

EQUINOX-3D™

v0.8.9

**User's manual
(a work in progress)**

© 1992-2006, by Gabor Nagy
<http://www.equinox3d.com>

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Introduction

EQUINOX-3D is intended to be a complete 3D modeling, animation and rendering software package.

The version number approximately represents how far it is from having the minimum functionality to achieve that (v1.0 will be the first such version).

Font conventions

When referring to a menu item or a button on the tool panel, the following conventions are used:

- **Menu->Transform->Reset** means the vertical menubar's "Transform" menu "Reset" menu item.

- **Tool->Surface->Skin** means the tool panel, "Surface" folder "Skin" button:

Key-words, such as Spline or Model are capitalized.

1. User-interface basics

EQUINOX-3D has the traditional 4-view look. There is a vertical menu bar and a "Transformation Panel" on the right (see Figure 1.).

Most buttons have tool-tips (bubble-help). These little help messages pop up if you rest the mouse pointer on the button for 2 seconds or longer.

Reading the tool-tips is a quick and easy way to get started with EQUINOX-3D.

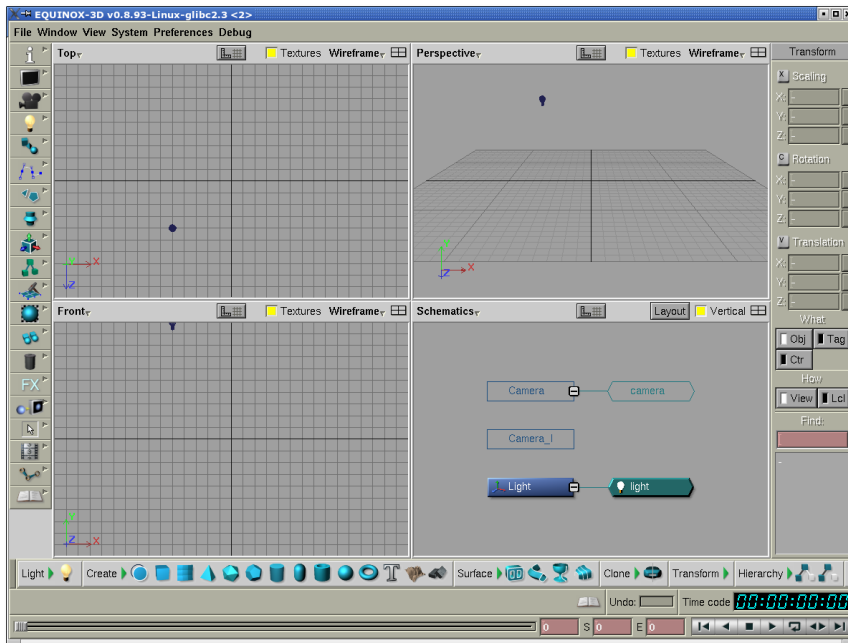


Figure 1: the main window of EQUINOX-3D

1.1. 3D windows

Each 3D window has a "header" with some controls and a main part with the 3D display.

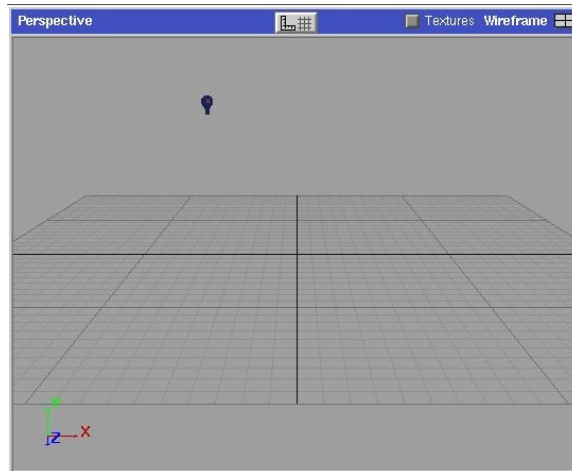


Figure 1.1: a 3D window with *Perspective* view and *Wireframe* display mode

The active window (where the mouse pointer is) has a filled-in blue header, like the one on Figure 1.1. All keyboard input will apply in the active window.

1.1.1. View-mode and rendering-mode

The top-left button of each 3D window activates a pull-down menu of choices for the **view-mode**.

