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# Quick guide

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**GEUP 3D v6** is an interactive geometry software for math calculation and visualization. Designed to be easy to use, it is a powerful and versatile mathematical environment. With GEUP 3D you can study graphically a general problem and obtain dynamically its particular cases. This property together with its calculation capability, enables you to study problems of different areas of Mathematics like Calculus, Algebra. GEUP 3D is the equivalent one to GEUP (plane geometry software) in the 3D space.

## Installation and System requirements

### Minimum requirements

- Microsoft Windows® 10, Windows 8, Windows 7, Windows Vista, Windows XP
- Pentium® Processor 133MHz (1GHz for Windows 10,8,7,Vista or 300 MHz for Windows XP)
- 1 Gb RAM for Windows 10,8,7,Vista or 256 Mb RAM for Windows XP, 2003, 2000 and NT4 or 64 Mb RAM for Windows ME, 98 and 95
- 16-bits 65536 colors video card - 640x480
- 10 Mb of free hard disk space for electronic distribution and 30 Mb of free hard disk space for physical distribution.
- Mouse or compatible pointer
- CD-ROM/DVD-ROM drive (physical distribution)
- Adobe Acrobat Reader® 3.0 or higher (required to read the manuals in PDF format)

To install **GEUP 3D v6**, download and run `geup3d6i.exe` and follow the instructions.

# Basic concepts

## Overview

The main purpose is to help in the study of Geometry through the computer. The user can carry out geometric constructions in the 3D space.

The fundamental thing is that you can modify the position and other geometric properties of the elements of the construction. The established mathematical relationships between the elements through the construction tools will be preserved: when an element is moved, the construction will be reformed by maintaining these relationships. This property is the most important feature of GEUP 3D: you can obtain many particular cases of a construction quickly, being able to verify geometric properties about any construction.

It is possible to study problems of Analytic Geometry, together with the capability to calculate and plot functions enhances its application in other areas of Mathematics.

You can modify the appearance of any element of the construction.



## Move or edit elements

To move or edit construction elements, activate the option [Edit][Move, edit] or 'click' on its button on the construction toolbar.

To edit an element, detect it and 'click' it with the right button, the edit box will be activated.

To move an element, detect/'click' it and move it. If we move a geometric element, the coordinates of the element not vary its z value (the element will be translated by a parallel vector to the plane oxy).

(to avoid rapid movements, the axis oz should not be parallel to the plane of the view(screen), to avoid this you can rotate the view until the axis z is not parallel to the plane of the view)

If the 'Shift' key is down, the element will be translated by a parallel vector to the axis oz.

To 'rotate the view', 'click' with the left button on a free position and move.

To 'move the screen', 'click' with the right button on a free position and move.

To 'zoom the screen', 'click' with the left and right button on a free position and move.




## Edit element

The appearance of the elements is defined by its color, shape (the names, text and numbers by its fonts), by its name and visibility.

To activate the edit box there are three different ways:

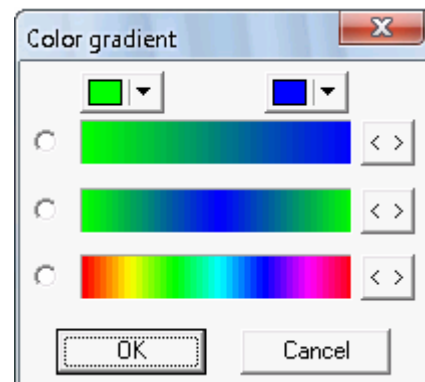
- a) Through the option [Move, edit]: detect and 'click' with the right button on the element to edit.
- b) Activate the option [Edit][Edit element] or through its button on the construction toolbar, and detect and 'click' on the element to edit.
- c) If the [Construction list] is visible: double 'click' on the line text that represents the element in the list.

## Color gradient

It is possible to assign a color gradient for loci (curves and surfaces) and iterations, through its edit box with the button .

In its dialog box it is possible to choose the following options for the gradient color:

- \* Shape: linear, linear bidirectional and spectrum
- \* Colors for the linear form
- \* Direction of the gradient



## Eliminating elements

It is possible to eliminate an element through the option [Edit][Eliminate element] or by activating its button on the toolbar, then detect/'click' on the element to eliminate.

If an element is eliminated, all the elements that depends on it will also be eliminated.



## Hide/View

It is possible to hide a visible element through the option [Edit][Hide/View] or through its button on the toolbar, then detect/'click' on the element to hide.

