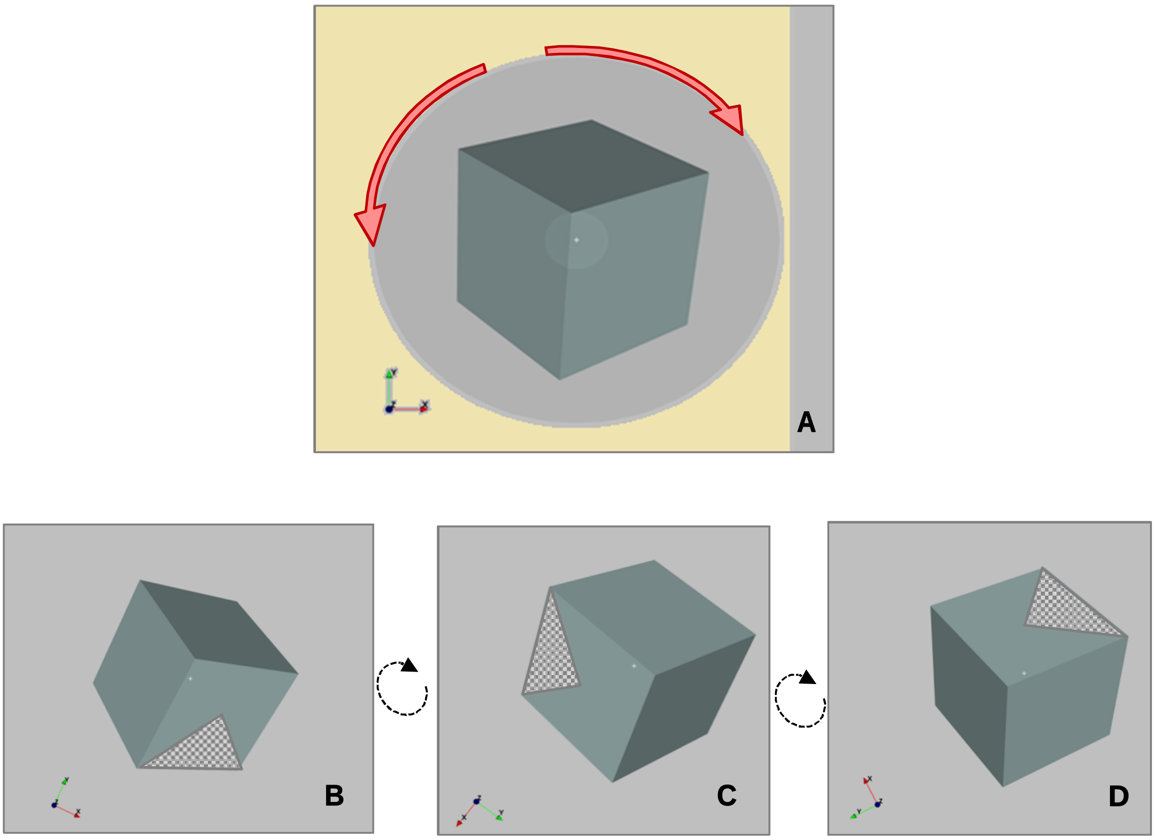


Figure 60: in A the object in the original position with the direction of rotation suggested; in B, C and D rotation of the cube in clockwise

At last, at the right side of the panel there is a vertical band which let to zoom in (shifting upwards) and zoom out (shifting downwards) the object in the scene. To do this, drag the mouse vertically on the band, holding pressed the left mouse button and release when the desired zoom is reached; it is also possible to achieve the same results through the use of the mouse wheel.

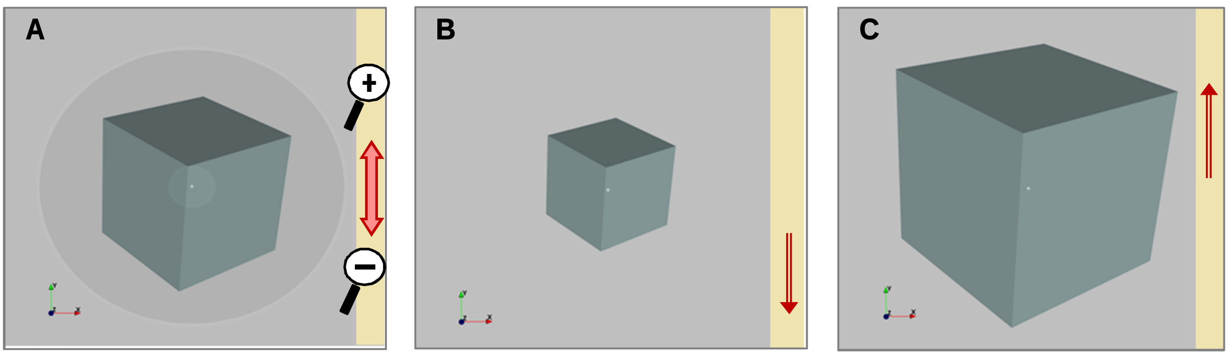


Figure 61: in A the object in the original position with the direction of rotation suggested; in B zoom out of the cube, in C zoom in of the cube.

6.0 ERT APPLICATIONS

ViewLab 3D has been programmed to manage the display of seismic and electric data. Most of the functions are in common, but in some cases there are some differences for the two methodologies, which will be treated separately.

In the following part of this document it was taken as a reference the electric module.

If when the program starts the proper USB protection dongle (Fig 62) is insert in the PC, some advanced features about electric application are enabled.

Figure 62: USB protection dongle for seismic applications

To load an electric project , and so a data files of the inversion made with the software ERTLab, it is sufficient to click with the right mouse button on *Home* node and then to *Load* button. Selecting the desired file from the pc (*.DATA or *.VIEWER are supported) and confirming the opening, the project will be loaded automatically and new nodes will be added to the tree.

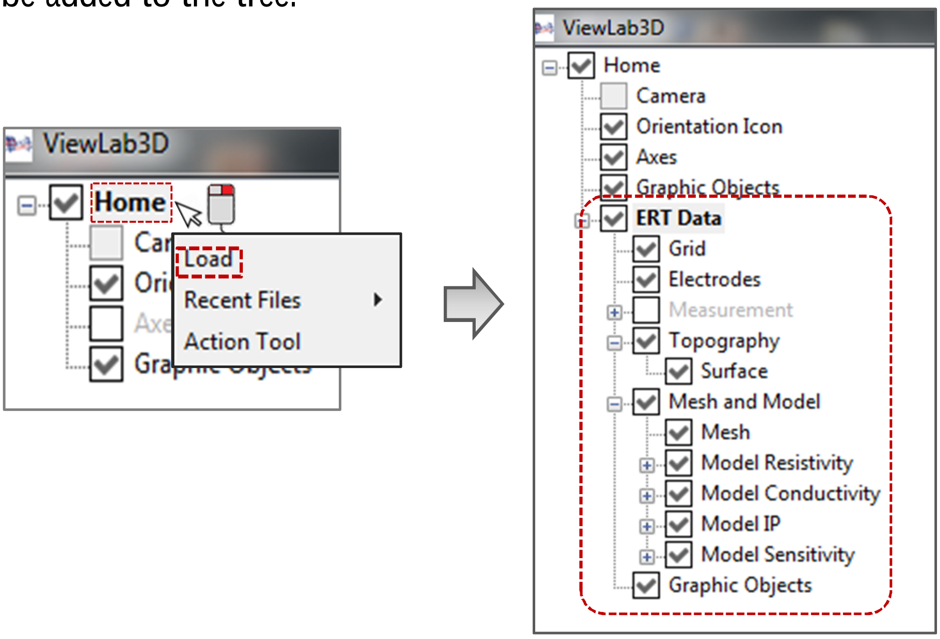


Figure 63: loading of electric data and activation of relative nodes in the tree

In this case, to better explain the properties of the software, an electrical survey project has been loaded; the work is related to an electrical survey performed along the semi-perimeter margin of two buildings. The related file can be found in the ViewLab3d installation folder.

7.0 ERT DATA

When a project is load, a new node "*ERT Data*" is added to the tree; this new node represents an entire project.
As for other nodes exposed in the previous paragraphs (see 1_*Home* paragraph) , even for this it is possible to give it a *Name*, to make it *Visible* or not and to set the *Rototranslation* parameters, numerically through the table or manually through *Pick* button, with or without *Lock Ratio* activated.

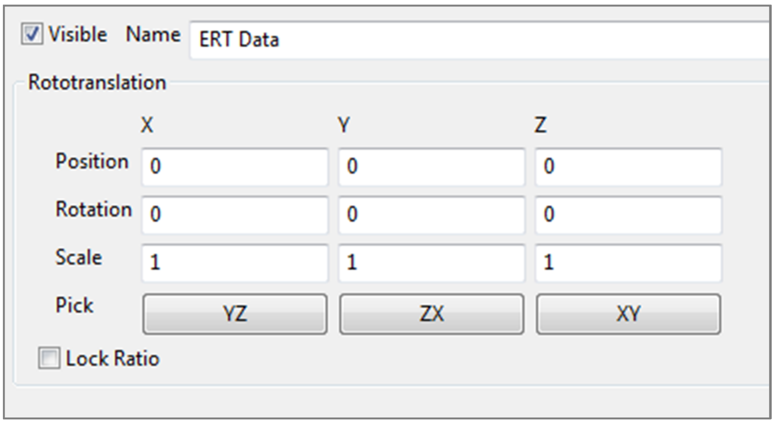


Figure 64: ERT Data panel

This main node is in turn composed by other many nodes, as shown in Fig 62; below there is the description of the properties of various elements.

7.1 GRID

This element is completely analogous to the global one, so the information about its property can be found at 5_*Graphic Object* Paragraph.

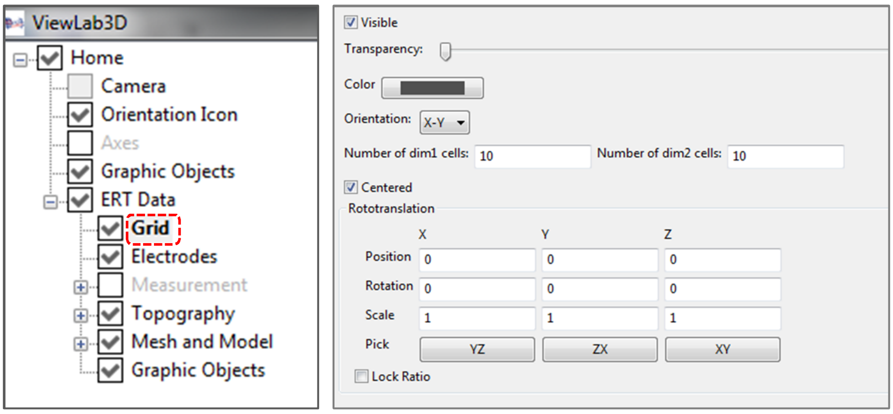


Figure 65: Grid panel in ERT Data node; see "Grid" in Data Object node for more details.

It is possible to add one grid for each project if there is the necessity to specify local references.

7.2 ELECTRODES

This element is used to display and manage the group of sensors used for data acquisition.

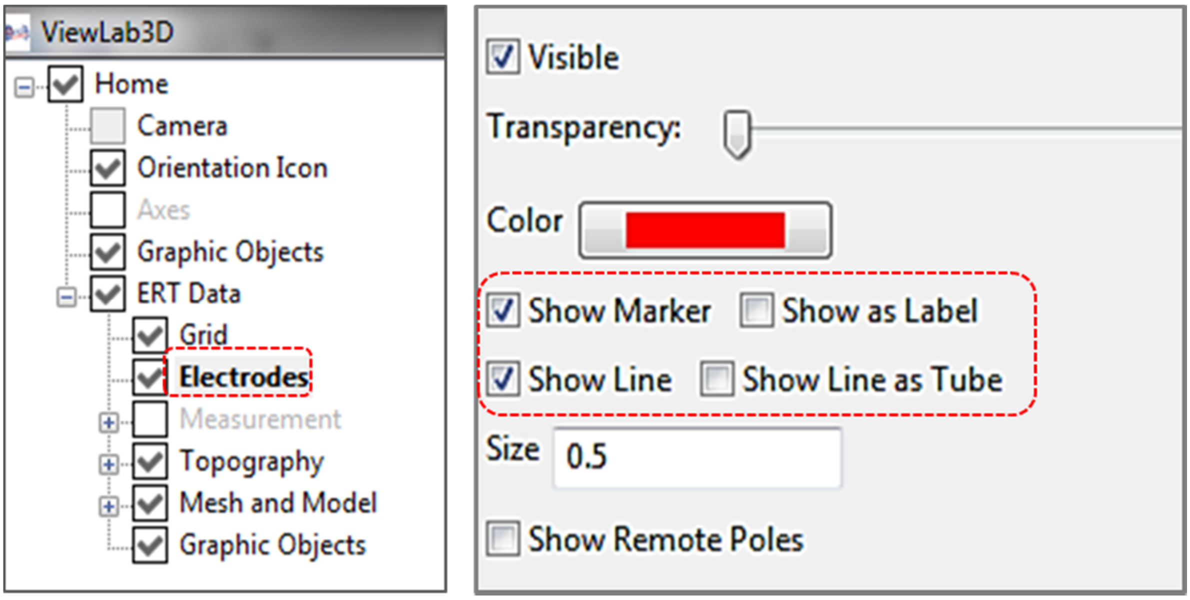


Figure 66: Receivers panel

As for other nodes exposed in the previous paragraphs, even for this it is possible to choose the color for the object (red by default), to make it visible or not and to set the level of transparency. In addition to this, there are other elements dedicated, highlighted by the red dashed line, which are described below.

- ***Show Marker:*** if the checkbox is selected, the sensors positioned in the scene are visible, otherwise they are present in the database but they are not visible in the 3D scene.

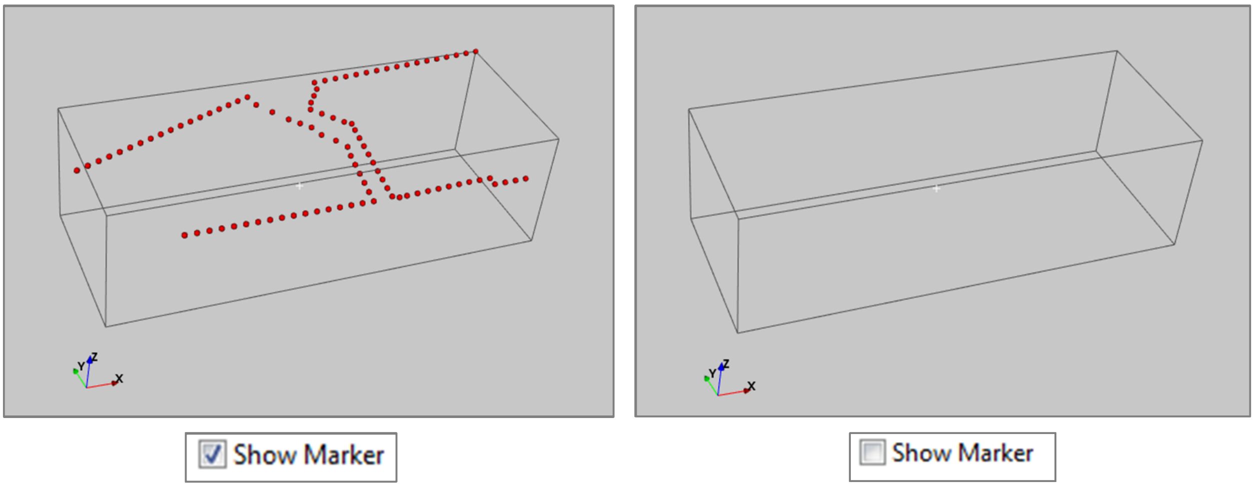


Figure 67: Sub-node receivers; in A the receivers are visible, in B the receivers are not visible

- ***Show Line:*** if the checkbox is selected, the line that links the sensors is visible, otherwise it is not, as shown in Fig. 68.

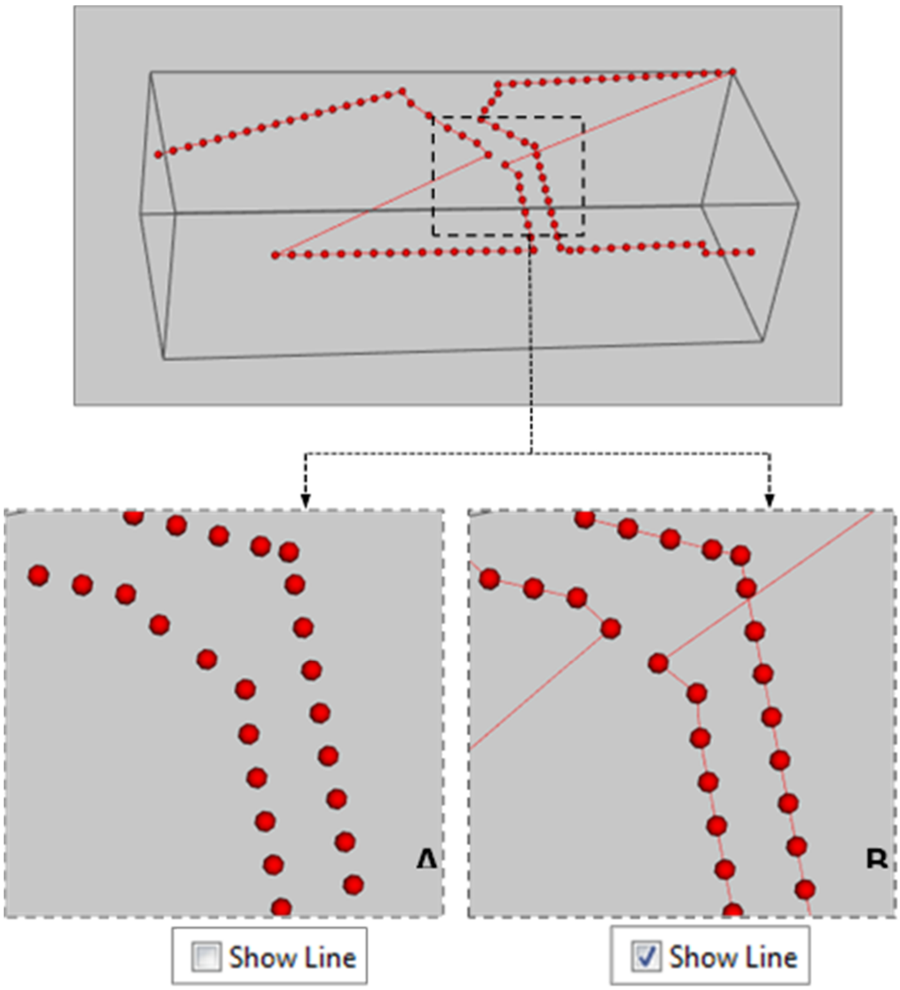


Figure 68: detail of electrodes with (at right, B) and without (at left, A) the line between sensors

- ***Show line as tube :*** if the checkbox is selected, the line that links the sensors is visible as a tube, otherwise it is visible as line (Fig. 69)

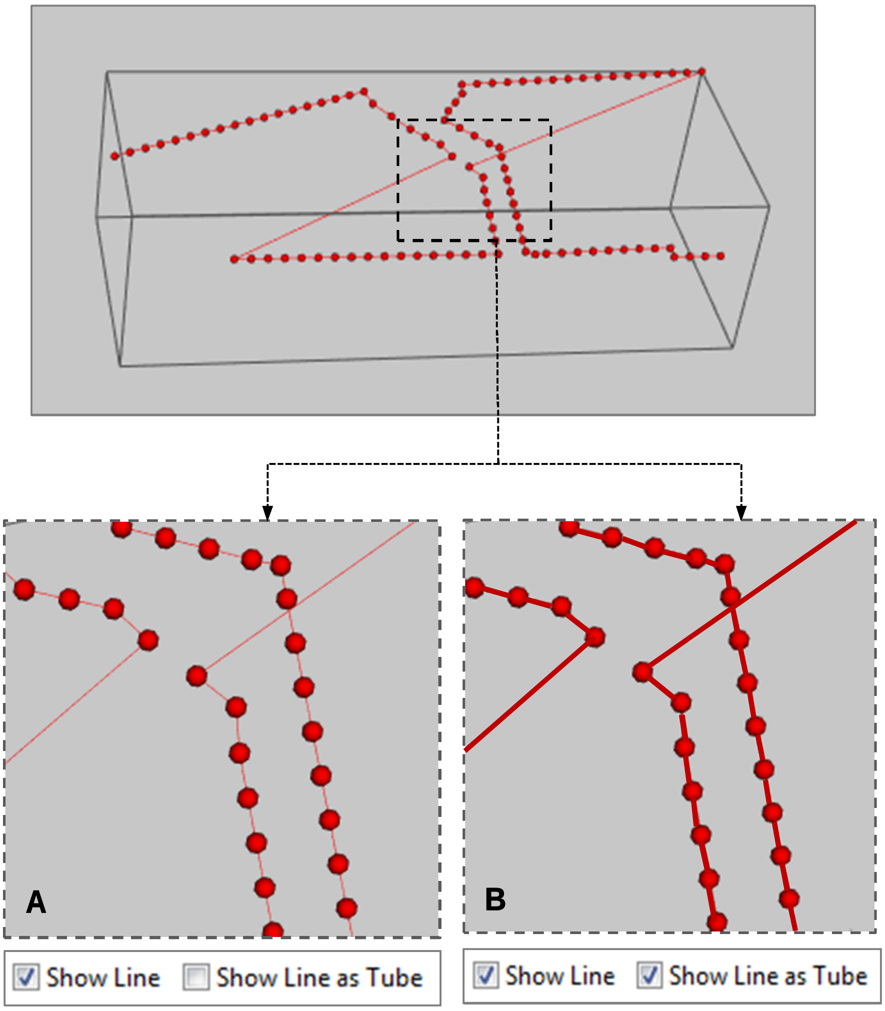


Figure 69: Detail of electrodes, linked each other by lines (at left, A) and by tubes (at right, in B)

- **Show Label**: if the checkbox is selected, the label composed by the "Group" (PD in the following example) and the "ID" (from 16 to 27, from 49 to 55 and from 73 to 76 in the following example) of each receiver is visible. This label contains the name associated to every electrode during the creation of the project, so prior to inversion data.