Any of the 3D windows may be set to one of these view-modes:

- Perspective - standard 3D view with a perspective or custom projections
- Top, Front, Right - “orthographic” projection
- Schematics - shows the relationships between objects as a graph
- Animation - animation curves
- Texture - texture-mapping view

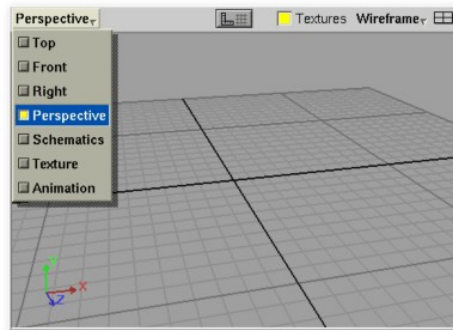


Figure 1.1.2 view-modes in a 3D window

The second button on the top-right activates a menu for selecting **rendering-mode**. Each display mode is a different renderer.

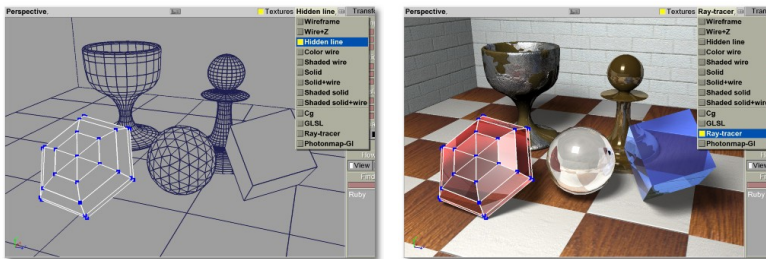


Figure 1.1.2 different rendering-modes in a 3D window

EQUINOX-3D has a unique and extremely powerful renderer infrastructure. Plugins can implement new renderers and any 3D window can then use those renderers while still displaying selections, 3D controls etc. and allowing editing in that window. In other words, plugins can add *fully integrated* renderers to EQUINOX-3D.

For example “Cg” and “Ray-tracer” renders are implemented by plugins, while “Wire-frame, Hidden-line etc. are built-in.

Also, EQUINOX-3D has an extremely fast interactive ray-tracer, so you can edit your 3D models directly in a ray-traced window with physically correct shading, reflections, refractions etc. changing as you change a shape!

Clicking the the Middle Mouse Button (MMB) on either the view-mode or the rendering mode buttons will toggle between the two most recent modes.

The button on the top-right of the window header is for changing the size of the window (stretch out horizontally/vertically or both ways), see the tool-tip on this button for more details.

1.2. Panels

On the bottom of the main window, there are 3 panels (bars). These panels can be turned on and off from the Panels menu or via the hot-keys.

1.2.1. Toolbar

This panel has folders that open and close. The folders can have buttons with icons:



The Toolbar is organized into folders. (Light, Create, Surface etc.). The folders can be opened and closed by clicking on the little green arrow after the folder's name.

Clicking on an icon with the **LMB** (Left Mouse Button) will activate a tool, while the **RMB** (Right Mouse Button) will bring up the tool's dialog box, if that particular tool has one (and possibly activate the tool).

For example: **LMB** on the Tube icon will simply create a “default” Tube, while **RMB** will also pop up the “Create Tube” dialog box and let you interactively change the parameters of the Tube (inner radius, outer radius, height etc.).

1.2.2. Status panel

The Status-panel has a message label, undo-stack indicator bar and a time code display for animaton.

The message label indicates the status of EQUINOX-3D, the function of the mouse buttons, it can display messages and/or a progress-indicator bar:



The Status panel is the main source of feedback to the user.

1.2.3. Time panel

The Time-panel includes the main time slider with the current-, start- and end-frame fields and the usual "VCR buttons".

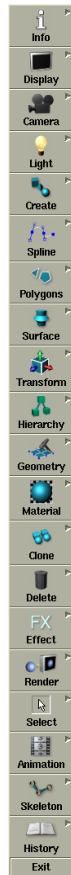
This panel is used for controlling and displaying (playing) animations.



1.2. Menus

There are two menu-bars in EQUINOX-3D. The horizontal one on the top has the standard "File" menu, user interface options, preferences etc.

The vertical menu-bar on the left has the 3D modelling, rendering and animation menus:



This menubar is configurable in the Preferences settings. The buttons can be displayed either with Icons only, Text only or both Icons and Text.

Menu buttons in the menu-panes can have an "Option dialog-box" activating "sub-button". This can pop up the a dialog box for a particular tool (similarly to "right-clicking" on a ToolPanel icon). The Clone->Immediate button is an example in Figure 1.2.1.