To show a hidden element, the option [Show hidden elements] must be activated, then activate the option [Hide/View] and 'click' on the element.

The option also changes the visibility of a previously selected group of elements.



## Move screen

Activate the option [View][Move screen] to move the plane of the view, also through its toolbar button.

Then 'click' with the left button on the visualization plane and move the mouse; the visualization plane will change by a translation specified by a parallel vector to the visualization plane.

If the 'Ctrl' key is down only the elements represented by text will move on the visible area.

To 'rotate the view', 'click' with the right button on a free position and move. To 'zoom the screen', 'click' with the left and right button on a free position and move.



## Zoom

Activate the option [View][Zoom] (or through its toolbar button) to zoom in/out the visualization plane.

Then 'click' with the left button on the visualization plane and move the mouse up to zoom/in and down to zoom/out.

To 'rotate the view', 'click' with the right button on a free position and move. To 'zoom the screen', 'click' with the left and right button on a free position and move.



## Rotate view

Activate the option [View][Rotate view] (or through its toolbar button) to rotate the visualization plane.

Then 'click' with the left button on the visualization plane and move the mouse; the visualization plane will rotate about a vector where its tail is the origin of the coordinate system.

To 'move the screen', 'click' with the right button on a free position and move. To 'zoom the screen', 'click' with the left and right button on a free position and move.



## Point redefinition

Redefine points on element to free points and free points to points on element.

### **Redefine free point to point on element:**

1° Detect and 'click' on the free point.

2° Detect and 'click' on the element to merge the point.

### **Redefine point on element to free point:**

1° Detect and 'click' on the 'point on element'.

2° 'click' on a free position of the space to place the free point.

# *Basic construction tools*

## • Point (free/on element/intersection)

Create a free point or a point on element.

### **Free point:**

To create: Move the pencil to a free position and 'click'. The coordinates (x,y,z) of the pencil are represented by three segments that represents the value of the coordinates x,y,z. The negative values are represented by a dashed style.

To modify the coordinate z, press the 'shift' key.

A free point can be moved to any position.

### **Point on element:**

To create: Detect the element (segment, line, ray, circle, conic, plane, polygon, sphere, cylinder, cone) and 'click'.

The created point will be linked to the detected element and will be able to move to any position on the element.



## Intersection points

Create the intersection points of segments, lines, rays, circles and their intersections with planes, polygons, spheres or the intersection of segments, lines, rays with cylinders or cones or the intersection of conics with segments, lines, rays, planes or polygons or the intersection of three planes or polygons. To create: Detect and 'click' on the elements to intersect.



## Plot points

Plot points given its coordinates.

To create: Once the dialog box is opened, enter the coordinates (numbers or expressions). 'click' on the button [point] to create each point.

'Click' on the button [OK] to close the dialog box.

Once the points are created, detect and double 'click' on the points to modify its coordinates.



## Point with coordinates

Create a point given its coordinates, the coordinates are represented by numeric values created in the construction.

To create:

1° Detect and 'click' on the coordinate x.

2° Detect and 'click' on the coordinate y.

3° Detect and 'click' on the coordinate z.



## Segment

Construct a segment given two endpoints.

To create: Detect the first point and click, detect the second point and click.

The segment will be able to move if both endpoints are free points.



## Vector

Construct a vector given two endpoints.

To create: Detect the first point (origin) and click, detect second point and click.

The vector will be able to move if both endpoints are free points.



## Line

Construct a line given two points.

To create: Detect the first point and 'click', detect the second point and 'click'.

The line will be able to move if both endpoints are free points.



## Ray

Construct a ray given two points.

To create: Detect the first point and 'click', detect the second point and 'click'.

The line will be able to move if both endpoints are free points.



## Circle

Create a circle by three given points or a circle by a given point and given the perpendicular line to the plane defined by the circle through its center.

**Circle by three given points:**

To create: Detect and 'click' on the three points of the circle.

**Circle by a given point and given the perpendicular line to the plane defined by the circle through its center:**

To create: Detect and 'click' on the point of the circle and the line (segment, vector, line, ray).



## Arc

Create the arc through three given points.

**Arc through three given points:**

To create: Detect and 'click' on the three points.



## Conic

Construct a conic defined by five points.

To create: Detect and 'click' on five points.



## Intersection line

Create the intersection line of 2 planes or the intersection circumference(circle) of 2 spheres or the intersection circumference(circle) of a plane and a sphere or the intersection conic of a plane with a cylinder or cone.

### **Intersection line of 2 planes:**

To create: Detect and 'click' on the 2 planes.