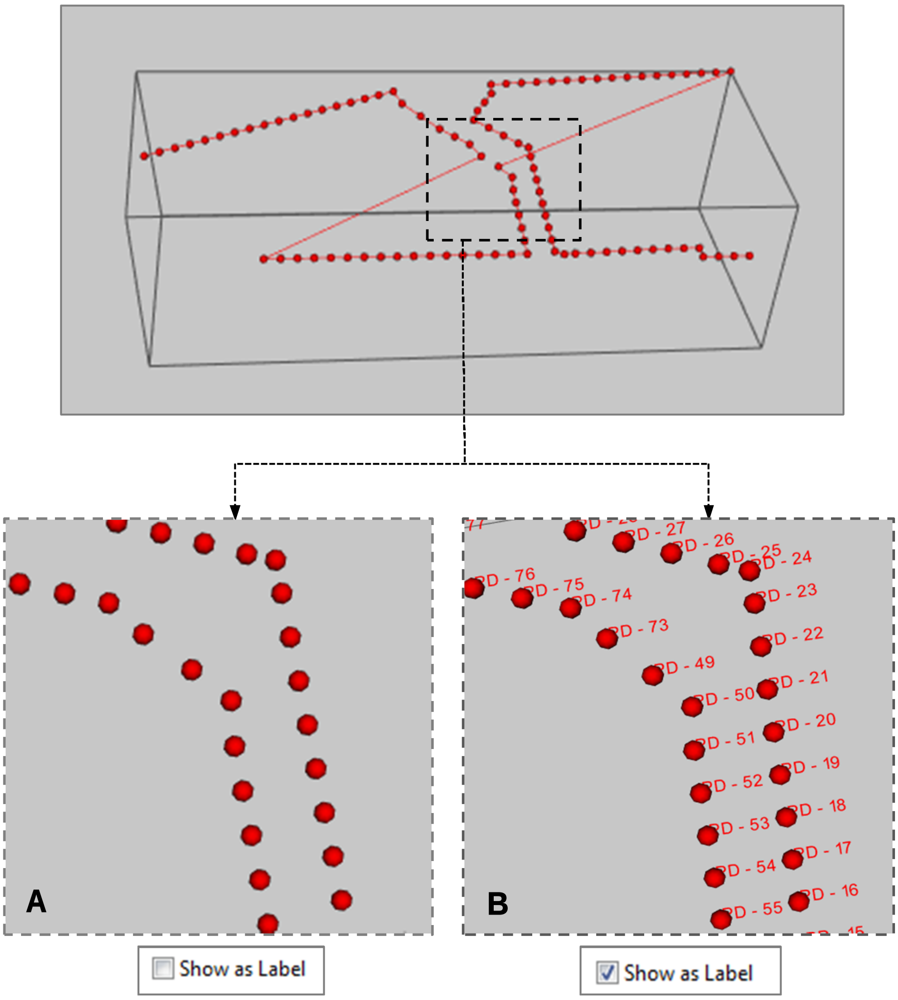


Figure 70: Detail of electrodes, with(at right, in B), and without (at left, A) labels.

- ***Size:*** to set the size of the receivers it is possible to use the slide or to insert manually the size number (in green in Fig. 71, 0.5 by default) between a minimum dimension of 0 and a maximum dimension of 30 (in the red circles in Fig. 71). Within this interval, it is possible to set a relative minimum and maximum value (in orange in Fig. 71), writing the corresponding number in the dedicated boxe; in this way the extreme value of the slider change from 0-30 to the new selected values.

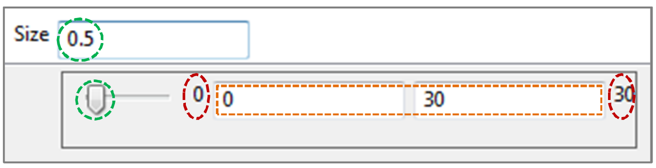


Figure 71: tool for electrodes size setting

For example, if the minimum size should be 5 and the maximum 15, writing this numbers in the first two dedicated boxes (in orange in figure 71) the slide will have 5 as value when it is totally at left, 15 when it is totally at right, and intermediate value in any other point of the sliding bar (figure 72).

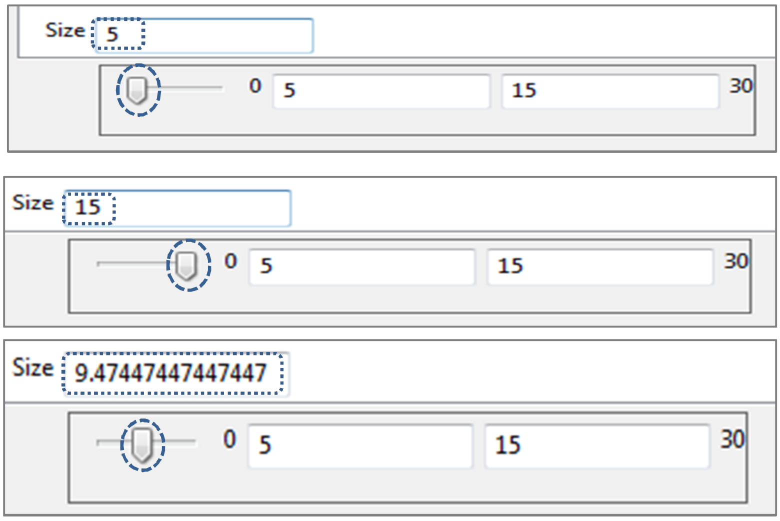


Figure 72: example of variation of extreme value of the sliding bar, from 0-30 to 5-15

As an example, in the following figure (figure 73) the same set of sensors is represented in two different sizes.

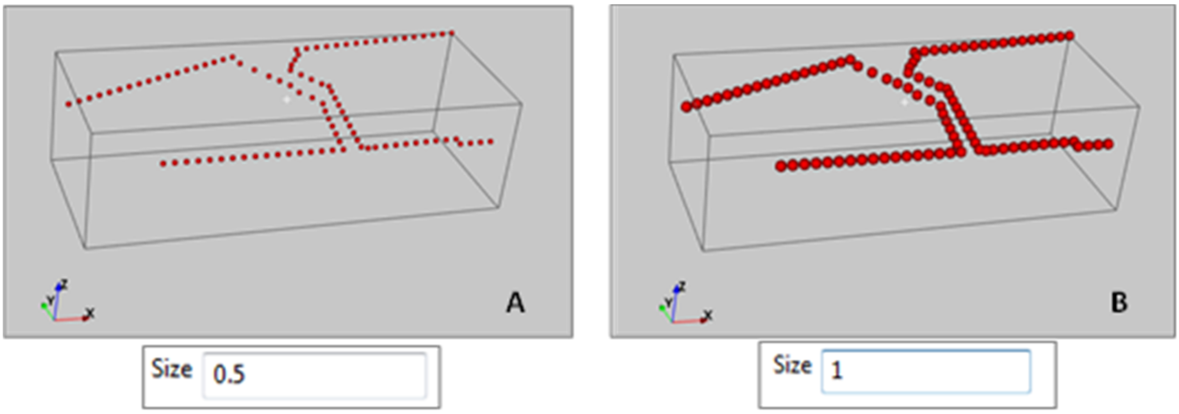
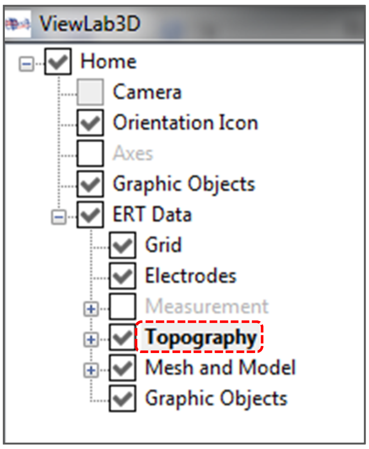


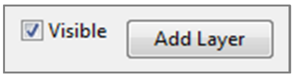
Figure 73 Sub-node receivers, example of two dimensions of receivers, 0.5 in A and 1 in B

7.3 TOPOGRAPHY

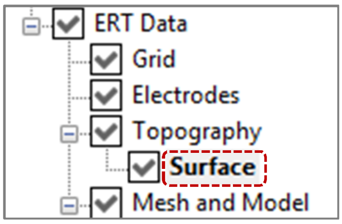


This element is associated to the topography, which may be present in the project uploaded. In the file used in this manual, the only georeferenced points are located in correspondence of the electrodes.

The topography can be visible or not through the checkbox *Visible* and one or more layer can be added through *Add Layer* button.



This is used to add more surfaces, to use advanced tools during the mesh generation; therefore topography actually is not related just to superficial information, but also to underground layers.



This node in turn contains another sub-node *Surface*; it is used to manage the way to represent the topography, as points or as a whole surface that interpolates each point.

The Surface panel is composed by two blocks:

Point: it manages the representation of the topography as simple points in the 3D scene. It contains the checkbox *Visible*, the slider to set the desired level of transparency, the *Color* (white by default, change in blue in the example) button and the box to set the *Size* of the points to represent.

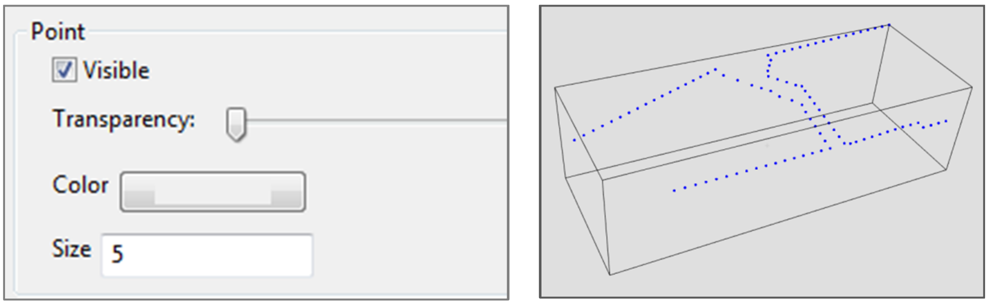


Figure 74: At left, point panel of Topography node; at right the topography visulized as points (in this case the topography was misured just in corrispondance of the electrodes)

Surface: This element is used to manage the representation of the points of topography as a surface which interpolates each point. Besides the same tool of Point panel, it has some additional elements, highlighted in red in the figure:

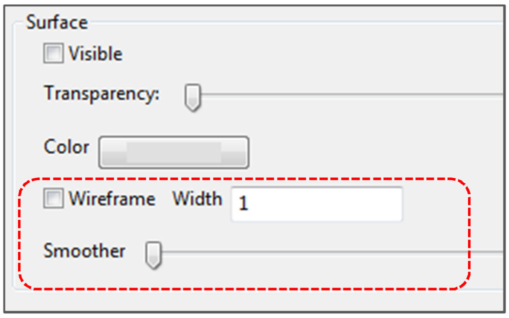


Figure 75: Surface panel of Topography node; in red dashed line the dedicated tools

- the checkbox "*Wireframe*" : if it is activated the topography is visulised as a 3D model in which only lines and vertices are represented. Otherwise the entire surface is visualized.

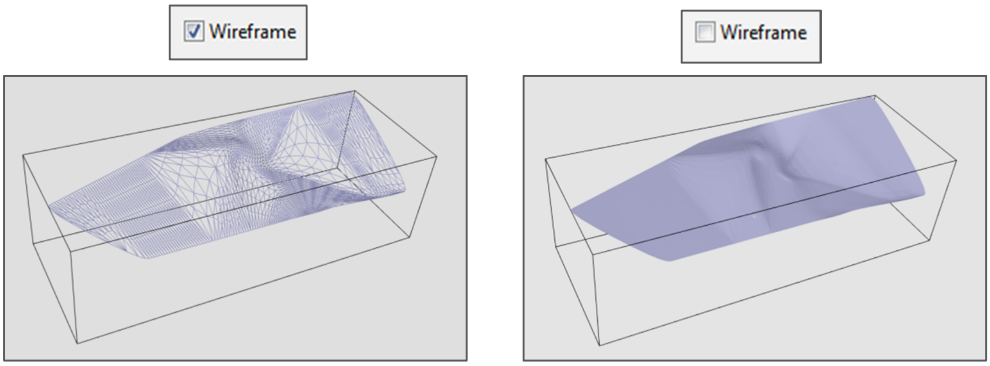


Figure 76: At left, topography visulized with "Wireframe" activated, at right The topography with the Wireframe not active, so the entire surface is visible.

- Button *width*: it allows to choose the width of the surface, writing desired number in the proper space.

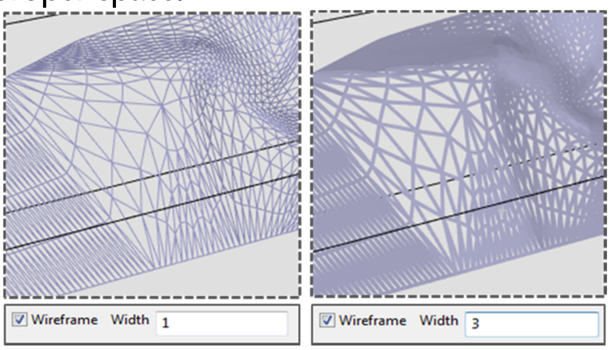


Figure 77: At left, a focus on topography visulized with Width=1; at right a focus on topography with Width=3.

- Slider *Smoother* : it allows to smooth the topography, through the use of the slider; it is advisable to don't exceed with the smooth in order to don't cause slowdowns to the software.

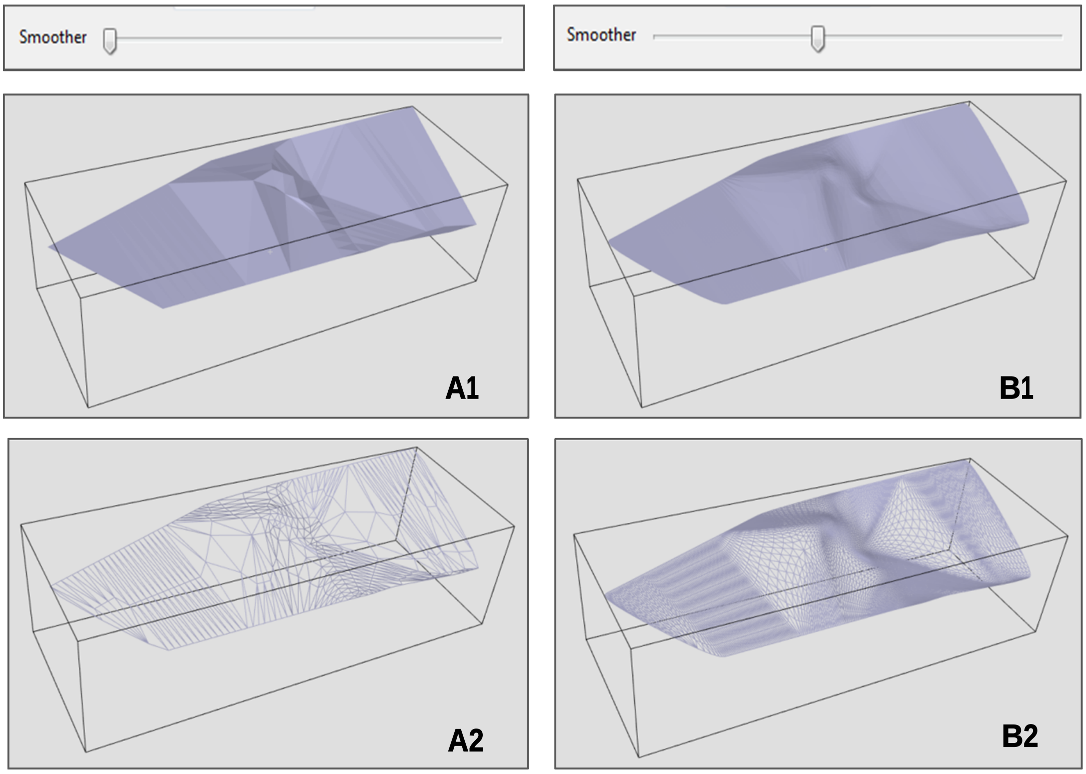
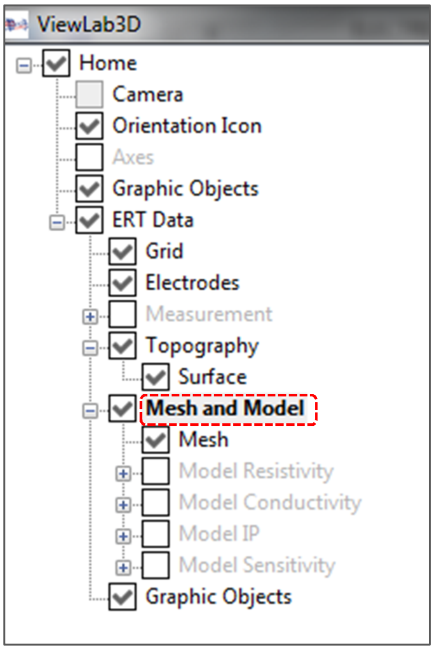


Figure 78: At left, topography with zero level of smooth (wiremode active on A2 and not active on A1); at right topography with medium level of smooth (wiremode active on B2 and not active on B1).

7.4 MESH AND MODEL



This node contains many elements; these have the purpose of modeling the subsoil with a 3D grid (mesh) and to assign to the various points of this half-space values of different physical properties under investigation (model).

This node has in turn other 5 nodes, which are explained below.

7.4.1 MESH

It allows to set the way to represent the mesh; the panel has the following item:

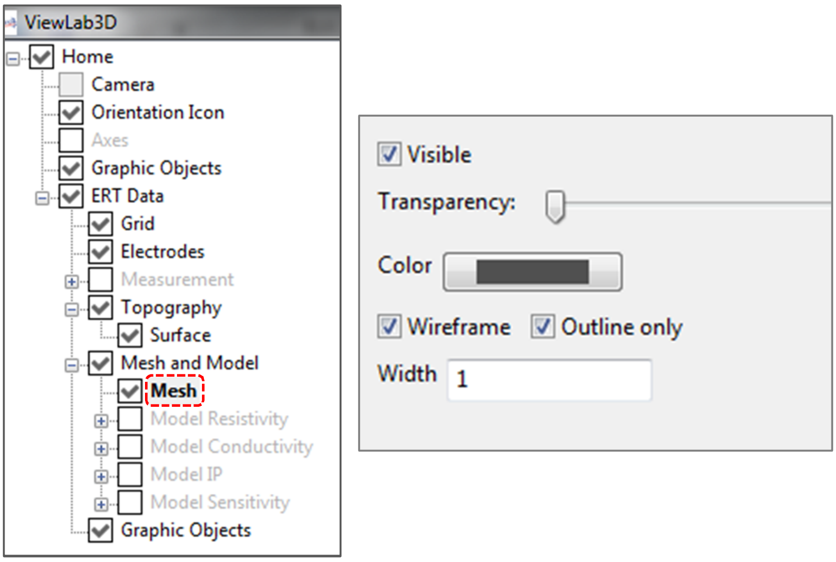


Figure 79: Mesh panel

- o ***Visible***: if the checkbox is active, the mesh is visible, otherwise it is not;
- o ***Transparency***: through the slide it is possible to set the transparency of the mesh, as shown below:

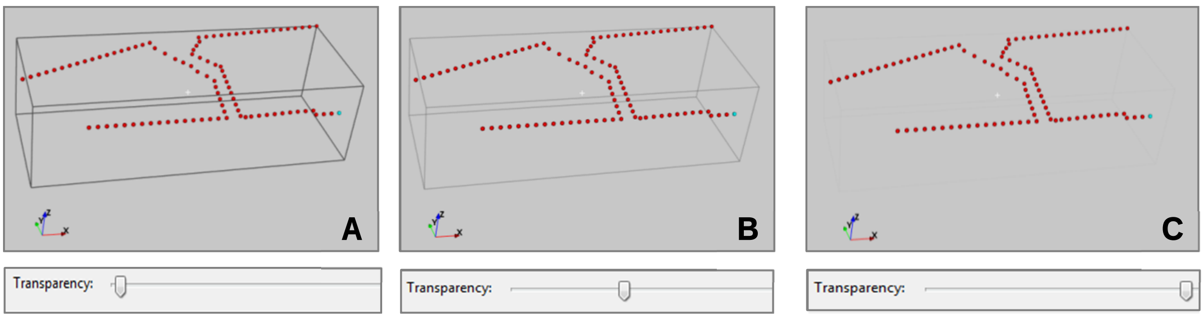


Figure 80: different levels of transparency of the mesh (minimum in A, medium in B and maximum in C)

- ***Color***: it allows to choose the color of the mesh; by default is selected the gray color, but there are many other choices . In the following example, the color of the mesh from gray is set to red.