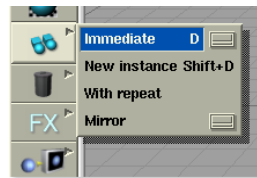


Figure 1.2.1. Menu button with dialog-box "sub-button"

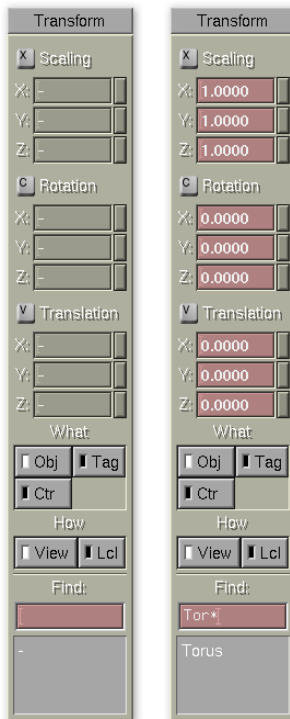
Clicking on a menubar button (e.g. Display) with the Middle Mouse Button will activate the last function again.

Note: plugins can add and remove buttons from both the menus and the tool-panel.

1.3. Transform Panel

This vertical panel is used for interactive transforming (scaling, rotating, moving etc.) objects or components of objects.

It controls the way objects are manipulated with the mouse.



This panel is inactive (left image) when there are no objects selected.

If an object is selected, the panel becomes active (right image) and shows the current transformation values as well as the name of the selected object(s).

You can enable/disable interactive transformations per coordinate axis (X, Y, Z) with the little buttons right to the number fields.

You can also turn them on/off simultaneously by clicking on the “Scaling”, “Rotation” or “Translation” buttons, or hitting the 'X', 'C' or 'V' keys.

Under the label “What”, you can select what will be transformed with the mouse (“transform target”):

- **Obj**: whole object(s) (Models), or
- **Tag**: tagged points of objects

Under the “How” label, you can select how the interactive translating will work (“transform mode”):

- **View**: drag objects or components along the view
- **Lcl**: move along X, Y or Z axis of an object

There is also an interactive finder tool on this panel. If you type in a name, or a partial name using the “*” wildcard character, it will select objects that match that name.

If the transform target is **Tag**, but there are no tagged points on the selected objects, it will temporarily switch to **Obj** (while the transforming is taking place; holding down a mouse button).

This allows for quick switching between transforming objects or points, just by tagging and un-tagging points.

Please note that interactive transforming is still a work in progress...

1.4. Camera control

To ease the transition from other 3D packages, EQUINOX-3D implements the camera control of some popular 3D programs, as well as its own.

In this manual, and in EQUINOX-3D in general (e.g. on the Status panel),

LMB means Left Mouse Button

MMB means Middle Mouse Button

RMB means Right Mouse Button

- Orbit:** While holding down the 'O' key on a perspective window, you can orbit the camera around the interest point with the mouse.
LMB: longitude+latitude **MMB:** longitude **RMB:** latitude
- Dolly:** While holding down the 'P' key on a perspective window, you can move the camera along the line-of-sight with the mouse (see the Status panel indications for the mouse button functions).
- Track/Zoom:** While holding down the 'Z' key on a perspective window, you can move the camera and the interest point parallel to the view plane (tracking) or you can change the field-of-view (zoom). On an orthogonal window (TOP, FRONT, Schematics etc.), holding down the 'Z' key will activate **Scroll/Zoom** mode.
- Zoom into region:** While holding down the 'Z' key on a non-perspective window, you can select a rectangular region with the right mouse button. When you release the mouse button, the camera will “fly” into that region.
 If you accidentally activate this, just release the 'Z' key before releasing the mouse button to cancel the action.

1.4.2. Single-key camera control

Orbit/Dolly/Track: while holding down the 'Ctrl' key, you can 'Orbit', 'Dolly' or 'Track' the camera by moving the mouse while holding down one of its 3 buttons.

Orbit/Track/Dolly: hold down the 'Alt' key and see the Status panel...

Note that the above modes are "transient modes", meaning that for example releasing the Ctrl key will deactivate **Orbit/Dolly/Track** mode and put EQUINOX-3D back in the state it was before (e.g. rotating an object).

This is much more efficient than having to switch back-and-forth between modes by clicking on buttons or icons.

1.4.3. “Fly to” / Framing things

When working on an object, we usually need to move the camera, so the object is in the middle of a window and zoom in on it: i.e. "frame" the object.

EQUINOX-3D has a sophisticated automatic framing feature. In a perspective window, it can frame an object or objects by not just putting it in the center of the window and getting close enough to it, but it also places the camera's interest point at a reasonable center point around which you can orbit the camera and keep the object(s) in the center. This allows you to easily examine the object from different angles.

EQUINOX-3D takes this feature a step further: instead of immediately placing the cameras to their new positions and orientations, it smoothly “flies” them there.