### **Intersection circumference(circle) of 2 spheres:**

To create: Detect and 'click' on the 2 spheres.

### **Intersection circumference(circle) of a plane and a sphere:**

To create: Detect and 'click' on the sphere and the plane.

### **Intersection conic of a plane and a cylinder or cone:**

To create: Detect and 'click' on the cylinder or cone and the plane



## Plane

Construct a plane by three given points.

To create: Detect and 'click' on the three points.



## Polygon

Construct a polygon given its vertices.

To create: Detect and 'click' on each point(vertex) consecutively. To end the construction, detect and 'click' one of the selected vertices.

The polygon will exist when its vertices lies on the same plane.



## Regular polygon

Construct a regular polygon given one of its vertices, given the perpendicular line to the plane defined by the polygon through its center (the center of the circumscribed circle) and given the number of sides of the regular polygon.

To create: Detect and 'click' on the first point(vertex) and the line (segment, vector, line, ray), and lastly select the number of sides.



## Sphere

Create a sphere given its center and a point on the sphere.

To create: Detect and 'click' on the first point (the center) and detect and 'click' on the point that lies on the sphere.





## Cylinder

Create a circular right cylinder given a point that lies on the cylinder and the axis(height).

To create: Detect and 'click', 1. the point on the cylinder, 2. the segment which defines the axis(height).

The surface is drawn between the perpendicular planes to the axis through the endpoints of the segment(axis).



## Cone

Create a circular right cone given a point that lies on the cone and a point that lies on its axis(height)(not the vertex) and the vertex.

To create: Detect and 'click' the three points: 1.the point on the cone, 2.the point on the axis(height), 3.the vertex.

The surface is drawn between the perpendicular planes to the axis(height) through the vertex and through the point that lies on the axis.



## Regular polyhedron

Create a regular polyhedron (tetrahedron, cube, octahedron, dodecahedron, icosahedron) given one of its vertices, given the perpendicular line to one of the faces formed by the selected vertex and through the center of the face (the center of the circumscribed circle to that face) and given the number of faces of the polyhedron.

To create: Detect and 'click' on the first point(vertex) and the line (segment, vector, line, ray), lastly select the regular polyhedron (tetrahedron, cube, octahedron, dodecahedron, icosahedron).



## Locus (curves and surfaces)

Create the locus (described by a point, segment or circle) defined by the movement of a 'point on element' or defined by the variation of one or two 'parameters' between its maximum and minimum values.

**Curve:** (generated by a point)

To create:

1° Detect and 'click' on the point that will generate the locus.

2° Detect and 'click' on the 'point on element' or on the parameter.

**Surface:** (generated by a segment, a circle or a point that depends on a point on a parallelogram(polygon) or a point that depends on two parameters)

To create:

1<sup>o</sup> Detect and 'click' on the segment or the circle that will generate the surface.

2<sup>o</sup> Detect and 'click' on the 'point on element' or on the parameter(press the 'Ctrl' key before 'click' on the parameter to select the second parameter in the step 3<sup>o</sup>).

3<sup>o</sup> (if necessary) Detect and 'click' on the parameter.



## Midpoint

Create the midpoint of two given points or a given segment.

To create: Detect and 'click' on the two points or on the segment.



## Conic center

Create the center of the given circle or conic or given an arc that defines the circle.

To create: Detect and 'click' on the circle or conic or arc.



## Mediating plane

Create the mediating plane of a segment defined by its two endpoints or by the segment.

To create: Detect and 'click' on the two points or on the segment.



## Parallel

Create a line through a given point and parallel to a segment, vector, line, ray or create the plane through a given point and parallel to other plane or polygon.

**Line:**

To create:

1<sup>o</sup> Detect and 'click' on the point that lies on the line.

2<sup>o</sup> Detect and 'click' on the element (segment, vector, line, ray) parallel to the created line.

**Plane:**

To create:

1° Detect and 'click' on the point that lies on the plane.

2° Detect and 'click' on the plane or polygon parallel to the created plane.

**Perpendicular**

Create the line through a given point and perpendicular and passing through a segment, vector, line, ray or create the line through a given point and perpendicular to a plane or polygon or create the plane through a given point and perpendicular to a segment, vector, line or ray.

The line through a given point  $P$  and perpendicular to other line  $r'$  and passing through  $r'$  will exist if the point  $P$  not lies on the line  $r'$ .

**Line:**

To create: Detect and 'click' on the point that lies on the line and on the element (segment, vector, line, ray, plane, polygon) perpendicular to the created line.