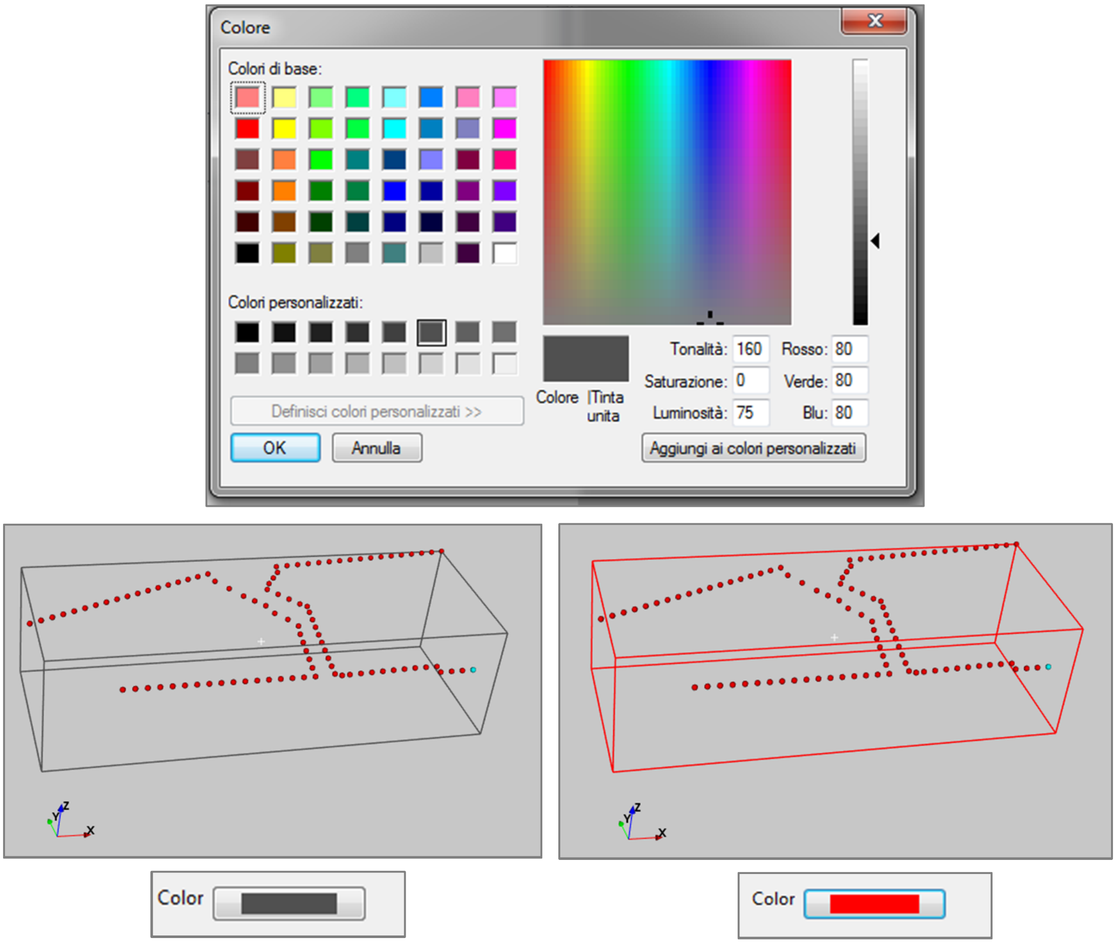


Figure 81: Example of different chooses of colors for the mesh

- ***Wireframe***: if this checkbox is selected, the mesh is visible with every cell that constitutes the entire volume or just the outline (case A in figure); if this is not selected, the volume is visualized as a "solid" body. In this case is not possible to visualize the cells that constitute it, but is possible to see inside the volume increasing the level of transparency (cases B and C in figure).

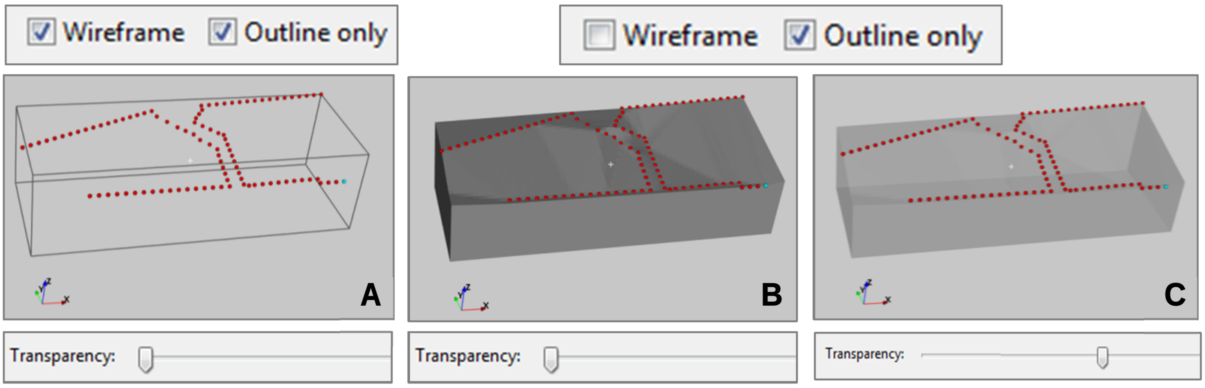


Figure 82: different way to display mesh; in A the modality "wireframe" is active, in B and C it is not, so the half-space is visible as a solid volume. In B the transparence level is zero, so it is not possible to see across se object; in C the level of transparency is high so it is possible to see inside the object.

- ***Outline only***: if Wireframe is selected, this option makes visible just the perimeter line of the investigated body and not all the frame of the cells.

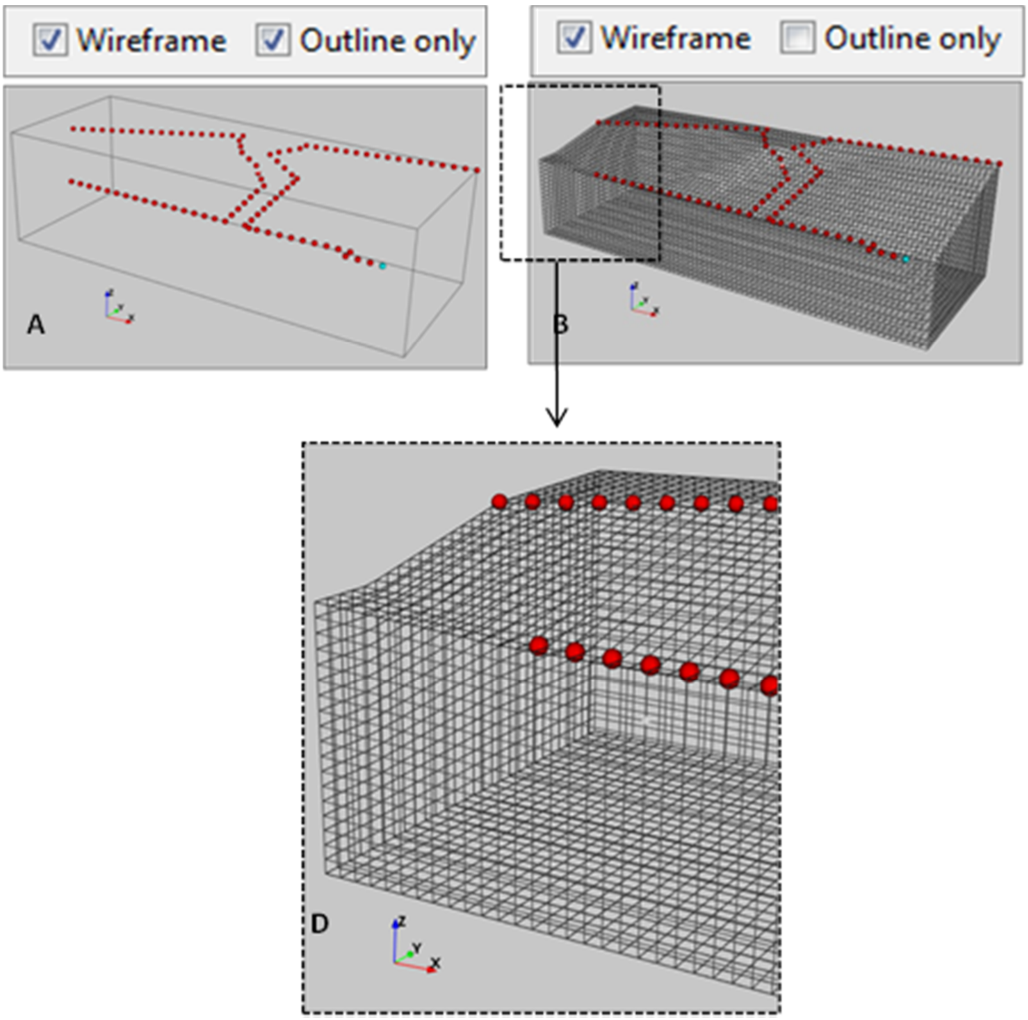


Figure 83: mesh visualized as "Outline Only" in A and with all the cells in B. In C detail of figure B

- ***Width***: if wireframe is selected, this option allows to choose the width of the frame or the outline, writing a number from 1 to 10 or through the slide which appears clicking on the proper space. Two different widths of the outline are shown in the following example.

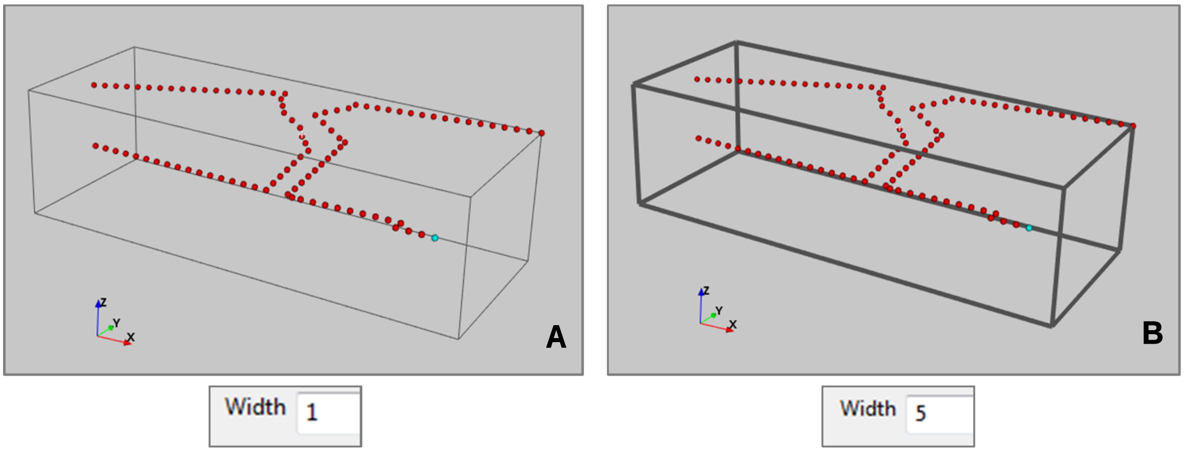


Fig 84: different widths of the mesh outline; in A width of default (value 1) and in B width of 5

The subsequent sub-nodes of *Mesh and Model* node allow to visualize different kinds of distribution of electrical properties : the *Resistivity*, the *Conductivity*, the *Induced Polarization* (IP) and the *Sensitivity*. They are all explained below.

7.4.2 RESISTIVITY

The Resistivity model quantifies how strongly the investigated body contrasts the flow of electric current. The panel has the following item:

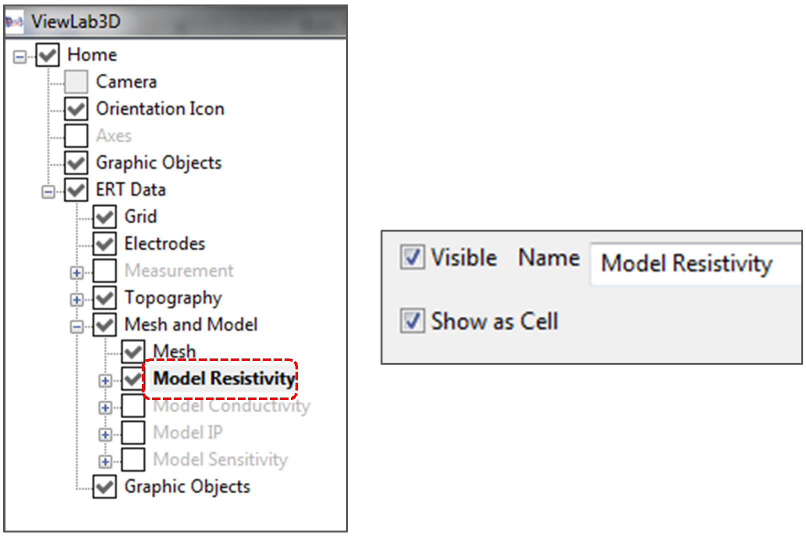


Fig 85: Model Resistivity panel

- ***Visible***: this checkbox makes the velocity model visible or not;
- ***Name***: it allows to choose an appropriate name to the model;
- ***Show as cell***: if this checkbox is selected, the model is shown by cells; otherwise it is represented as an interpolation of points, which comes from the concentration on their centers of every hexahedral. The model obtained in this last case is more smooth.

To better understand the difference between the two ways to represent data, a volume of resistivity model was added in the scene; how to insert and manage it will be discuss later.

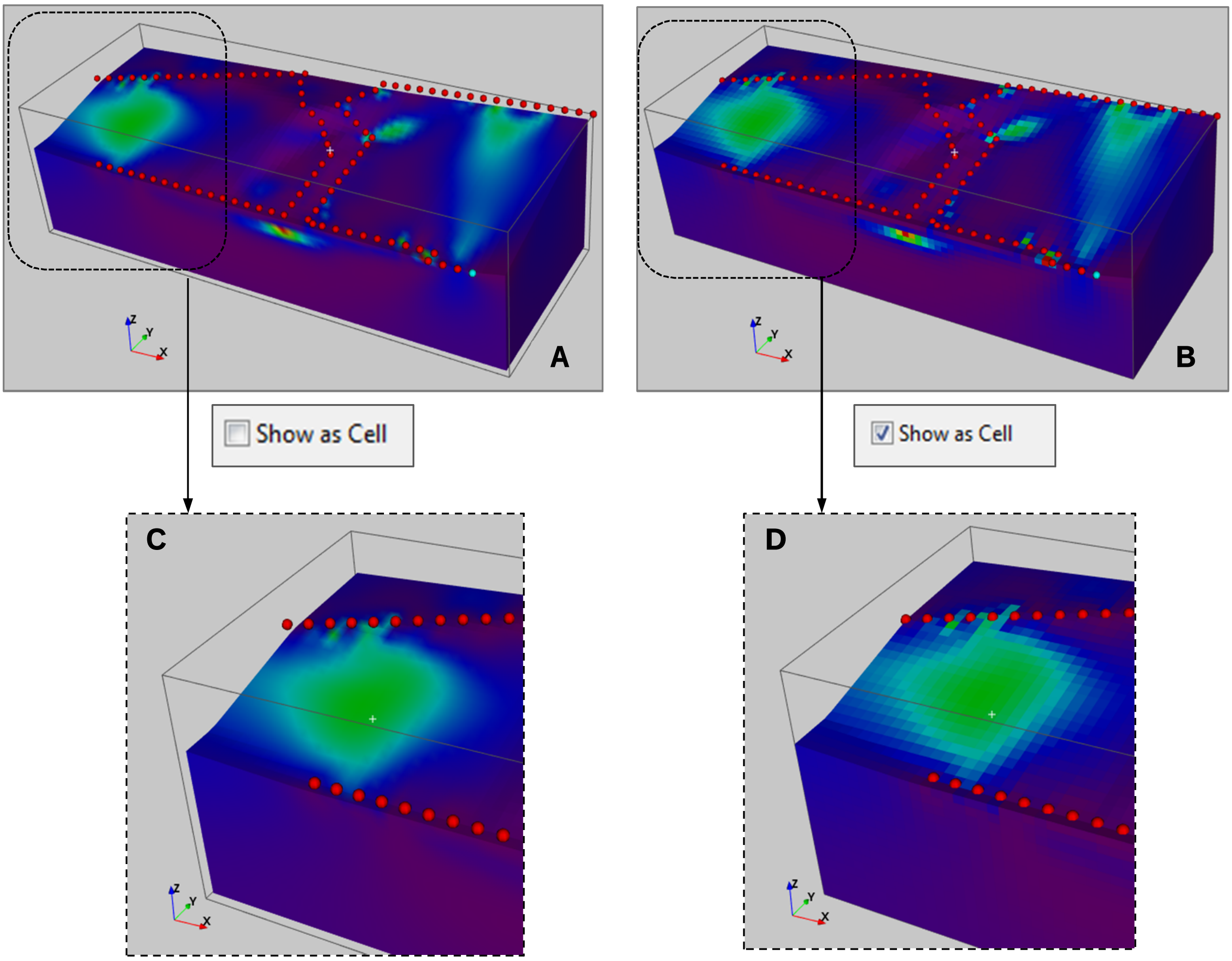
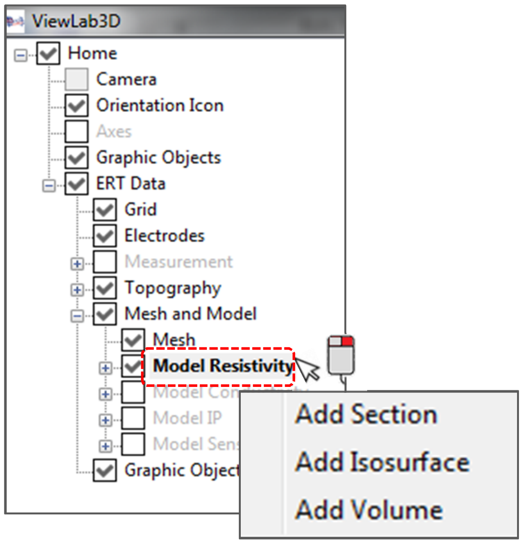


Figure 86: in A example of representation of "smooth"model, in B the same model with "cells mode" active and in C and D details.

It is possible to add new *Sections* (on default there are 3 sections), *Volumes* and *Isosurfeces* clicking with the right mouse button on *Model Reisitivity* node; 3 dedicated buttons will appeears("Add Section", "Add Isosurface" and "Add Volume")



For every Section/Isosurface/Volume inserted one new sub-node will be added to those already present, as is shown in the following figure:

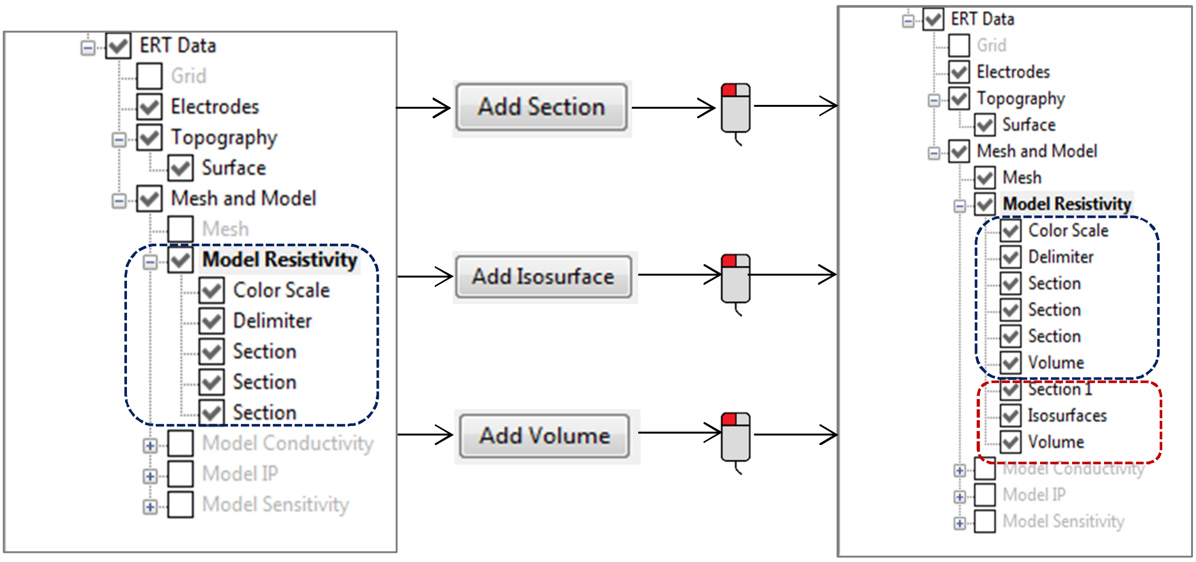


Figure 87: insertion of Section, Isosurface and Volume in the Resistivity Model node; into the red dashed line there are the new nodes, into the blue those already present.