The framing/fly-to function works in any view (3D, schematics, animation curves etc.). This helps you maintain a sense of relative location of objects and it provides a more pleasant user experience.

Similar techniques are common in video games, but EQUINOX-3D is the only modeler to support it (since the last edition of this manual, some modelers partially copied this feature, but only for 3D views).

You can adjust the duration of the fly-to under **Menu->Camera->Settings**.

Hitting the 'F' key will frame the camera to the selected object(s) in the active window.

'A' will frame the camera to all objects in the Scene.

'F' or 'A' with Shift will perform the fly-to in all 3D windows simultaneously.

"Frame selection" works for Models (transform Nodes), Geometries (Meshes, Splines etc.), PolyGroups or even a group of selected Polygons.

2. Objects and Models

EQUINOX-3D has two fundamental 3D elements: *Object* and *Model*

Objects represent:

- Lights
- Cameras
- Geometries
- Special elements defined by plugins. For example: force-fields

Models “bring” Objects into the 3D scene. The 3D industry calls this *instantiating* or *instancing Objects*.

Models also define the *transformation* (scaling, orientation (rotation) and position) of Objects, therefore they are also called *transformation-nodes*, or *transform-nodes*.

On the schematics view, Models are shown as blue boxes with a coordinate-system icon. Objects are shown as a torquise box with angled sides and a little icon.

When you create an Object, EQX will automatically create a Model for it and place it at the origin.

It will also name them: the Model will have the name of the tool that created it, starting with a capital letter and the Object will have the same name starting with a lower-case letter:

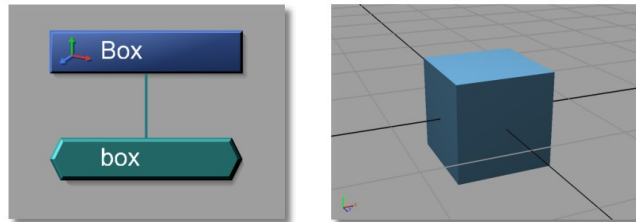


Figure 2.1. Schematics-view and 3D-view of a Model with an Object

2.1. (Multiple) instancing

An Object might be added to multiple Models and those models may be placed, oriented and scaled differently in the scene.

This is a powerful and commonly used technique, called “instancing”.

Imagine that you want to build a long hallway with 20 identical columns. If you create 20 duplicates of your column, when you edit one of them, only that one will change.

Instancing it on the other hand will create “links” to the same Object from multiple Models, so if you change one, all instances will change simultaneously.

This will allow you to see your hallway with all 20 columns while you are refining your column model, but save you the repetitive work of applying every change to all copies.

Instancing is also more efficient because EQUINOX-3D will only have to keep one copy of the Object in memory.



Figure 2.2. Schematics view of a duplicated (left) versus instanced (right) Object

2.2. Hierarchies

Models may be connected together to form hierarchies. Hierarchies allow for relative transformations, which means that each Model is scaled, rotated and moved *relative to its "parent"*.

This makes it easy to have a person's upper arm rotate relative to the torso (at the shoulder joint), the lower arm rotate relative to the upper arm (at the elbow joint) etc.

A hierarchy is sometimes referred to as a “tree”, because its representation on the Schematics view resembles an upside-down tree. Sub-trees are also called *branches*.

Figure 2.1. shows an example for a hierarchy.

Note that the branch containing the Models named “Tube”, “Sphere” and “Capsule” is selected (the edges of the Models are highlighted with white lines).

“Tube” is the root of that branch, while “Box” is the root of the whole hierarchy (tree).

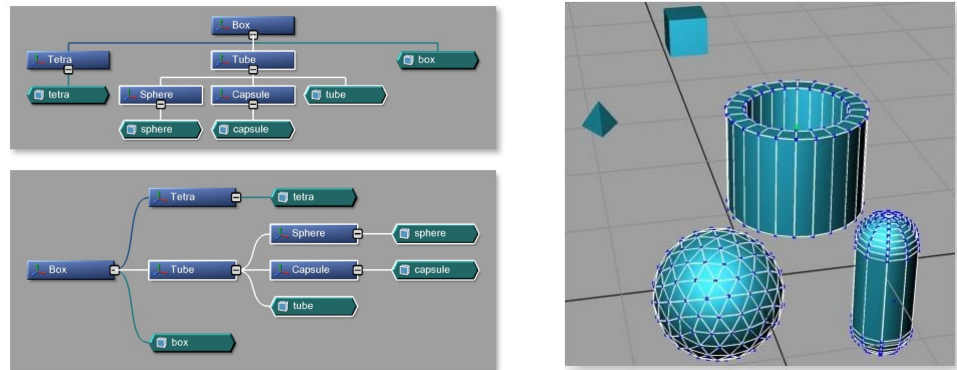


Figure 2.1. representations of a hierarchy on the Schematics view with vertical and horizontal layout and different connector types (left) and the actual 3D shapes (right).