**Plane:**

To create: Detect and 'click' on the point that lies on the plane and detect the element (segment, vector, line, ray) perpendicular to the plane, then press the 'Ctrl' key and 'click'.

**Vector sum**

Create the vector sum of two given vectors.

To create:

1° Detect and 'click' on the two vectors.

2° Detect and 'click' on the endpoint that defines the vector's tail.

## ***Numeric tools***

**Length/distance**

Calculate the following measures:

**Length of a segment, vector, circle, arc or the perimeter of a polygon.**

To create: Detect and 'click' a segment, vector, circle, arc or polygon.

**Distance point-point, distance point-line, distance point-plane, distance line-line.**

To create: Detect and 'click' the two elements.



## Angle

Calculate the measure of an angle given by 3 points, given by a line and a plane or given by 2 planes.

### Angle given by 3 points

To create: Detect and click three points that define the angle, the second point will be the vertex.

### Angle given by line and plane

To create: Detect and click the line and the plane.

### Angle given by 2 planes

To create: Detect and click the 2 planes.



## Area

Calculate the area determined by a circle, polygon, sphere or regular polyhedron.

To create: Detect and 'click' the element.



## Volume

Calculate the measure of the volume determined by a sphere or regular polyhedron.

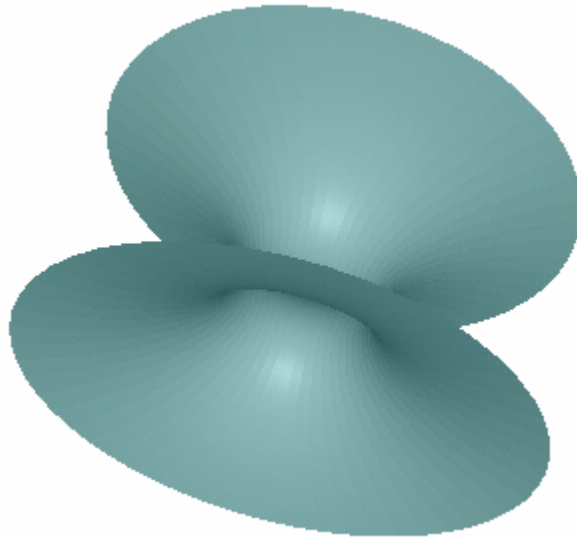
To create: Detect and 'click' the element.



## Coordinates

Create the coordinates of a point.

To create: Detect and 'click' the point.



## Calculate

Calculate the result of a mathematical expression through numbers (entered by the keyboard or by numbers created in the construction). You will be able to use the result in other construction step.

It works like a calculator:

- Enter the numerical values with the keyboard.
- Detect and click on the variables (numbers(a,b,c,d,...))
- Enter the operations with the buttons or with the keyboard.
- To obtain the result click on the [=] button.
- To use the result on the construction, click the result and drag the number to an appropriate position. You can edit the number to add it a name or description.

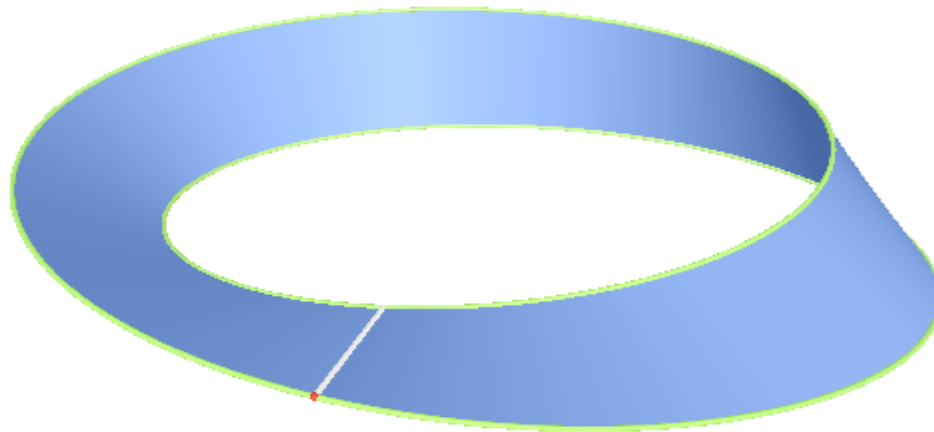
If you have created a number by using variables and these variables changes, the created number will be calculated again.



## Parameter

Calculate the result of a mathematical expression as with the tool calculate. If we create the number (drag the result to the plane), it will be a parameter we can modify (detect and double 'click'). This shows its edit box.