The *Model Resistivity* node has in turn further nodes, which are described below:

- ***Color Scale**:* it allows to set the property of the color scale; the relative panel shows the following item:

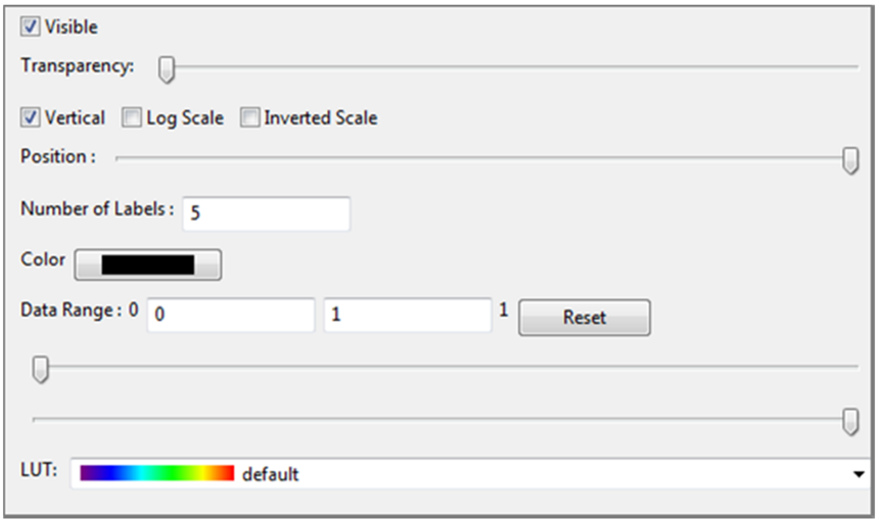


Figure 88: Color scale of Resistivity panel

  - *Visible:* it makes the color scale visible or not, as is shown in the following figure (Fig.88)

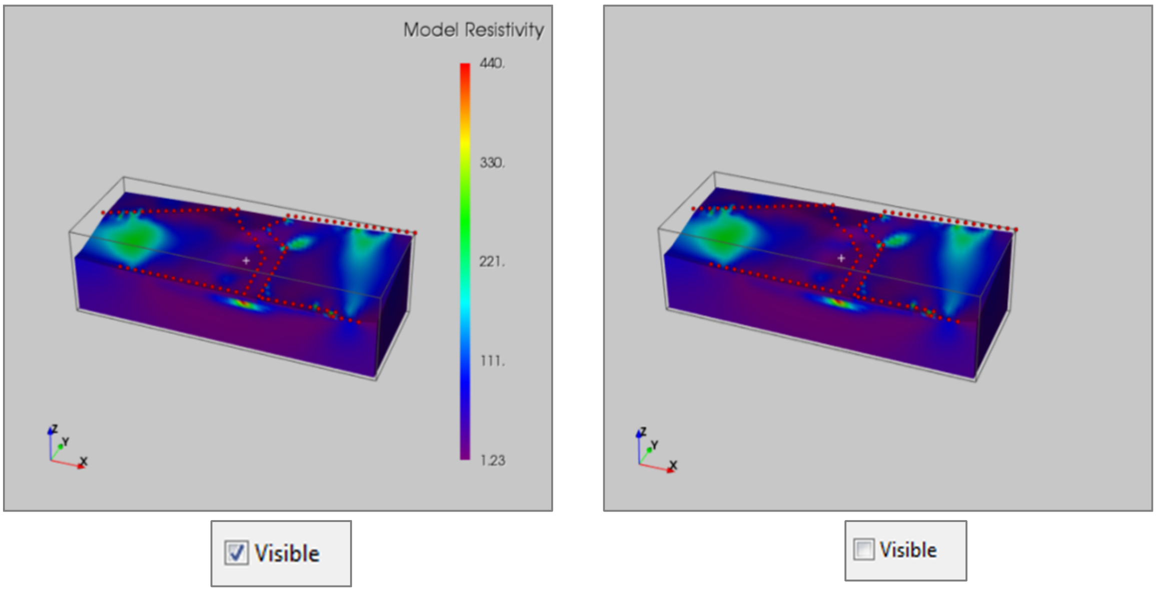


Figure 88: Setting of visibility of Model Resistivity color scale

- *Transparency:* : through the slide it is possible to set the transparency of the color scale, as shown below. As the slide shift to the right the scales become increasingly transparent:

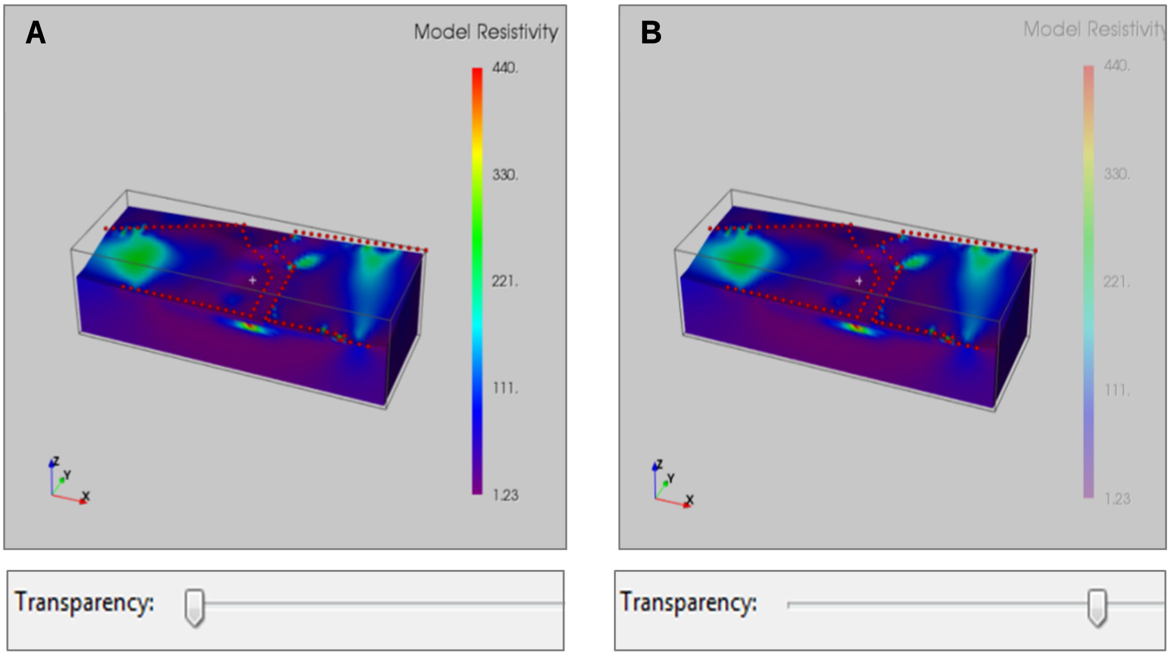


Figure 89: different levels of transparency of the color scale (minimum in A, high in B)

- *Vertical:* if this tool is selected, the color scale is in vertical position; otherwise it is horizontal.

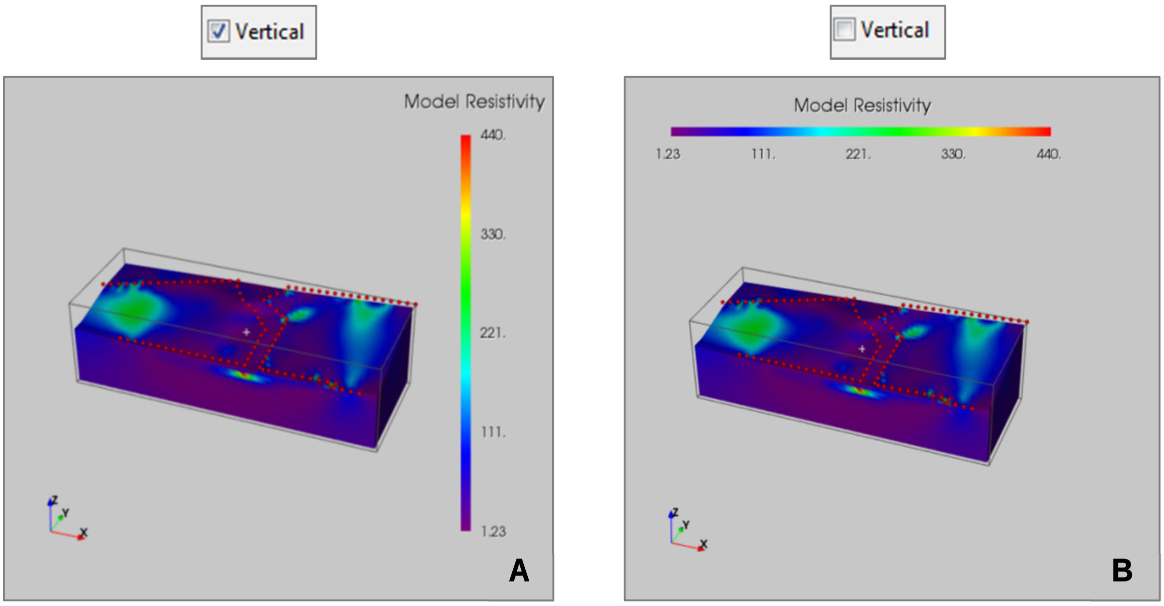


Figure 90: Color scale in vertical position in A and in horizontal position in B.

- *Log scale:* it turns the scale from linear to logarithmic; the following example shows as the colors of the scale are the same but the values are different (the number at the center of the bar is 221 in linear scale and 107 in logarithmic scale). Obviously also the representation of the resistivity model changes and in some cases it helps to better appreciate the resistivity variation of interest.

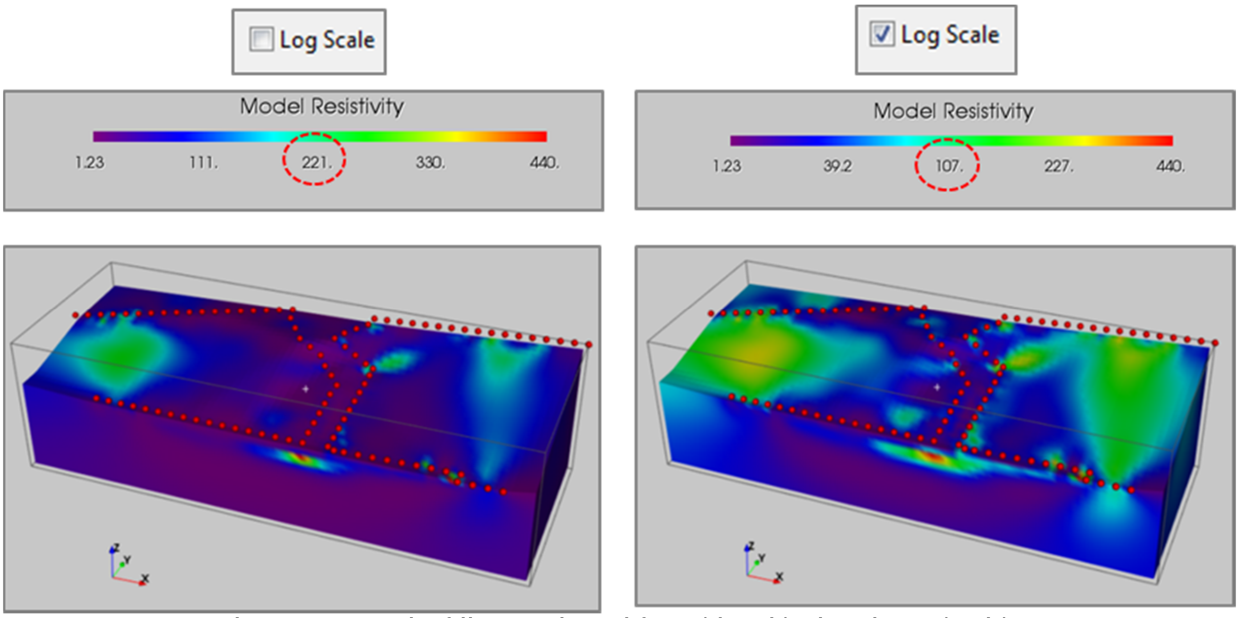


Figure 91: example of linear scale, on left, and logarithmic scale, on the right.

- *Inverted Scale* : it inverts the scale of colors, so the color associate with the maximum value will be associate to minimum value and vice versa. Obviously also the representation of the resistivity model changes (Figure 92)

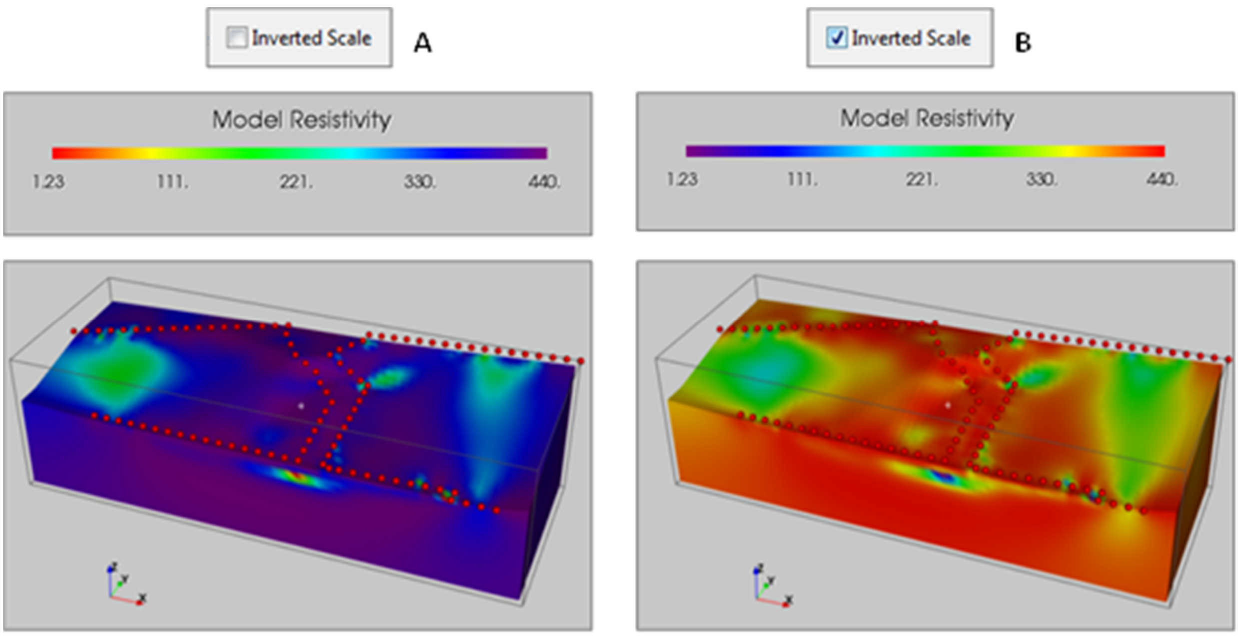


Figure 92: example of inversion of scale; in the original scale, the blue is associated with the minimum value, 1.23 in this case (case A). In the inverted scale the minimum value, is associated to red color (case B)

- *Position:* through the proper slider, it is possible to choose the position of the color scale in the scene, moving it laterally in case of vertical checkbox active and from top to bottom in case horizontal mode is active, as shown below:

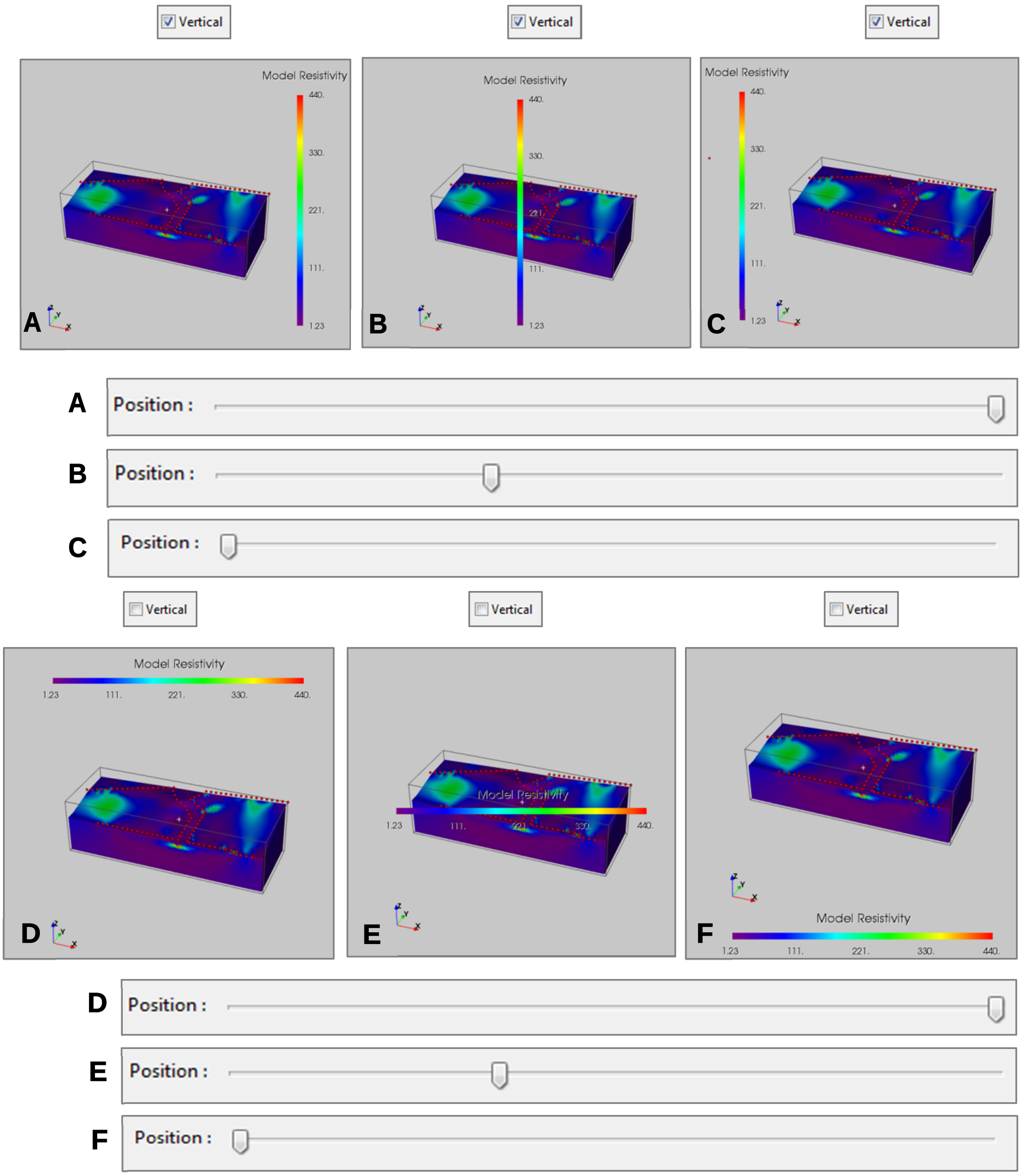


Figure 93: different positions of the color scale in the 3D scene; in A, B and C the Vertical checkbox is selected and the color scale is totally at right (A), totally at left (C) and in an intermediate position (B). In D, E and F the Vertical checkbox is not selected and the color scale is at the top of the 3D scene (D), at the bottom (E) and at intermediate position (F).

- *Number of labels*: it allows to choose how many labels to display in the color bar, as is shown in the following example.

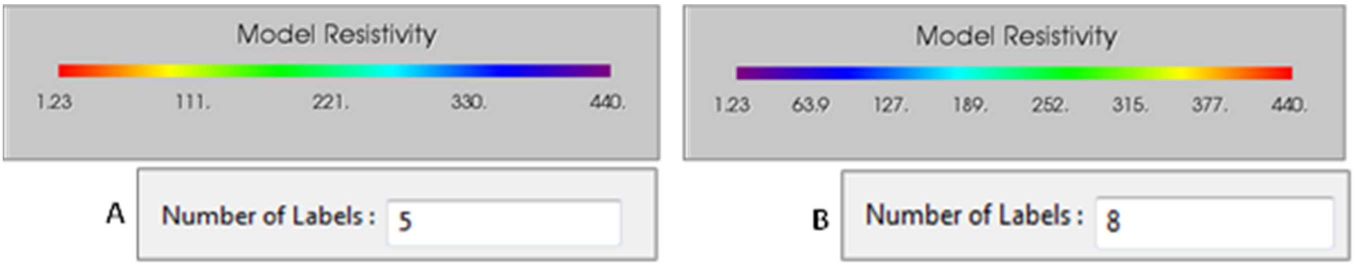


Figure 94*: different number of value of the color scale, 5 of default (case A) and 8 (case B)*

- *Color*: it allows to choose the color of the text; it is black on default and it is turn in red in the following example (Figure 95)

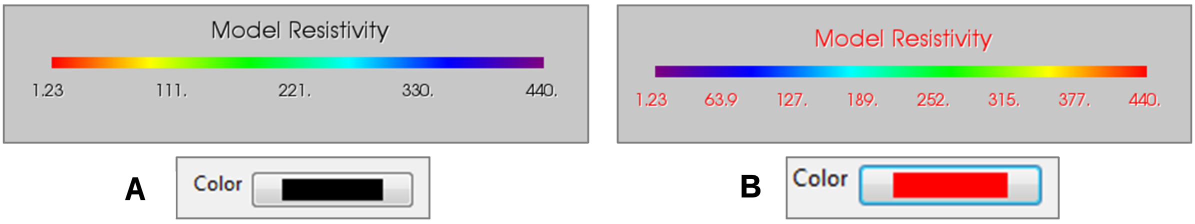


Figure 95: *example of different colors of the text of color scale; in A it is black, as default, in B it is red.*

- *Data range*: it allows to set the minimum and maximum value of the scale. Varying the extreme numbers of Color Scale they will be displayed the colors in the given numerical range and this allows to better visualize the distribution of the physical property shown.