3. Geometries

A Geometry is a type of Object that describes a line, a surface or a volume of a solid, liquid etc. object.

EQUINOX-3D allows for multiple Geometries (Mesh, Spline etc.) per transform-node (Model), so unlike in many other 3D programs, there is usually no need for 'empty' Models to group Geometries.

This simplifies hierarchies and avoids performing the extra transformations, leading to faster rendering. At the same time, it still allows you to easily select (and edit) Geometries.

3.1. Meshes, PolyGroups and Polygons

A Polygon Mesh is a type of Geometry. It is a surface, described by Polygons.

A Mesh has groups of Polygons that share a Material (a.k.a. Shader). These "shading-groups" are called *PolyGroups*.

PolyGroups within a Mesh can share Vertices.

If a Model or a Mesh is selected, its Vertices are shown with little blue rectangles (see Figure 3.1.1.). If only a Geometry of a Model is selected (not the whole Model), the edges will be highlighted with cyan, instead of white.

If only a PolyGroup is selected in a Mesh, the Vertices of the Mesh will not be shown.

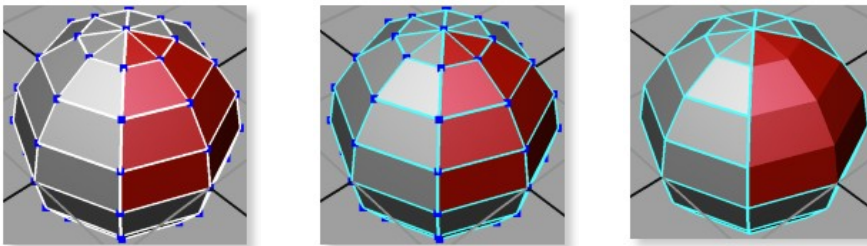


Figure 3.1.1. A Polygon Mesh with 2 PolyGroups (Grey and Red Polygons). The Model selected (left), the Mesh selected (middle), the red PolyGroup selected (right).

3.2. Splines, Spline Segments and CVs

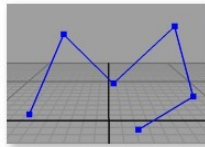
A Spline is a (usually) curved line that is described by a mathematical formula, using a parameter, hence the other name: parametric curves.

Splines are usually composed of multiple segments. The shape of the segments is determined by points, called Control Vertices, or CVs.

Depending on the type, the Spline might not necessarily go through its CVs.

EQUINOX-3D supports the following Spline types:

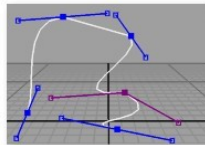
- **Linear:** Continous segments of straight lines going from one CV to the next:



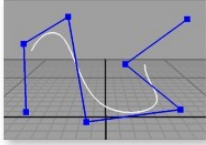
- **Bezier:** A very versatile Spline that goes through all of its CVs and the type of the segments can be changed individually. There are 4 CVs for each segment. These are usually represented by 2 lines, called *handles*. These lines are parallel with the tangent of the curve.

The CVs can have diferent editing constraints:

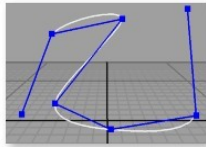
- C1-continuity (mirrored handles: **blue**). When you move one end of such a handle, the other side will have the same direction (tangent continuity) and length.
- G1-continuity (direction-mirrored handles: **purple**). The other side will keep the same direction, but not the length..
- C0-discontinuity (independent handles: **cyan**)



- **B-spline:** This Spline might not go through its CVs, instead the CVs "pull" on the curve, like magnets:



- **Cardinal:** A simpler type of Spline that goes through its CVs and has only two CVs per segment (no "handles").



3.3. Parametric Faces

A Parametric Face (or just Face) is a flat surface, defined by closed Splines. Each Spline defines a *contour* of the Face.

The first contour defines the exterior of the Face, while the rest define the holes.

Creating a Face is very easy. Just make a Spline, close it and activate **Menu->Spline->Convert to face**. See Figure 2.1.2.

Then you can add further Splines to “cut” holes in the Face, using **Menu->Spline->Attach hole to Face**

Note that the Spline and Face-related functions are all in the Spline menu and there is a separator before the Face functions.

Appendix A describes all the above mentioned tools with examples.