It is possible to modify directly the parameter or change its value with the track bar or to change its maximum and minimum values.



## Geometric transformations



### Central symmetry

Create the symmetrical image of an element by a given point (symmetry center).

1° Detect and 'click' on the element to transform (point, segment, vector, line, ray, circle, arc, conic, polygon, plane, sphere, cylinder, cone).

2° Detect and 'click' on a point (symmetry center).



### Axial symmetry

Create the image of an element defined by an axial symmetry.

1° Detect and 'click' on the element to transform (point, segment, vector, line, ray, circle, arc, conic, polygon, plane, sphere, cylinder, cone).

2° Detect and 'click' on the symmetry axis (segment, vector, line, ray).



### Reflection

Create the image of an element defined by a reflection (defined by a plane).

1° Detect and 'click' on the element to transform (point, segment, vector, line, ray, circle, arc, conic, polygon, plane, sphere, cylinder, cone).

2° Detect and 'click' on the plane or polygon.



## Translation

Create the image of an element after a translation given a vector.

1° Detect and 'click' on the element to transform (point, segment, vector, line, ray, circle, arc, conic, polygon, plane, sphere, cylinder, cone).

2° Detect and 'click' on the vector.



## Rotation

Create the image of an element rotated around an axis a given angular value.

1° Detect and 'click' on the element to transform (point, segment, vector, line, ray, circle, arc, conic, polygon, plane, sphere, cylinder, cone).

2° Detect and 'click' on the axis (segment, vector, line, ray).

3° Detect and 'click' on the number (angular value).



## Translated point given number

Create a point that is obtained moving a point on a path a given distance.

1° Detect and 'click' on the point to translate.

2°

**On a line:** Detect and click on a 2° point: [the first point will be translated on the ray(imaginary) through both points].

**On a circle:** The point to move should belong to the circle. Detect and click on the circle: [the first point will be translated on the circle].

3° Detect and click on the number that defines the distance to translate the first point.

## Macros



A macro creates final elements given initial elements, carrying out the steps automatically, avoiding that you have to make each step one by one. Once designed, the macro works as any other construction tool.

When you activate a macro, once the initial elements are selected, the final elements and the necessary elements will be created.

## Create a new macro

To create a new macro you will have to carry out a construction that contains the constructive process for the macro to create: the initial and the final elements.

### 1º Select the Initial elements:

- Activate the window('Macros') and click the button('Initial elements').
- Detect and click the initial elements.

### 2º Select the Final elements:

- Activate the window('Macros') and click the button('Final elements').
- Detect and click the final elements.

An element can be a last element if can be constructed with the basic construction tools, starting from the initial elements that you have chosen.

### 3º Complete macro:

- Activate the window('Macros') and click the button ('Complete macro').
- Enter a name for the created macro.

To add a comment for the macro: select the macro, edit the text and save.

To save the macro: select the macro(click the name) and click the button('Save macro').

## Apply a macro

To apply a macro, activate the menu option[Macros][Macro options] or click on its button on the toolbar or with the keyboard [ctrl][M].

If there are not available macros, you will have to load them from the disk drive, from other document or create a new one.

When a macro is available, you can to activate it and enter the initial elements, (double click or click on its name and 'Start macro').

The last step is to select the initial elements. The following element type is shown in the status bar.

## Iterations



Through the tool 'Iteration' it is possible to iterate(repeat any number of steps(with recursion)) the construction created by 'initial elements'(points) starting with corresponding 'destination elements'(points), with each iteration step the construction is repeated using as initial elements the destination elements obtained in the previous step.



(When the iteration is created it draws the iteration of the visible geometric elements that depends on the 'initial elements').

Activate the menu option [Transform-Check][Iteration] or 'click' on its button in the main toolbar or press the keys [ctrl][I].

To create a new iteration you will have to carry out a construction that contains the constructive process for the iteration to create: the 'initial elements' and the 'destination elements'.

**Select elements:**

This option starts the selection of initial or destination elements (points).

The 'initial elements' are named as 1,2,3,... and the corresponding 'destination elements' as 1',2',3',... .

**Add destination elements:**

This option adds a new set of 'destination elements'.

**Remove:**

This option removes the set of initial or destination elements currently selected on the list.

**Number of iterations:**

It is possible to select a constructed number(detect and 'click') to assign the number of iterations of the iteration element or to assign a constant value('click' without detect) which can be changed later when the iteration is edited.