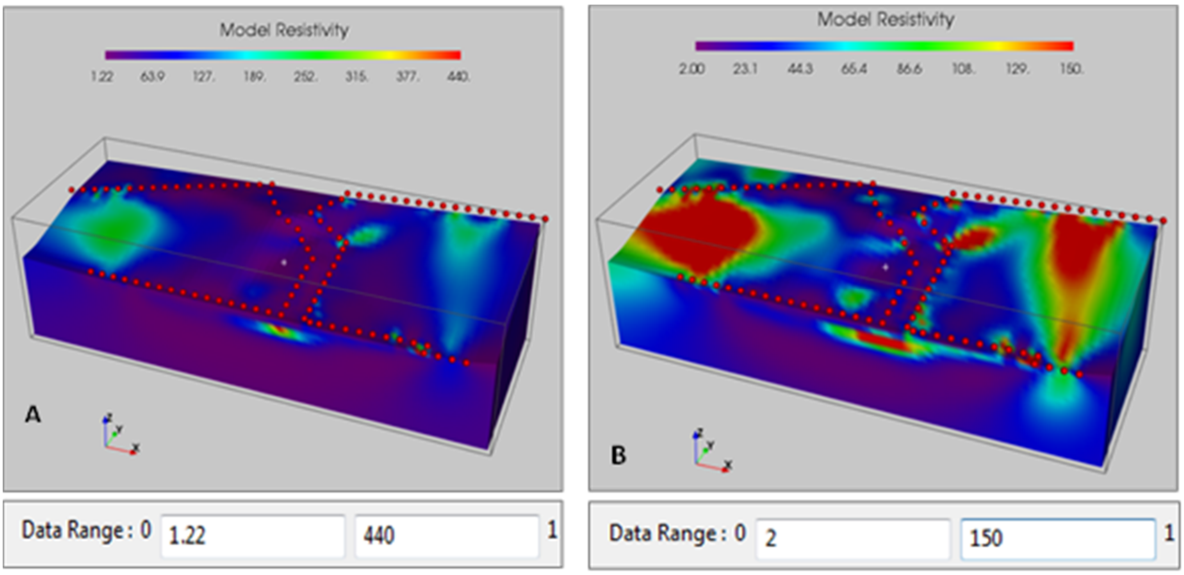


Figure 96: different data range displayed; In A the data range of Color scale is 1.22-440 (the entire data set), too big to appreciate the distribution of the physical property in 3D model; in B the limits of color scale are 2-150 and the anomalies are more visible.

Clicking on “Reset” button the software sets automatically the limits value of color scale coincident at minimum and maximum value of the data set (1.22-440 in this case), as is shown in the following figure (Figure 97).

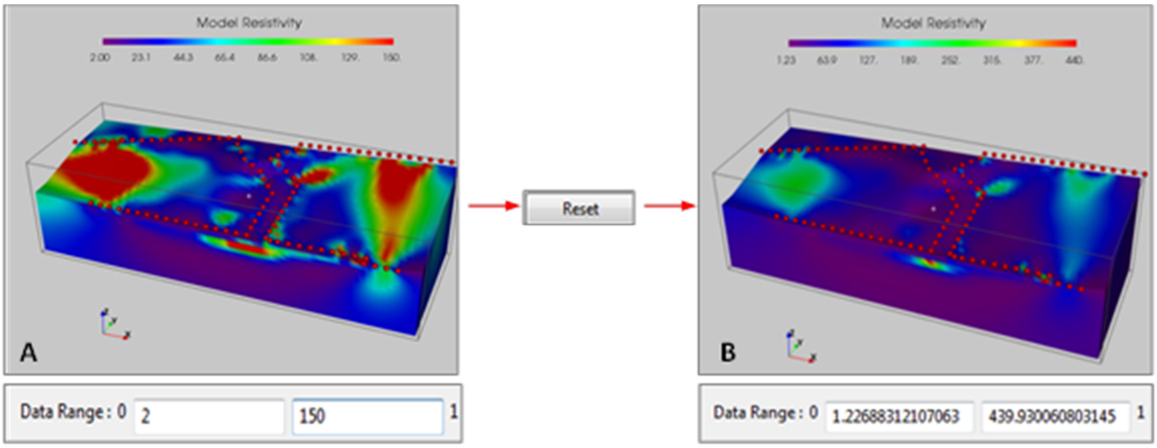


Figure 97: in A casual value of minimum and maximum value of the color scale; in B, minimum and maximum value of the color scale coincident with extreme value of dataset, through “Reset” button.

- *LUT*: it allows to choose the colors of the scale. The list in figure below shows the possibility of default; these are generated during startup of the program through consultation of a folder “Colormap” present in the installation folder. The files *.lut in that folder are then put on the list, so to delete some or create new ones just delete a file or generates a new one (in an adequate format).

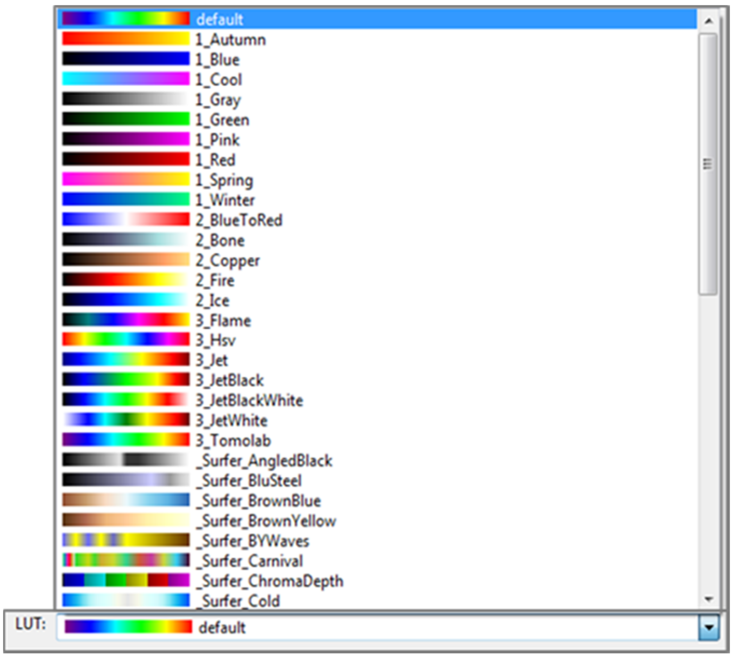
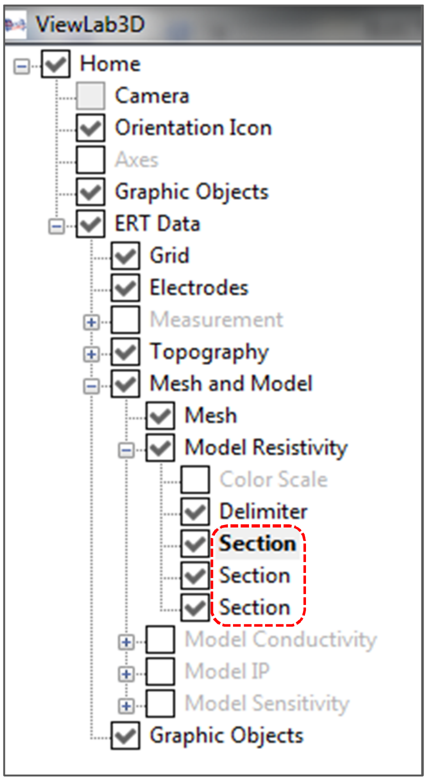


Figure 98: example of some colors available for the scale of colors

- **Section:** it creates a new surface that cuts the pattern according to different directions.



By default there are three predefined sections, one for each main direction XY, XZ, YZ, but it is possible to add other sections through the proper button "Add Section", as explained at the beginning of the paragraph.

The Section sub-nodes has the panel divided into two different part: *Section* and *Contour*. The first has the following items:

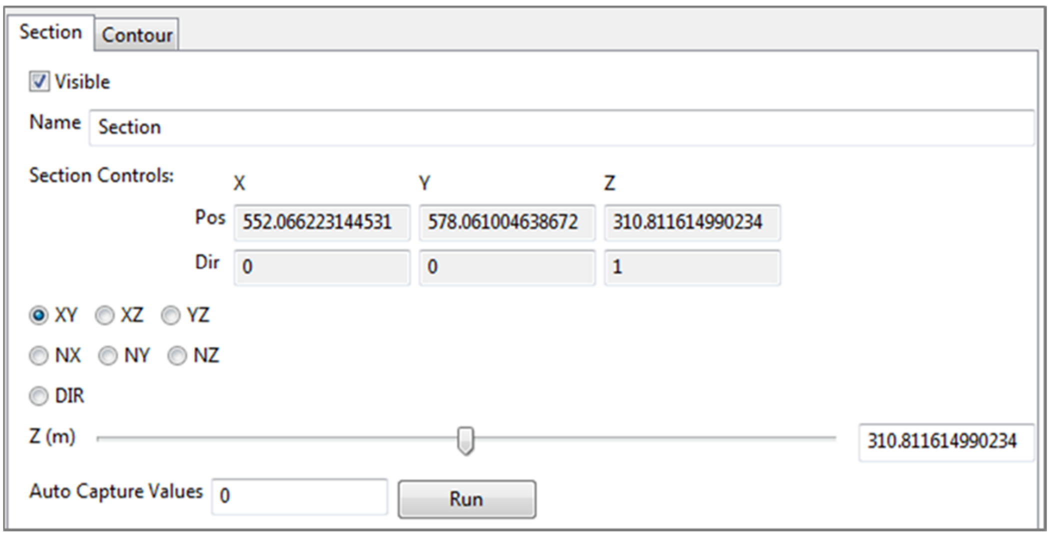


Figure 105: Section Panel

- *Visible:* it makes the delimiter line visible or not
- *Name:* it allows to give a name at the section
- *Section Control:* it is a not editable table which shows in every moment the information about the Position and the Direction of the object in the 3D scene. It is automatically updated every time the operator acts on the directional buttons explained below.
- *XY, XZ, YZ button:* it allows to set the direction of the section between these three main directions of the 3D space

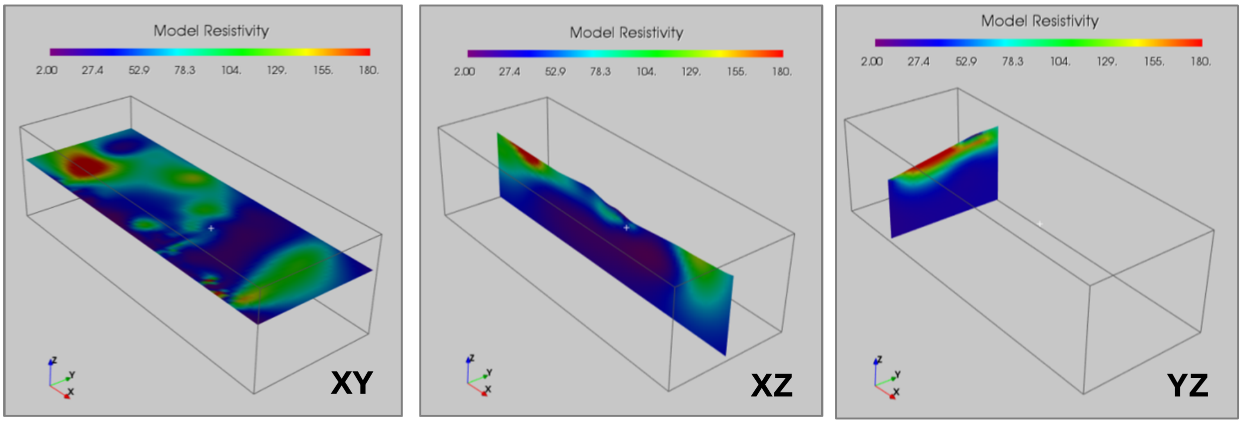


Figure 106: default sections on three main directions.

Checking NX button, for example, it is possible to tilt the section of an angle N (15° in figure) respect to plane YZ and checking NY button it is possible to tilt the section of an angle N (15° in figure) respect to plane XZ:

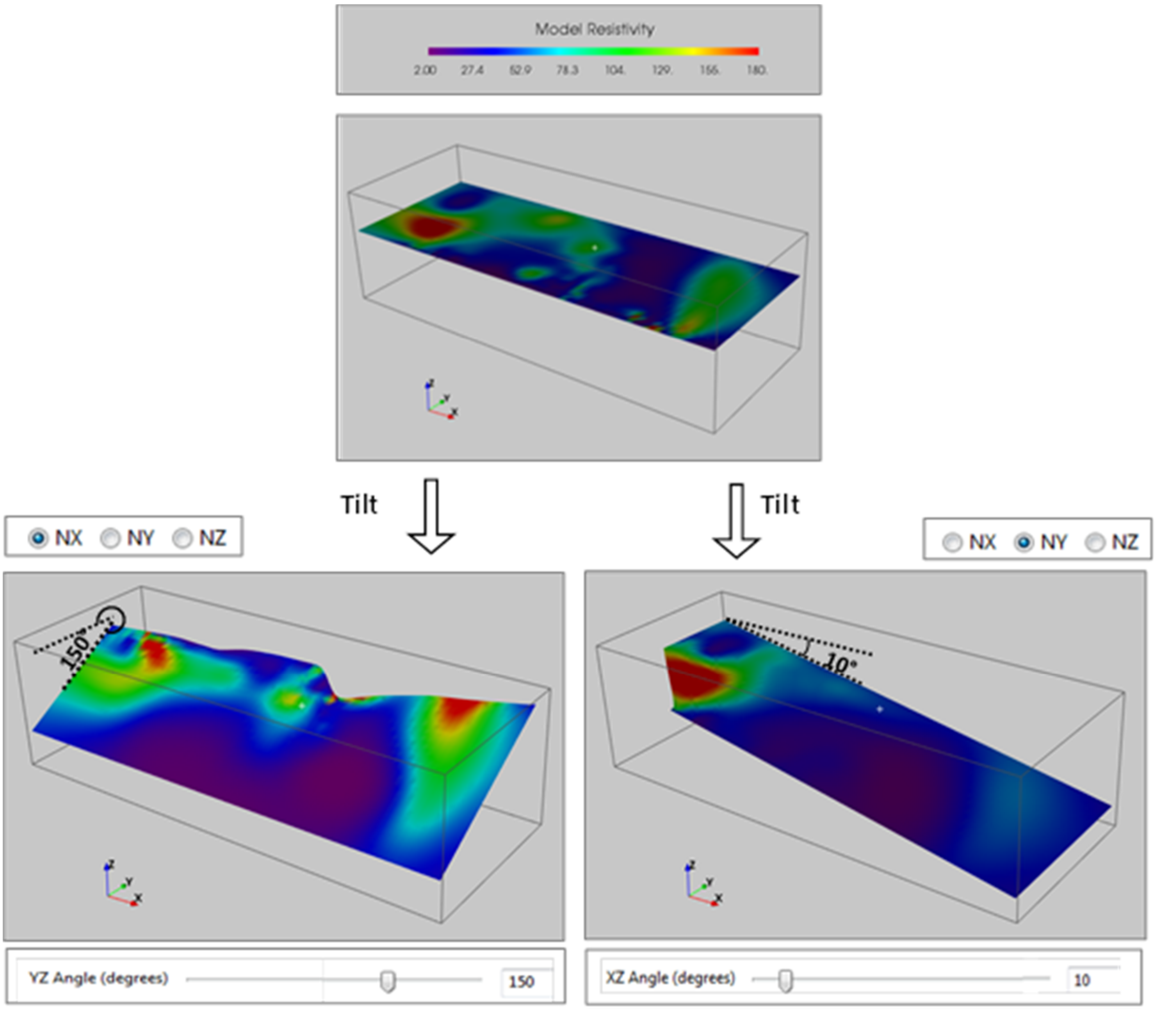


Figure 107: example of cutting of 3D volume with a section of 10° respect XZ and 150° respect XZ plane

These cases are shown as example but it is possible to cut the mesh with a plane tilted of any degree (between 0 and 180) and oriented in any direction, to better visualize the internal velocity trend.

- *Dir:* it allows to move a plane orthogonal to one of the main directions (so with NX, NY or NZ checked) into the mesh ; moving the proper slider, or writing the desired number, the section will move toward the mesh until the desired position.

In the following example a YZ plan is moved along Y axe (Figure 108):

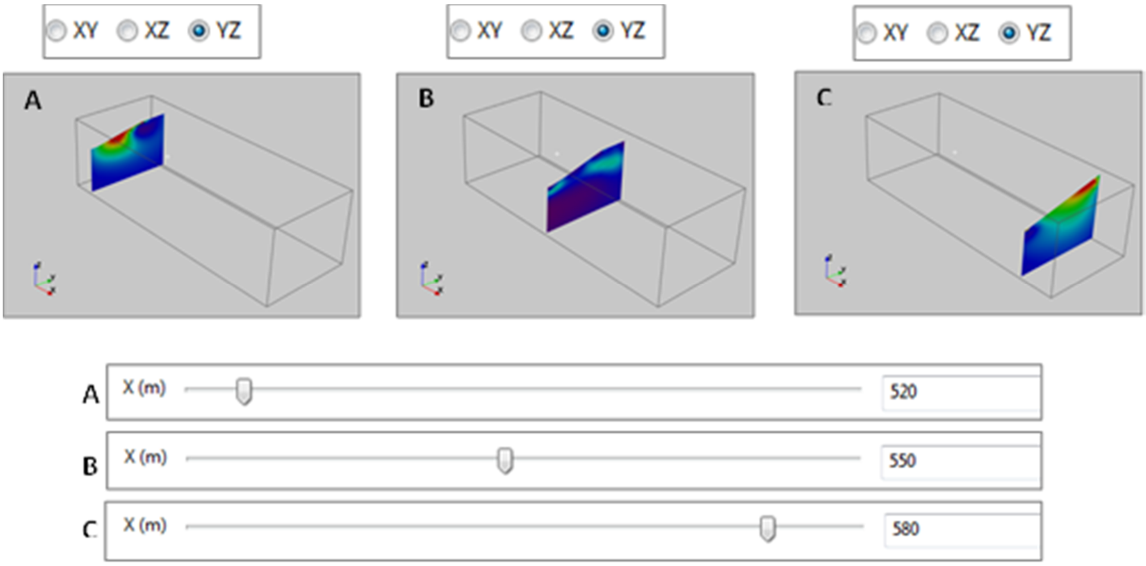


Figure 108: different positions of the section parallel at the YZ plan

- *Auto Capture Values*: it is a useful tool when it is required to capture a lot of screenshots of the 3D scene, with the section in different positions. It is possible to do this writing in the proper space the sequence of number or using a specific notation, as is show in the following example.

It is worth mentioning that the numbers to write in the box refers to the measure shown in the slider over it; it is X (m) in this case but it can be an angle (degree) if NX, NY, or NZ is selected

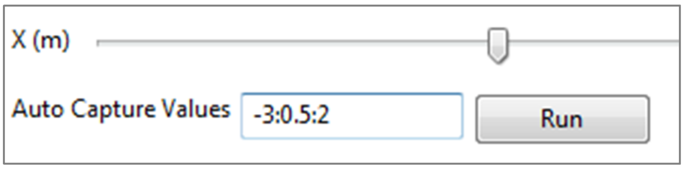


Figure 109: example of notation for determine the image to save

In this case, we save images with the section from position -3 to position 2, along X axe, with a step of 0.5 (11 figures throughout). Clicking on *Run* buttons, the figures are automatically saved in the working folder.

It is possible to obtain the same result using the button "Capture" at the top of the screen, but in this case it is necessary to do it for every single figure; using "Auto Capture Function", instead, it ispossible to save many images all at once.

- ***Contour***

This tool manages the display of the contour lines of the plan to which the section refers.

The panel has the following tools:

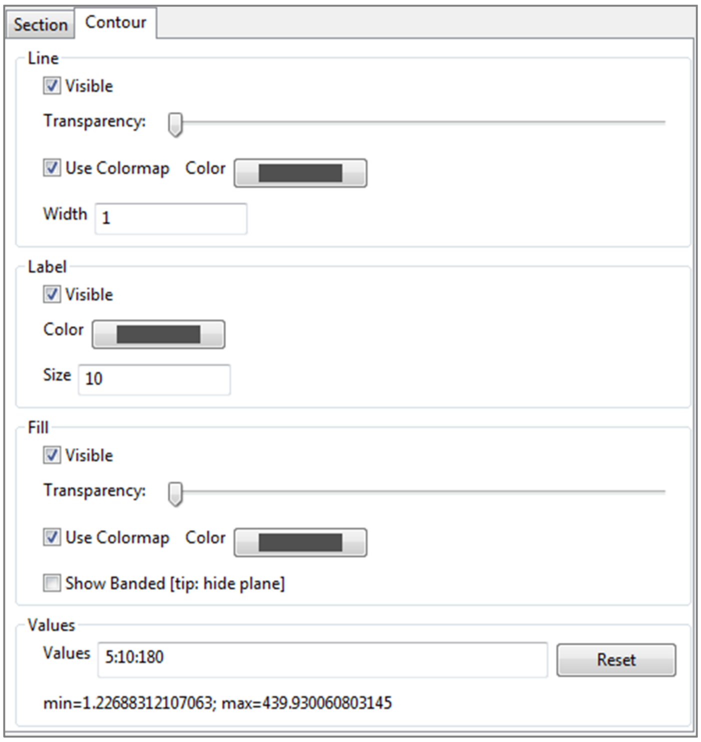


Figure 110: Contour panel

It is divided into 4 sub-panels: *Line, Label, Fill, Values*.