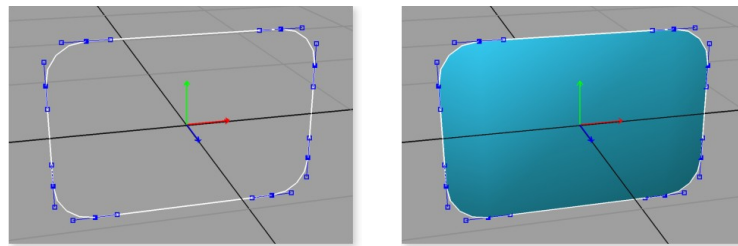


Figure 2.1.2. Converting a Spline to a Face

Faces with holes are essential for shapes like letters, such as “A”, “B”, “D” etc., because these letters have enclosed holes in them.

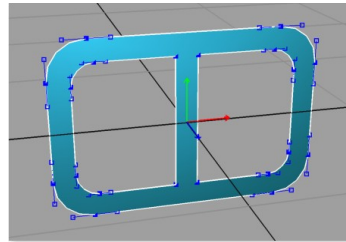


Figure 2.1.2.1. A Face with holes

4. Selecting

EQUINOX-3D has context-sensitive selection and three main selecting modes:

4.1. Model selecting

Hold down SPACE bar:

Information is displayed in the Status-panel about the Model under the mouse pointer and the functions of the 3 mouse buttons are shown (Left button: select Node (single Model), Middle button: select Branch, Right button: select whole tree (hierarchy)).

To select multiple Models, hold down the Shift key simultaneously with the SPACE bar.

Clicking on 'nothing' while in single selection mode (no Shift key) will unselect everything in the scene.

4.2. Geometry selecting

Hold down the 'G' key:

Information is displayed in Status Panel about the Geometry under the mouse pointer: The Geometry type is identified and proper options displayed. E.g. if the object under the pointer is a Mesh, you can select:

- the Mesh itself (Geometry)
- the PolyGroup, or
- the Polygon under the pointer. In this mode, holding down the right button while moving the pointer will 'paint-select' (or unselect if started on a selected Polygon) the Polygons under the pointer.

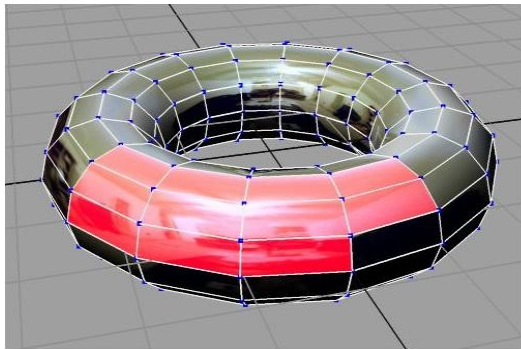


Figure 2.2.2. Polygons selected with "Polygon paint-select".
Note that selected Polygons are highlighted with red, but the original surface will show through (including textures and reflections).

If the Geometry under the pointer is a Spline, you can select:

- the Spline itself (Geometry), or
- the Spline Segment under the pointer

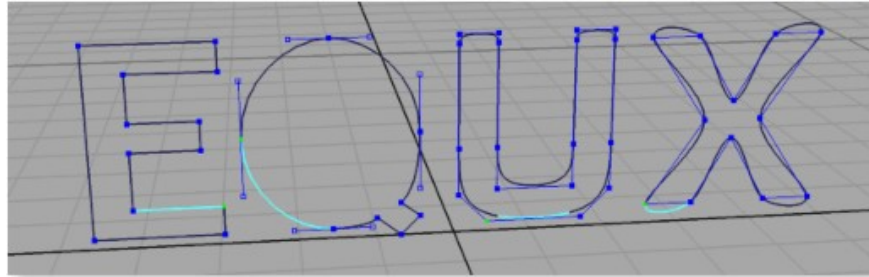


Figure 2.2.3. Splines with one segment selected

Multiple Geometries or sub-geometries (PolyGroups or Spline Segments) can be selected by holding down the Shift and 'G' keys simultaneously.

Clicking on 'nothing' while in single Geometry selection mode (no Shift key) will unselect every Geometry or PolyGroup in the scene.

In 'Solid' display modes (as opposed to wireframe), when selecting, a ray is cast through the scene, and the intersection between this ray and the closest surface (closest "hit") is selected.

In the preferences dialog box, an option can be set to limit ray-intersect testing to the selected objects when performing this kind of selecting. This can be useful for example to select Polygons on an object behind an unselected object. It could also mean a significant speedup when selecting Polygons in "Polygon paint-select" mode.