**New iteration:**

This option is enabled when a new iteration can be created.

Once an iteration is created it is possible to modify the next options through its edit box:

- View/Hide the iterated points.
- View all the iterations(steps) (the 'Number of iterations(n)' assigned when the iteration element was created)/View only the last iteration(step).
- Own color (assign a common color for all the iterated elements) or keep the initial color for the iterated elements.
- Number of iterations.

## *Other operations*



Create a text on the visualization plane.

To create:

- 1° 'Click' on the position of the visualization plane to add the text.
- 2° Edit the text in the edit window. It is possible to change the window size.
- 3° 'Click' the button ('OK') to put the text on the plane.

Later the text will be able to be moved freely.



## Button - Hide/View

Construct a button to assign the visibility of a group of elements.  
There are two ways.

Way 1

- 1° Activate the button in the edit toolbar.
- 2° Select the elements.
- 3° 'click' on a free area of the screen to place the button.

Way 2

- 1° Select the elements.
- 2° Activate the button in the edit toolbar.
- 3° 'click' on a free area of the screen to place the button.



## Button - Movement

Create a button to move a given point to other point (the points are independent).

- 1° Select the button in the edit toolbar.
- 2° Select a set of points (pairs).
- 3° 'click' on a free area of the screen to place the button.

## Viewer mode

Activate the menu option [View][Viewer mode].

The purpose of the viewer mode is to optimize the visualization and usage of constructions when its modification is not required.

The viewer mode hides the construction and edition elements of the program interface to maximize the visible area.

If a document is saved with the viewer mode enabled then that document is activated with the viewer mode enabled when it is opened through a command line, this method is useful to publish documents in web pages or to work with multiple documents by using a file manager.



## Animations

Enable/disable the animation of points on element and parameters.  
Detect and 'click' on the elements to enable/disable its animation.

### Animation box

You can control the speed, direction of the elements and enable/disable its animation.

Also is possible to pause of all elements in the animation.



## Step by step

Select the menu option [View][Step by step] to view the construction step by step (visible elements) or click on its button on the toolbar or with the keyboard [F2].

Button [ > ] Step forward.

Button [ < ] Step back.

Button [ |< ] First visible element.

Button [ >| ] Last visible element.

The element for each step is shown blinking. The element type is also named.



## List construction

To show the construction list, activate its button on the toolbar or activate the menu option [View][Construction list] or with the keyboard with the key [F3].

It is possible to go up and down through the construction steps, the current element will be selected.

It is possible to Hide/View the hidden elements with its option in the context menu.

To copy the construction to the clipboard, 'click' with the right button on the list and activate the menu option [Copy list to clipboard].

## Print the construction

The print dialog box can be activated through the option [File][Print] or through its button in the main toolbar or with the key [Ctrl][p].

The visible area of the visualization plane will be printed.  
Select the number of copies.

It is possible to choose the printer, the configuration of the printer and the paper size through the button 'Properties'.

To print, 'click' on the button 'OK'.

## *Configuration options*

### General options

It is activated with the menu option [File][Options].

#### Environment variables

**Adapt cursor message color:** Choose this option if you usually change the background color.

**Background color:** If you change the background color, change the color of each element type with the option 'Elements appearance', the color of the hidden elements and the color of the selected elements to make sure that they are visible on the screen.

**Hidden elements color:** It is advisable to choose a different color to the selected color for each one of the visible elements to be able to distinguish them.

**Selected elements color:** It is necessary to choose a different color to the selected color for each one of the rest of the elements.

**Construction list:** It is possible to choose the background color and the font.

**Language:** It is possible to choose one of the languages included in the directory [languages] of the installation directory.

#### Construction settings

**Coordinate system:** It is possible to choose the visibility of the system, its shape and its size.

**Projection:** It is possible to choose central projection and parallel projection to represent the visualization plane.

**Automatic rotation:** Select the speed and the direction of the rotation.

**Number of decimal places:** The numbers will show this number of decimal places on the screen.

**Angle unit:** You can choose radian(RAD), grad(GRA), degree(DEG).

**Length scale:** Length scale factor for the measurements of the document.

**Hide intermediate elements when a macro is applied:** Choose this option if you are not going to work with the intermediate elements of a macro.

**Begin step by step with last element:** It allows to select the order for the visualization of the construction steps.

## **Elements appearance**

**Geometric elements appearance:** Choose color, size and shape.

**Antialiasing:** Activate the option 'antialiasing' for the elements without 3-Dim shape.

**Fonts:** The font of texts, numbers and names.