The *Line* panel has the following tools:

Figure 111: Contour panel, Line detail

- *Visible*: it allows to makes the line of contouring visible or not, as is shown in the following example.

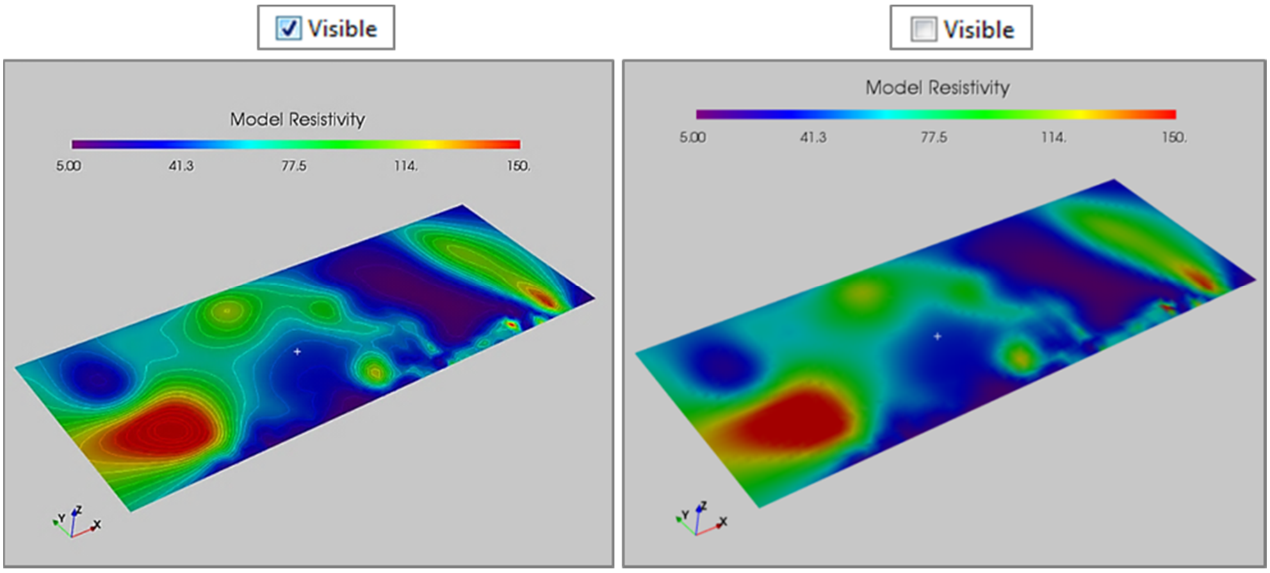


Figure 112: at left contouring line visible, at right not visible.

- *Transparency*: it manage the level of transparency of the line; when the slide is totally at left the lines are completely visible, when it is on the right they are not visible at all and at the intermediate positions they are more transparent as the slide goes towards the right.

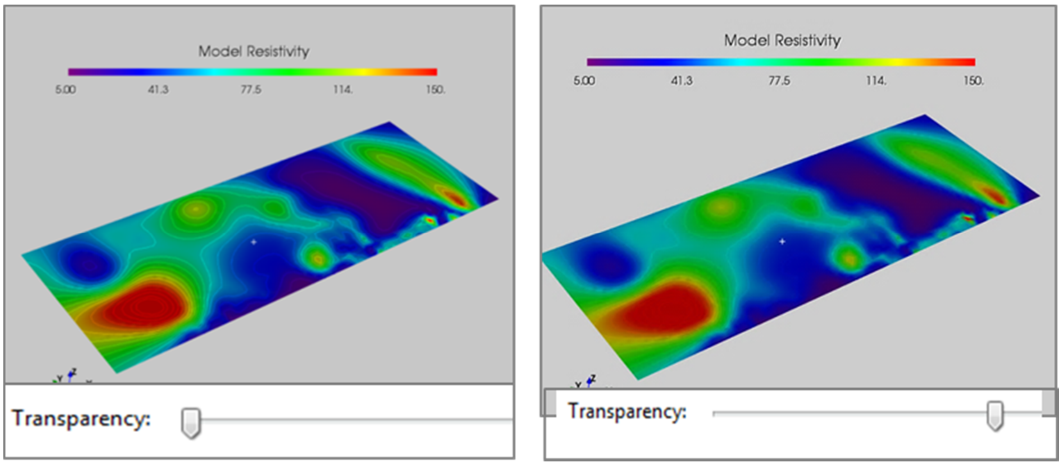


Figure 113: at left contouring without any level of transparency, at right high level of transparency

- *Use Colormap*: if it is checked, the lines have the color of the Colormap, so their color changes in function of the relative values. If it is not checked, all the lines have the same color, sets by the proper button nearby (it is dark gray by default)

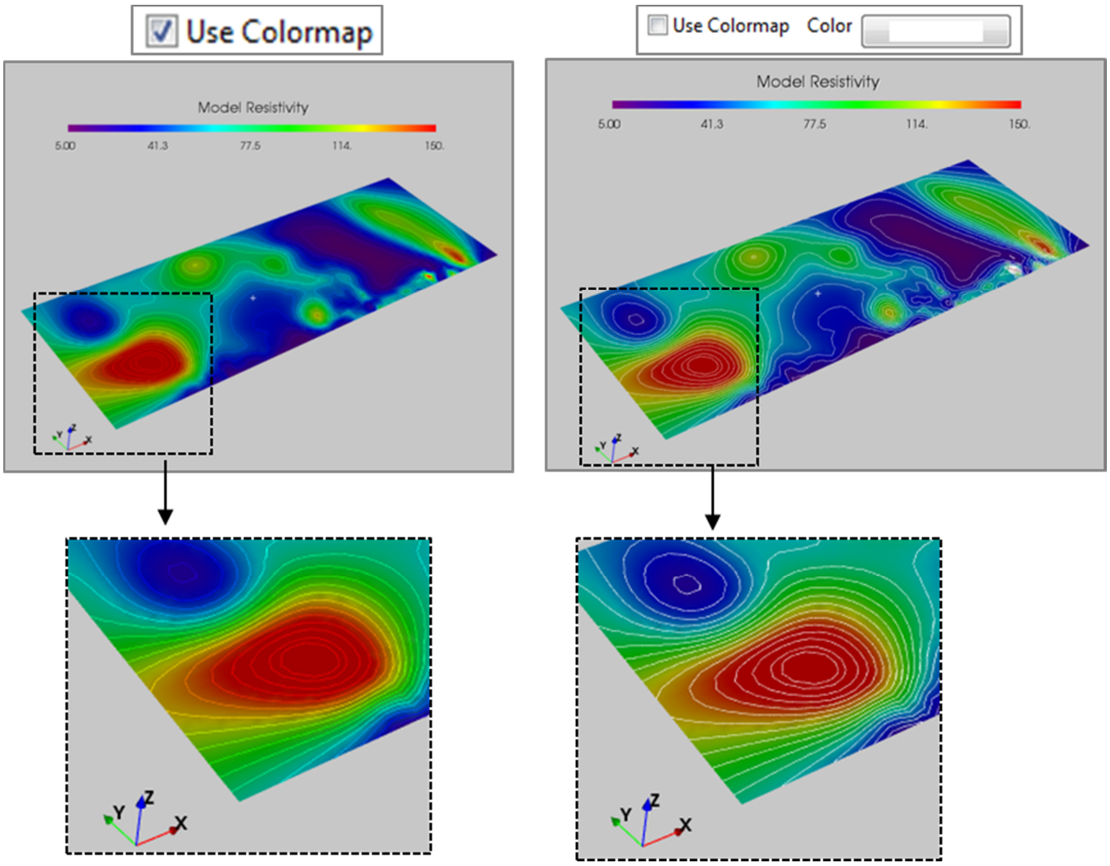


Figure 114: at left countoring line with colors of colormap, at right all the line are white.

- *Width:* It lets to set the width of the line, writing a number from 1 to 20 in the box.

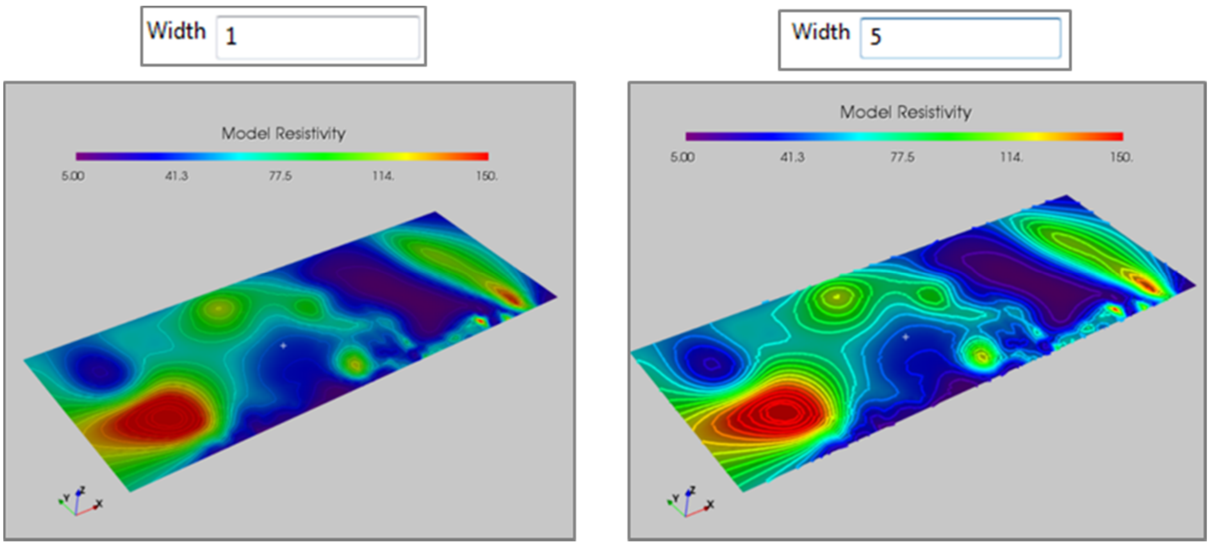


Figure 115: at left countoring line with width of 1, at right countoring line with width of 5

The *Label* panel has the following tools:

Figure 116: Contour panel, Label detail

- *Visible*: it allows to make the label visible or not, as is shown in the following example.

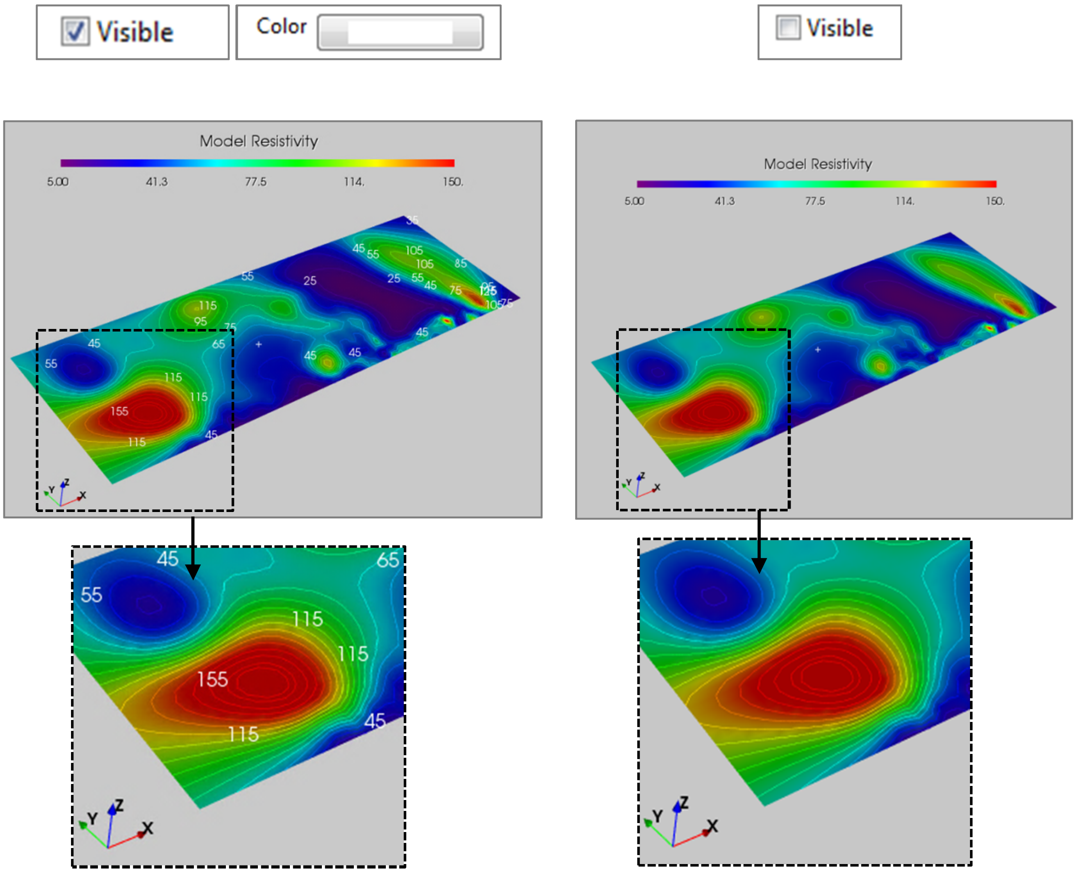


Figure 117: at left countoring line with white label visible, at right countoring without labels.

- *Color*: it lets to set the color of the label through the proper box. It is gray by default; in the following example it is change in white and black.

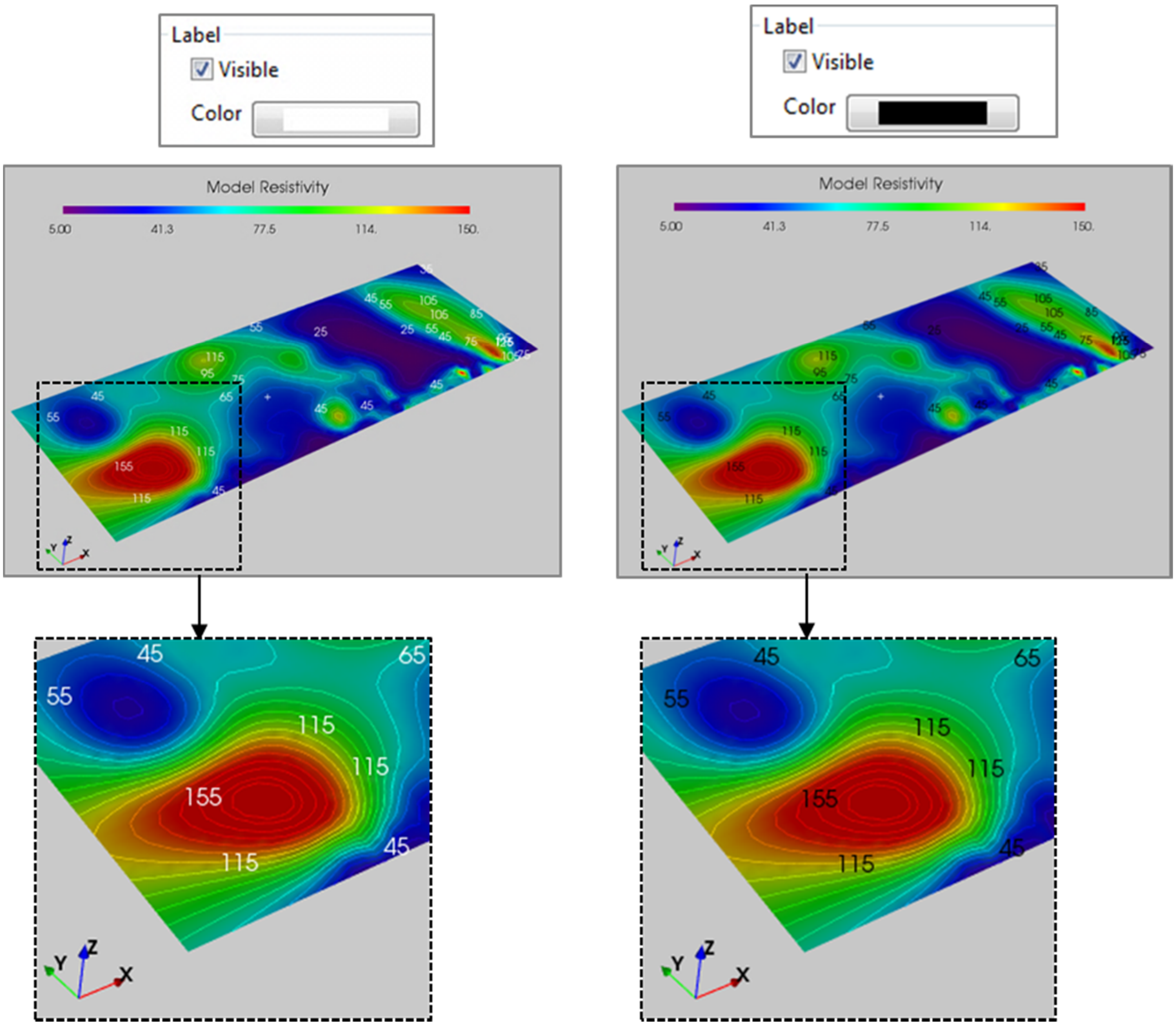


Figure 118: at left countoring line with white labels visible, at right countoring line with black labels visible

- *Size*: it lets to set the size of the label, writing a number from 1 to 50 in the box. In the following example it is set at 10 and 20.

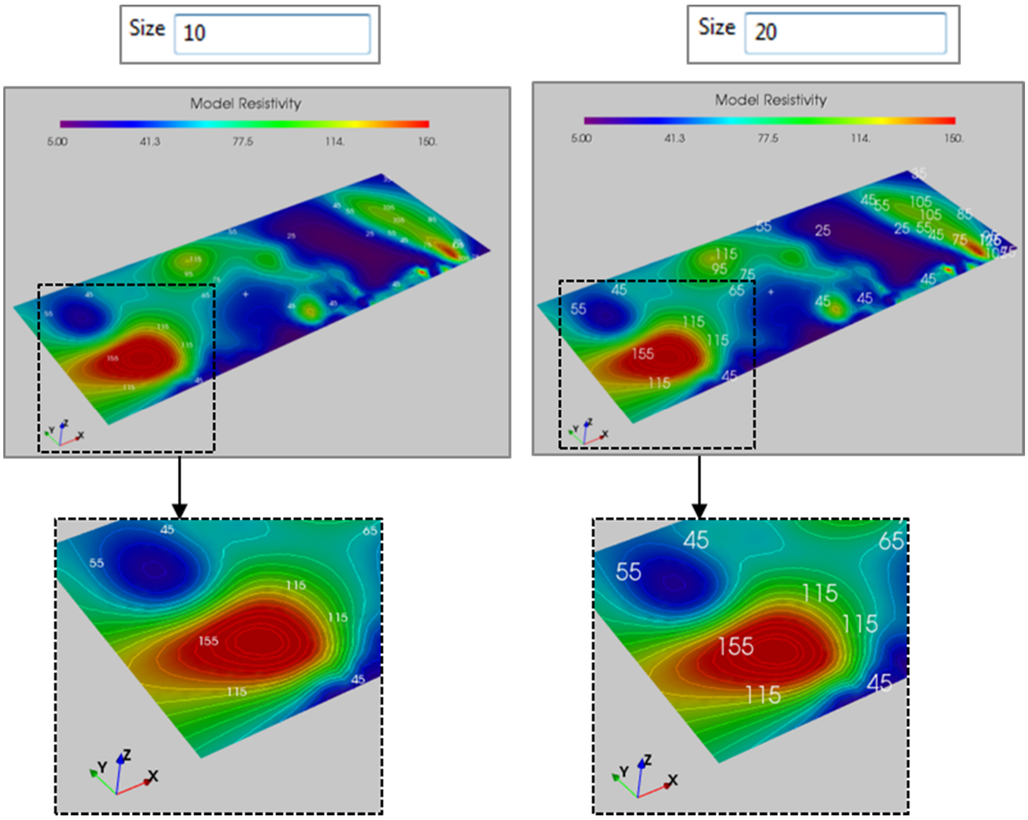


Figure 119: at left contouring line with white labels of dimension 10, at right contouring line with white labels of dimension 20

The *Fill* panel has the following tools:

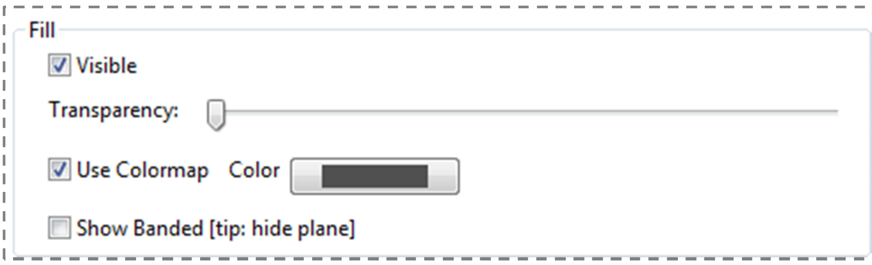


Figure 120: Contour panel, Fill detail

- *Visible*: it lets to display the entire section with the contouring visible or not; if it is checked, the section is colored in every point (so it is displayed the section with the contouring lines overlaid), if it is not just the contouring is visible, as is shown in the following example:

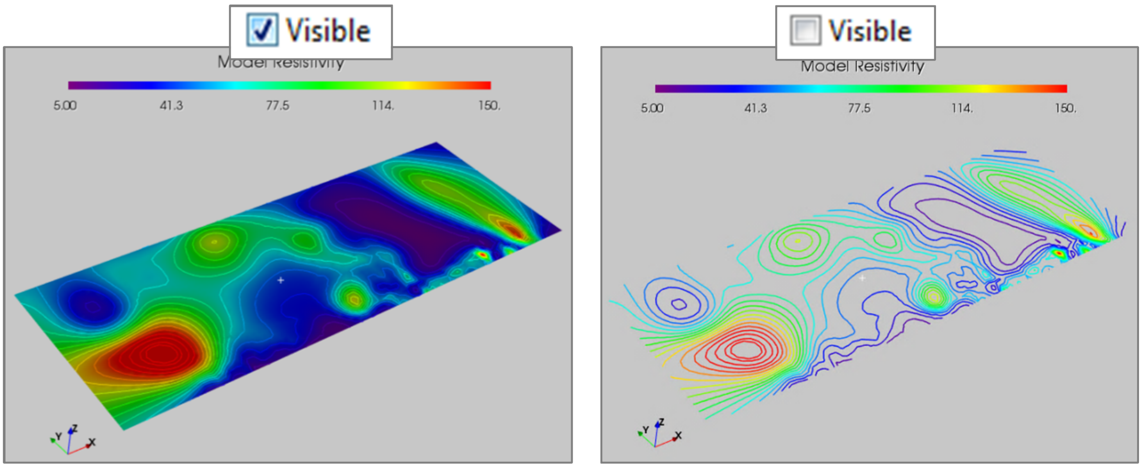


Figure 121: at left filling visible, at right filling not visible and just the contouring line are displayed

- *Transparency*: it manages the level of transparency of the filling, as is shown in the following figure. The contouring doesn't changes.