Selected Polygons are highlighted in "solid" display modes (this is optional though, see the "display controls").

The highlight is blended with the surface, so shading and textures show through as fig. 2.2.2. illustrates.

4.3. Selecting Points

Hold down the 'T' key and drag the mouse with one of its 3 buttons pressed. This will draw a rectangular area in which points are tagged (selected), un-tagged or the tags are inverted when you release the mouse button.

The Status Panel will explain the function of each mouse button.

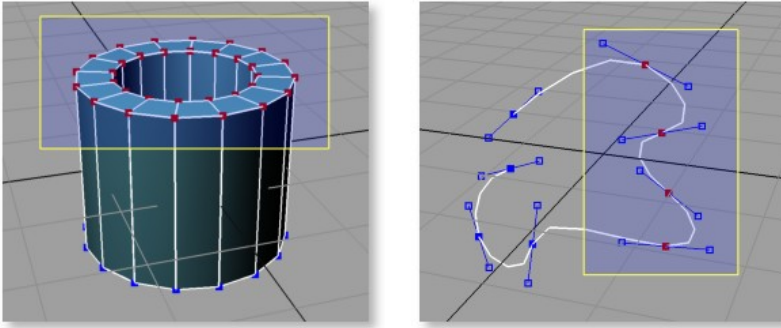


Figure 2.2.2. Tagging points of a Mesh and a (Bezier) Spline

Another way to select points:

- select Polygons on a Mesh/PolyGroup as described before
- go to: **Menu->Select->Tag Vertices of selected Polygons.**

To un-tag all points of the selected objects, go to: **Menu->Select->Un-tag all vertices.**

Once points are tagged, you can transform them by selecting “**Tag**” in the Transform panel. and activating Scaling, Rotation or Translation. See figure 2.2.3.

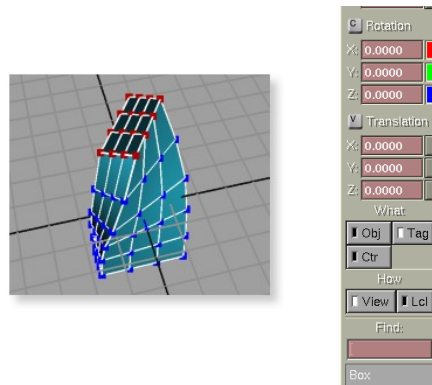


Figure 2.2.3. Rotating Vertices of a Mesh

5. Basic Geometry editing

The easiest way to edit Geometries is to move their points (the control-vertex of a Spline or a Vertex of a Polygon Mesh).

To move a single point, activate the "Move point" tool by holding down the 'M' key. This is also a transient mode tool. As soon as you release the 'M' key, it deactivates, so you can very quickly select an object, move a few points on it, select another one etc. The point being moved becomes active which is indicated by a green highlight.

When you create a Bezier spline, its "Previous" and "Next" sub-keys will be at the same position as the CV itself, so all segments of the Spline will appear linear. However, when you start moving a point with the Move point tool, it first "pulls apart" the Previous sub-key, so the segments around the key will become curved.

5.1. Editing the attributes of a Spline

Select a Spline Geometry or one of its Segments by holding down the 'G' key. The Spline or Segment should turn turquoise as seen on Figure 2.3.3.

Now go to **Menu->Info->Edit on selection**, or just hit the 'E' key.

This should bring up the dialog box shown below:

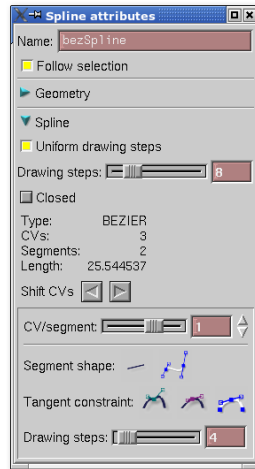


Figure 2.3.1. Spline attributes dialog box.

If a Spline Segment was selected, the current CV (Control Vertex) will be the one at the beginning of that selected Segment.

Selecting a different Spline segment while the dialog box is up, will automatically update the "CV and segment information".

This dialog box shows allows you to change attributes of the spline, such as tessellation (piecewise-linear approximation) settings and segment types.

EQUINOX-3D lets you change the tessellation per segment. This is very useful when you use a spline to create a surface (e.g. with the "Revolve" tool) because it lets you finely control the number of polygons in the resulting surface.

There is also a very useful function, called "Shift CVs":

Often, when you create a Spline, you might not start with the CV you will want to be the first one.

Sometimes this does not matter. For example, when a closed spline is used for modeling. However, when you want to use a Spline to move the camera along a path, the start and end points matter, even if the Spline is closed.