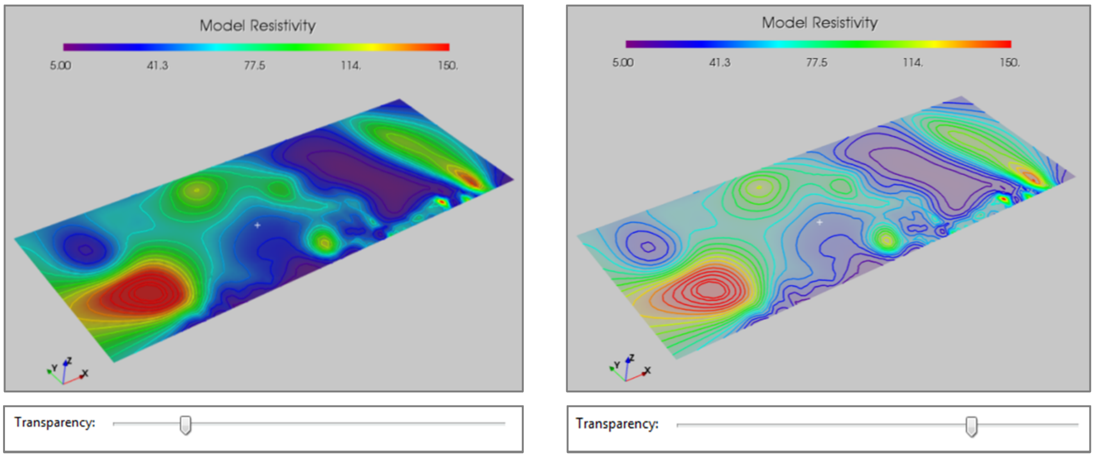


Figure 122: at left filling visible with low level of transparency, at right filling visible with high level of transparency

- ***Use Colormap***: if it is checked, the filling has the color of the Colormap, so its color changes in function of the relative values. If it is not checked, all the area has the same color, sets by the proper button nearby (it is dark gray by default)

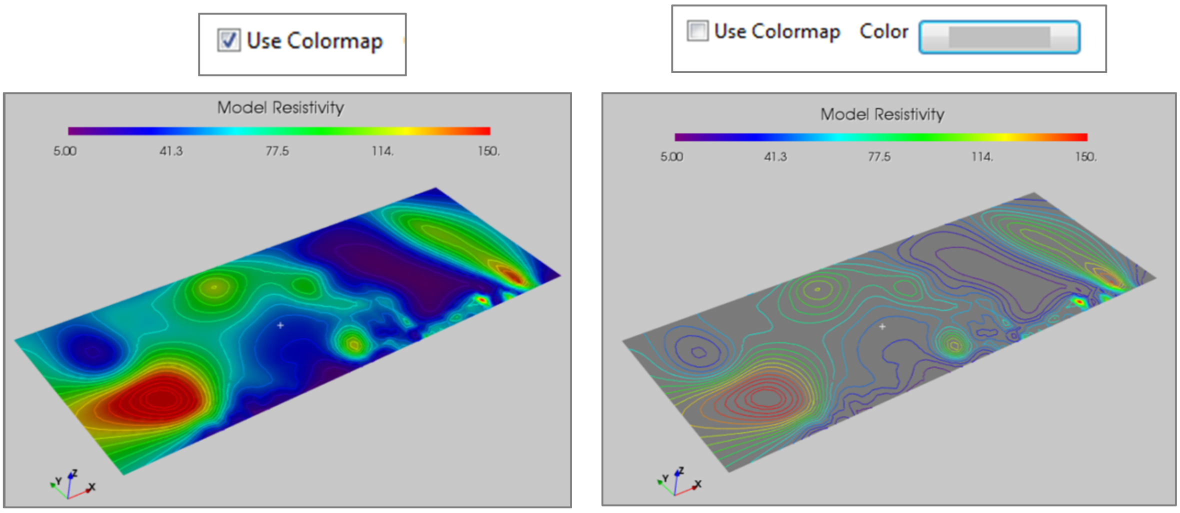


Figure 123: at left, filling with the same colors of the Colormap, at right filling of gray color

- ***Show Banded***: if it is checked, the filling is banded when it pass from a value to another; if it is not checked the passage from one color to another is faded. The difference between the two ways to represent data is more evident if the line visibility is not checked.

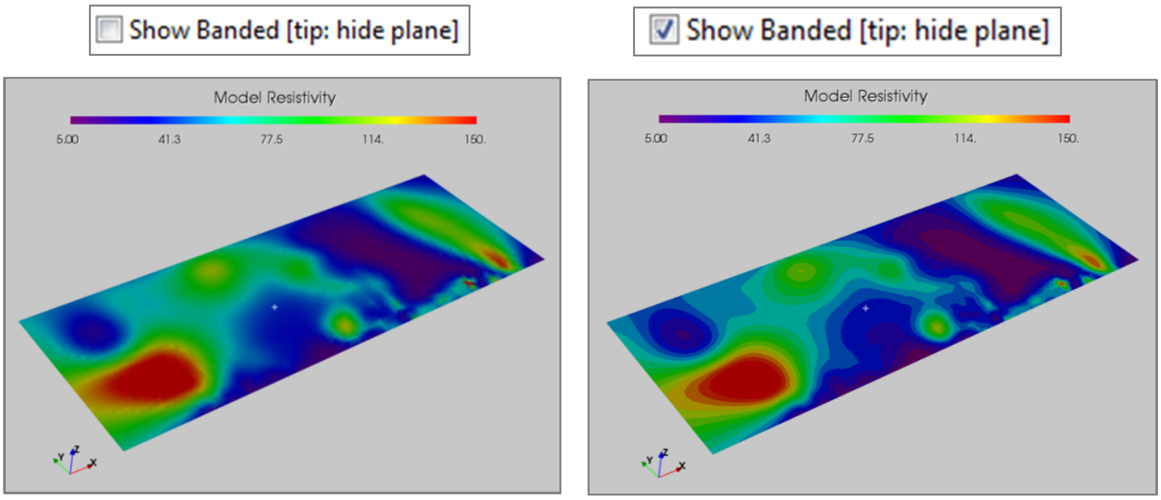


Figure 124: at left, filling with Banded checkbox disabled; at right banded tool activated

The *Values* panel has the following tools:

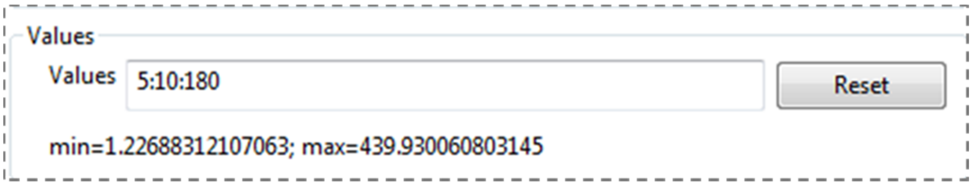


Figure 125: Contour panel, Values detail

Through this panel it is possible to choose the maximum and minimum value to apply at the contouring and the step interval within one line and the other. In the lower part of the box it is automatically reported the minimum and maximum value of the entire dataset.
One of the correct way to write the numbers is:

Minimum value to represent : *Step*: *Maximum value to represent*

In this example has been choose to represent the values from 5 to 180 with step 10 (5:10:180)

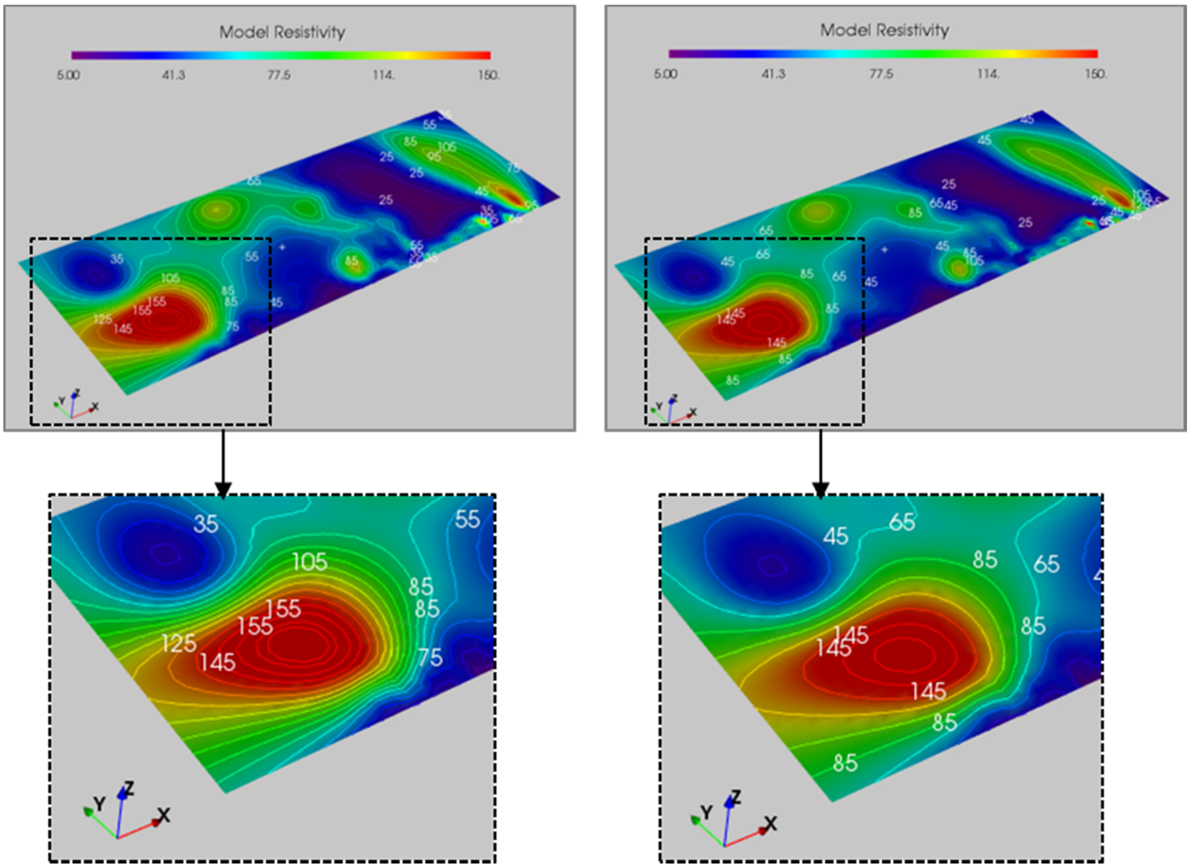


Figure 126: at left values from 5 to 180, step 10 (in the detail are displayed the value 35-55-75-85-105-125-145-145); at right left values from 5 to 180, step 20 (in the detail are displayed the value 45-65-85-145)

As mentioned before, in addition to these sub-nodes there are further node which are generated by "Add Isosurface" and "Add Volume button" in the Model Vs panel:

- ***Add Isosurface:*** This tool allows to identify in the model the surfaces which have the same value of some parameter, the iso-surfaces.

The panel shows the following items:

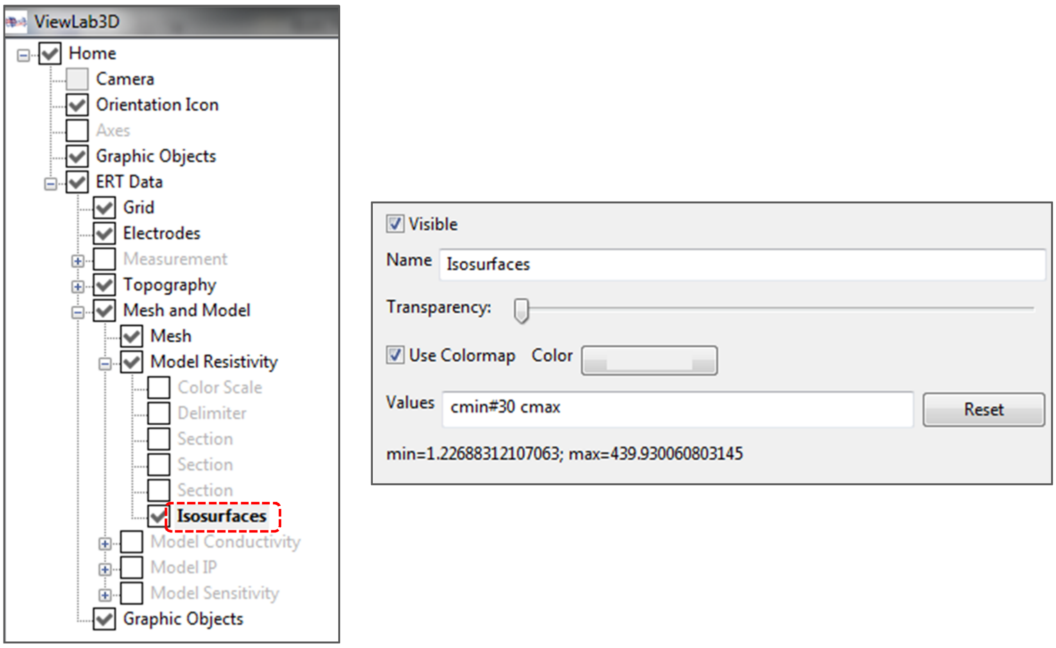


Figure 127: Isosurface Panel

- ***Values:*** it allows to set the value of the isosurface to display; it can be a unique value or a range. The maximum and the minimum value of the data set is suggest at the bottom of the panel.

By default, is represent almost the entire range of value of the dataset (Fig 128):

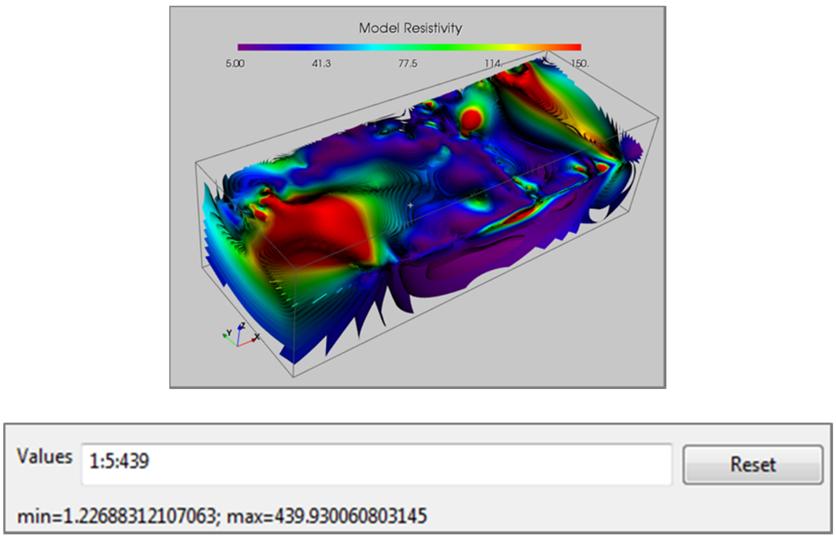


Fig 128: isosurface of the entire range of value of the dataset

In the following case, instead, a specific range of values is represented in every single case (Figure 129). In this way it is easy to evaluate what range of values counts the most data. In this specific case, the range selected are: 1-20 (low resistivity), 20-50 (medium-low resistivity), 60-90(medium-high resistivity), 120-180 (high resistivity);

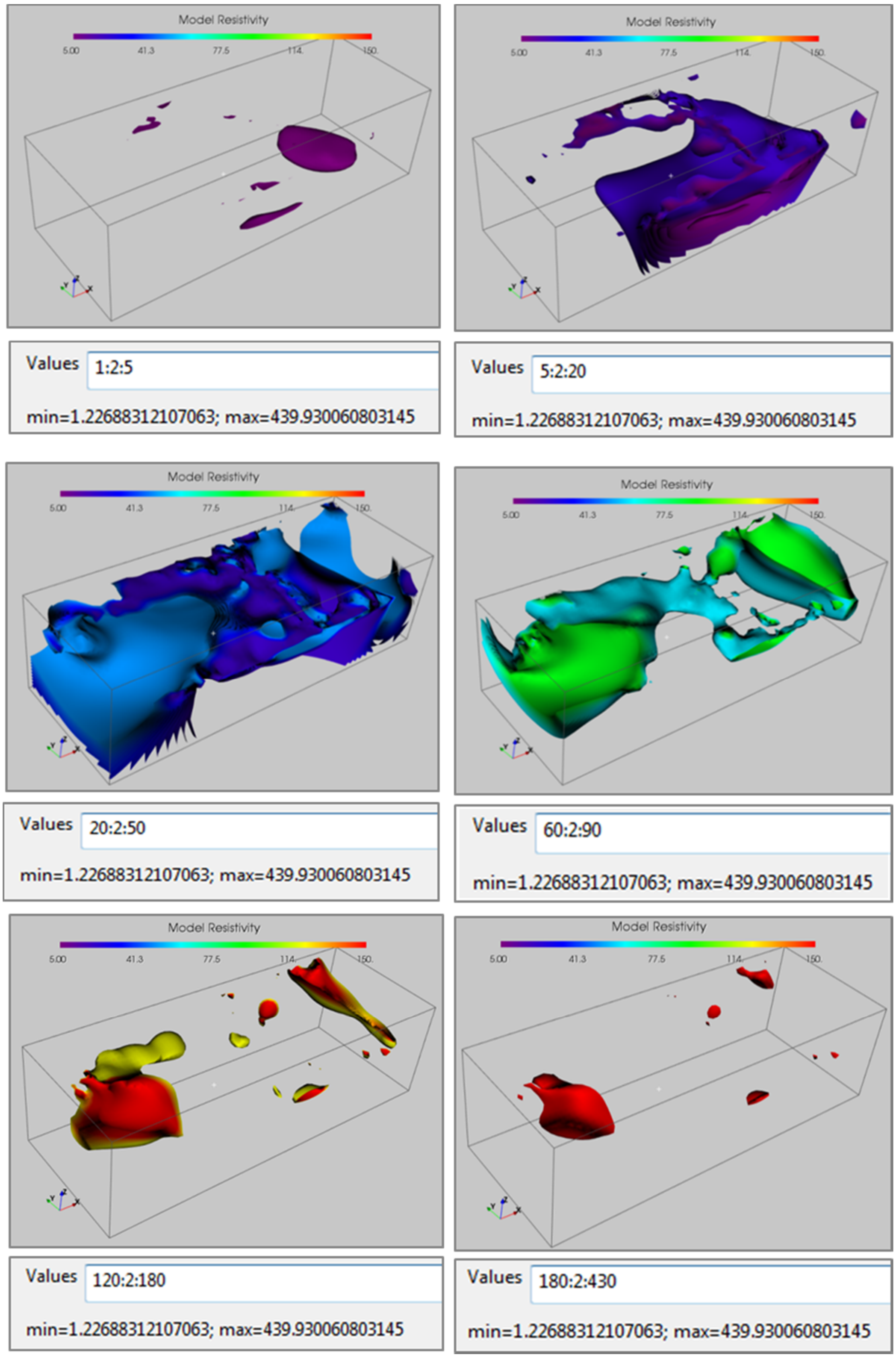


Figure 129 : example of isosurface with different ranges of values

As shown by the images, the values below 5 and above 180 refers to a restricted amount of data, so the analysis can be restricted to data comprised between 5 to 180, as are the sections shown until now.

It is also possible to add more than one isosurface and to show them simultaneously; in the following example two isosurfaces are shown in the same time, that relating to 1-8 values and that relative to 145-152, both of them with step 0.5 (Figure 130):

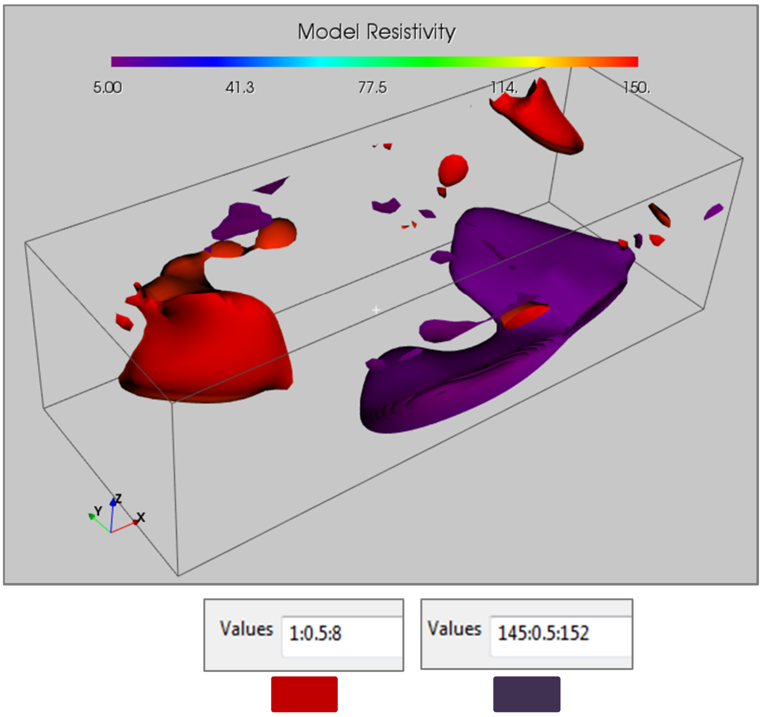


Figure 130: Two isosurfaces displayed at the same time

- *Visible:* it makes the isosurface visible or not;
- *Transparency*: it allows to set the transparency of the isosurface; when the slide is totally at left the object is completely visible, when it is on the right it is not visible at all and at the intermediate positions it is more transparent as the slide goes towards the right.
  To better appreciate the effect of this tool, in the following example the contours line are visible (Figure 130):

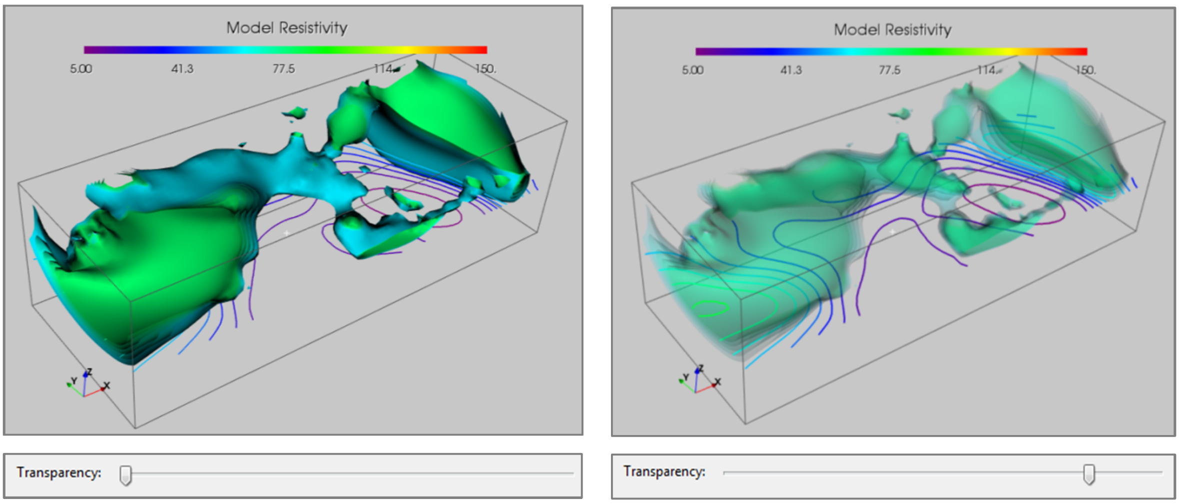


Figure 130: at left, isosurface (60:5:80) with zero level of transparency and contours lines partially visible; at right the same isosurface with high level of transparency and contours line more visible then before.

- *Use Colormap:* if it is checked, the isosurface is displayed with the same color of the Color Scale; if it is not checked it is possible to choose a color from the proper button.

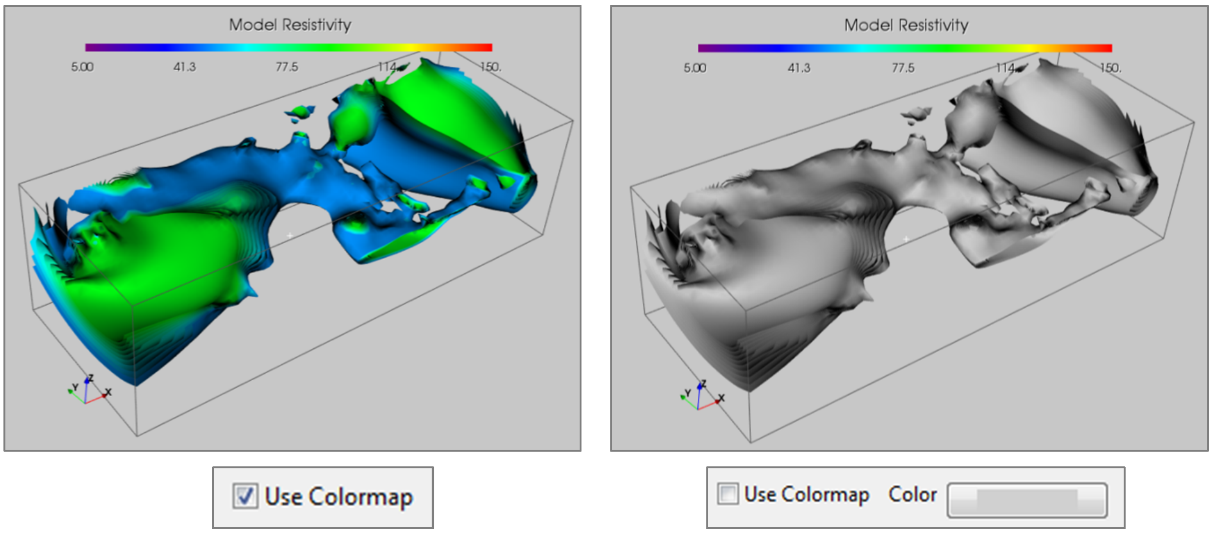


Figure 131: at left isosurface (50:5:90) with the same colors of the colormap, at right the same isosurface with a unique color (light gray) for any values.

- *Add Volume:* this tool allows to identify in the model the volumes that have the same value of some parameter, the iso-volumes. It is similar to iso-surface tool but the iso-surface inside is empty, the volume is full.

The panel shows the following items:

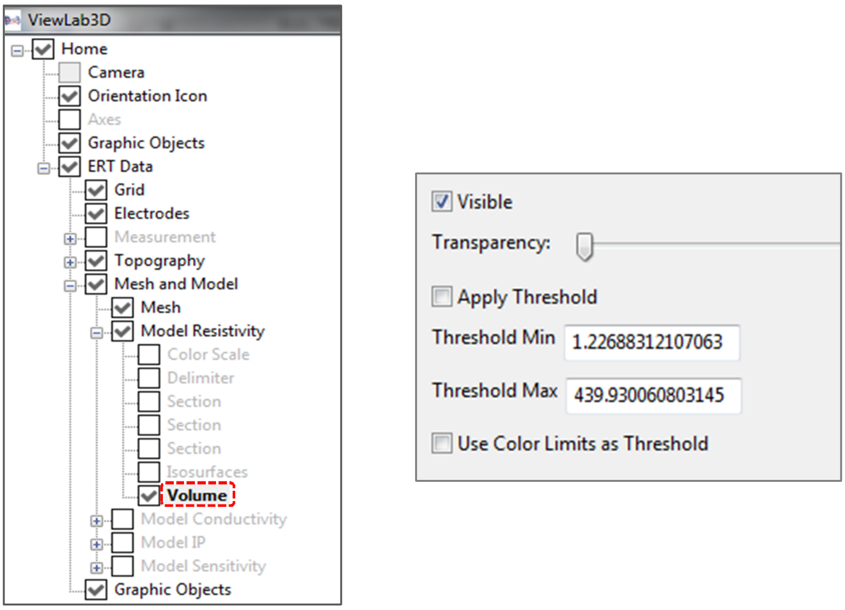


Fig 132: Volume Panel

- ***Visible***: it makes the volume visible or not.

- ***Transparency***: it allows to set the transparency of the volume; when the slide is totally at left the object is completely visible, when it is on the right it is not visible at all and at the intermediate positions it is more transparent as the slide goes towards the right.

In the following example the volume of the entire dataset and a section are displayed; in the first case (case A) the transparency of the volume is zero and the section is not visible. In the second case (case B) the level of transparency is high and the section parallel to plan XZ appears.

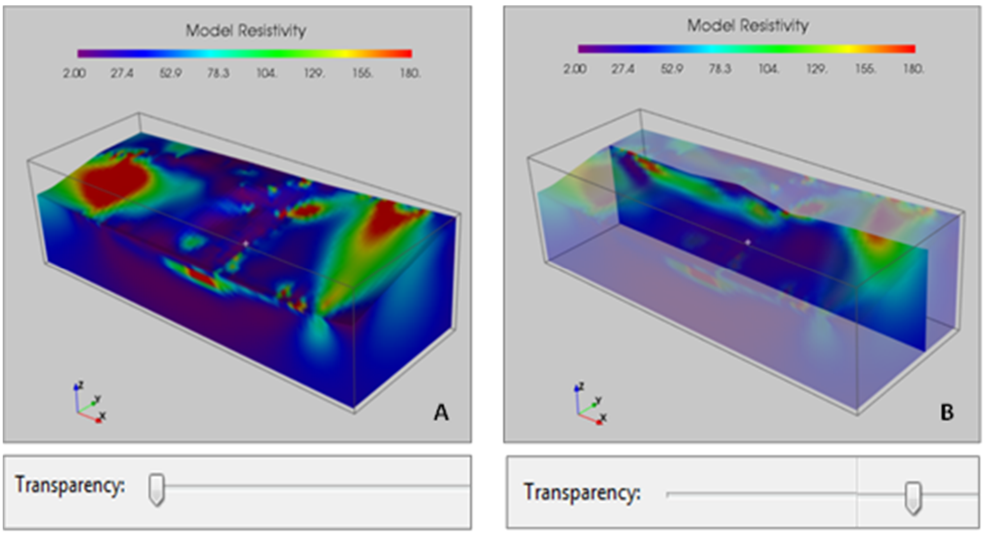


Figure 133: in A volume with zero level of transparence (section not visible), in B high level of transparence and the section is not visible.

- ***Apply Threshold***: if the box is checked, the threshold of the value to display is active, otherwise all the range of data is shown.

- ***Threshold Min/Max:*** this is the proper space to set the threshold value of the volume to display. On default it is set the minimum and maximum value of the data set.

For example, selecting determinate ranges of values it is easy to estimate what parts of the investigated area (and in what proportions compared to the entire dataset) have a maximum, medium or minimum resistivity values.

In the case reported in the example, almost all of the volume has low resistivity value (2-70 Ω·m); a relevant part of data has medium value(70-130 Ω·m), mostly in the surface and a lower part but nonetheless significant data have an high resistivity value (130-180 Ω·m), as is shown in the following figure:

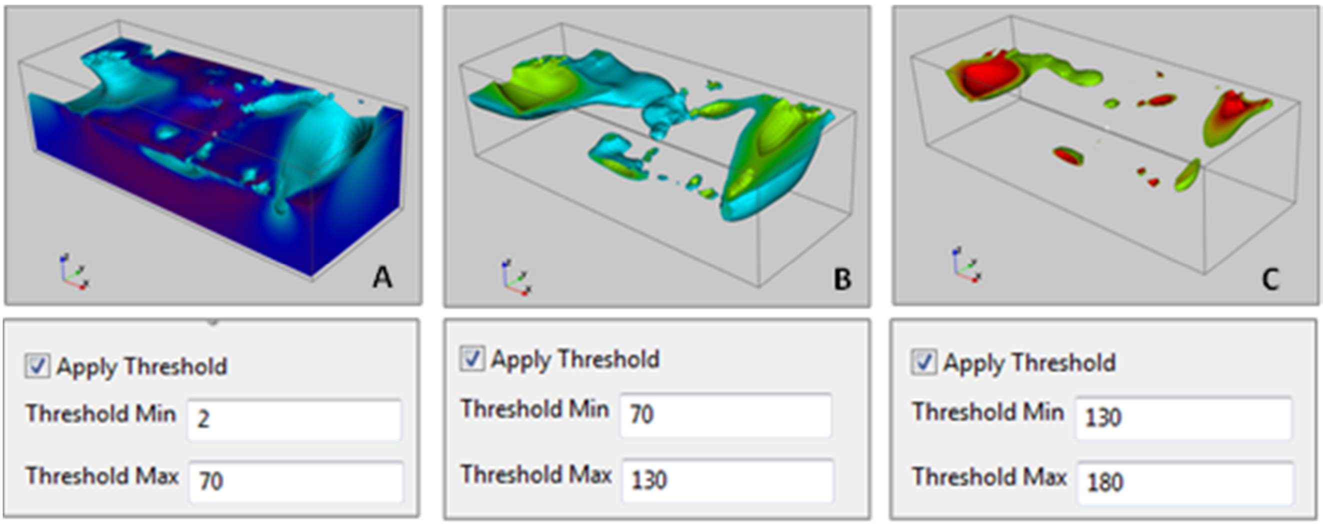
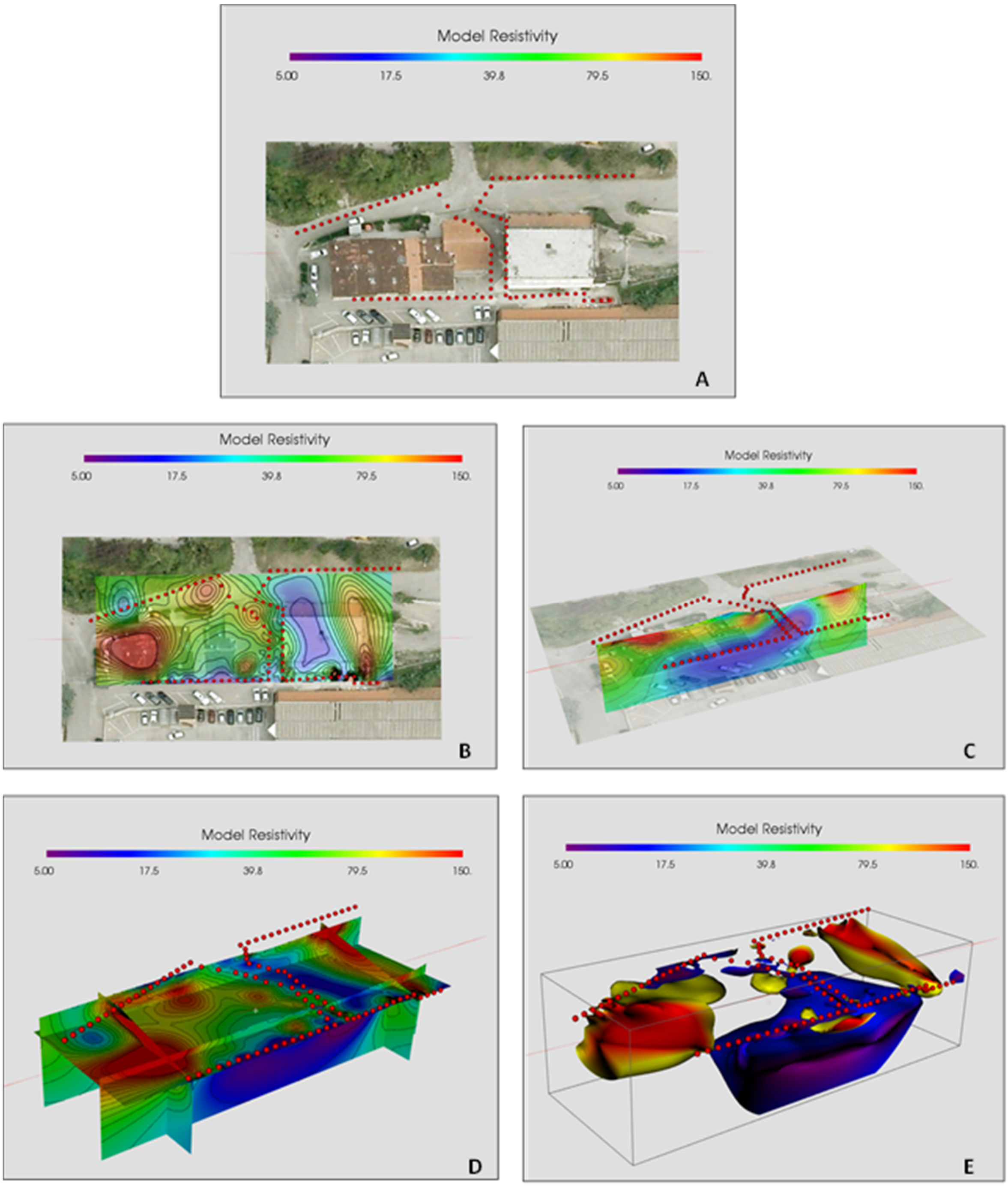


Figure 134: Example of volumes of minimum (A), medium (B) and maximum (C) value of resistivity of the dataset.

As a final example, the following images shows some of the many data representation possibilities:



*In **A** photo of the site obtained from Google Earth overlaid with the electrodes used for the acquisition; in **B** the insertion of a section of Resistivity Model parallel to the XY plane; in **C** insertion of a section parallel to YZ plane; in **D** insertion of 5 sections, 2 parallel to the YZ plane, 2 to XZ plane and 1 to XY plane; in **E** visualization of the mesh and two volumes, one incorporating the most conductive areas (5-15 ohm * m, in blue) and the other the most resistive area (80-150 ohm * m, in yellow-red)*

7.4.3 CONDUCTIVITY

The conductivity model quantifies how easily the model allows the flow of electric current. It is the contrary of Resistivity model. As is shown in the following figure, the areas that in the model of *Conductivity* show the maximum values in the model *Resistivity* show the minimum, and vice versa.

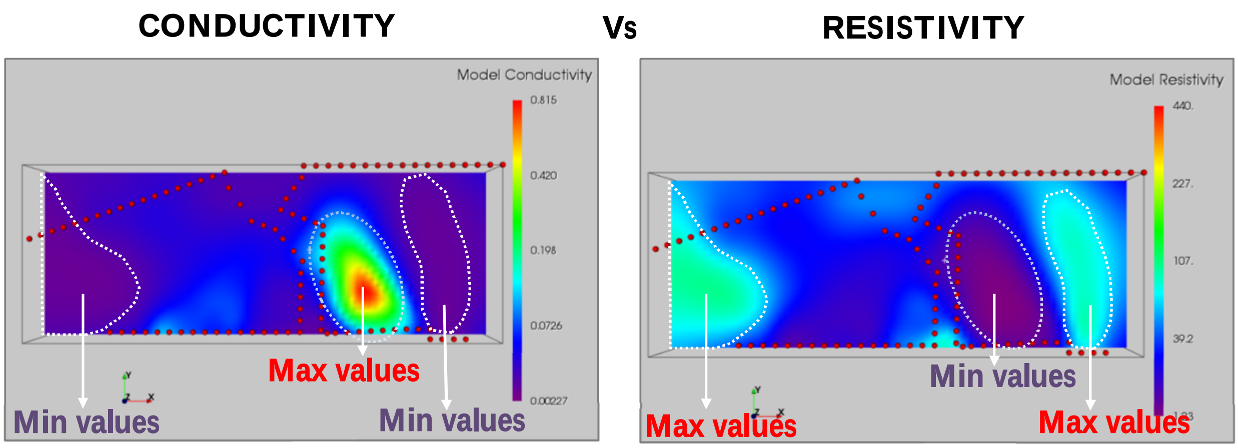


Figure 135: comparison between Conductivity and Resistivity model

All its sub node and tools are completely analogous at those of resistivity model, so refers to paragraph 1.4.2 for more details.

7.4.8 INDUCED POLARIZATION (IP)

It consist in energizes the ground with an alternating square wave pulse and in measuring the IP effect as a time diminishing voltage at the receiver electrodes. The method consists in the observation of the decay of the potential curve subsequent to the interruption of the input current, so the extent of the "residual chargeability" retained by the soil under investigation.

All its sub node and tools are completely analogous at those of resistivity model, so refers to paragraph 1.4.2 for more details.

7.4.9 MODEL SENSITIVITY

It indicates the degree to which the variations in resistivity of a section of the subsurface will influence the potential measured by the array; so it is a measure of how much an electrical property of the ground must vary to produce significant effects on the measurement. Different arrays have different sensitivity patterns, some describe better the superficial levels, others the deeper levels.

All its sub node and tools are completely analogous at those of resistivity model, so refers to paragraph 1.4.2 for more details.