The "Shift CVs" tool allows you to "move" the CVs around, forward or backward.

Each CV will preserve its attributes, so the Shape of the Spline will not change (unless the Spline is open, in which case the "gap" between the last and the first CV will move around).

5.2. Construction history

Geometries in EQUINOX-3D can "remember" how they were created. This information is called *construction history*.

For example: create a torus and close the Torus dialog box.

Even though this torus is now represented as a Polygon Mesh, EQUINOX-3D remembers that it was created by the "Torus" plugin. This plugin can re-build the torus with different parameters.

If you want to, say change the main radius of the torus, just:

- select the torus Geometry ('G' key + Left Mouse button)
- hit 'E' to edit the parameters again (radius, number of subdivisions etc.)

5.3. Deleting

Delete selection" (Delete key) will:

- delete selected Polygons in a Mesh/PolyGroup if they are selected as a Geometry or a PolyGroup.
- if there are no selected Polygons in a (selected) PolyGroup, it will remove the Polygroup from its Mesh.
- deleting a single Model (node) or a Branch of a hierarchy also works.

6. User preferences (settings)

The preferences files are located either in: `/usr/local/equinox/.equinox` or in `.equinox/` from the user's home directory.

The main preferences file is called: `.EQUINOX-3D`. It stores the following information:

- Size of displayed points
- Line width used for drawing
- Camera orbiting speed
- Display control settings (Show camera, Show vertices, Show control-points, Show lines etc.)
- Font settings for the user interface
- Path names
- Which panels were visible
- Which ToolPanel folders were open
- Menu-bar mode (Icons only, Text only or Icons and Text)
- Point size for displaying vertices and spline keys
- Selecting preferences
- File-selection dialog settings

Plugin preferences are saved in separate files, specified by the plugins (e.g.: `.povrender` for the POVRay renderer plugin).

These files are saved in the same directory where the main prefs file was found when EQUINOX-3D was started.

Plugins can define a list of "resources" (variables with type information) and these are all automatically saved into the appropriate files when the user selects "Save preferences".

Appendix A

Summary of menus



Information

Edit selection (hot key: 'E'):

When this menu item is activated, the program parses the scene and finds the first selected Item by analyzing the selection modes.

It can be a Model node, a Geometry (Mesh, Spline etc.), a PolyGroup or many other things.

Depending on what is selected, a dialog box will appear with the appropriate parameters, e.g. The "Edit PolyGroup" dialog box.

If the selected Geometry has construction history (e.g. a torus), "Edit selection" will bring up the dialog box of the appropriate plugin (such as the "Edit torus" dialog box).

Remove attributes (hot key: 'Alt+Del'):

Remove extra information, such as construction history from the selected Geometries and Models.



Spline / Face

Draw Linear:

Create a Linear Spline by adding CVs. When a new CV is created, it can be moved right away without releasing the mouse button.

A new CV can be added after the last one, before the first one or between two existing ones (the tool finds the closest point on the Spline).

For a description of the different Spline types, see section: 2.1.2.

Draw Bezier:

Create a Bezier Spline by adding CVs. When a new CV is created, the handles can be pulled apart right away without releasing the mouse button.

A new CV can be added after the last one, before the first one or between two existing ones (the tool finds the closest point on the Spline).

If you add a new CV before the first one, this will pull out the "Previous" side of the handle. For "after" and "between" CVs, it pulls out the "Next" side.

This also works in the "Add point" tool.

Draw BSpline:

Create a B-Spline by adding CVs. When a new CV is created, it can be moved right away without releasing the mouse button.

A new CV can be added after the last one, before the first one or between two existing ones (the tool finds the closest point between the CVs).

Draw Cardinal:

Create a Cardinal Spline by adding CVs. When a new CV is created, it can be moved right away without releasing the mouse button.

A new CV can be added after the last one, before the first one or between two existing ones (the tool finds the closest point on the Spline).

Add point tool:

Add new CVs to an existing Spline. You need to select a Spline before activating this tool.

When a new CV is created, it can be moved right away without releasing the mouse button.

A new CV can be added after the last one, before the first one or between two existing ones (the tool finds the closest point on the Spline).

Delete point tool:

Delete CVs from a Spline. You need to select a Spline before activating this tool.

Edges to Splines

Takes a Mesh as an input and for every edge of that Mesh, it creates a linear Spline. It can be useful for extruding a shape (Spline) along those edges to create a manifold shape.

Convert to Face

Convert the selected Spline or Splines into Face(s). The Splines must be closed. The resulting Face will have its own copy of the Spline, but the original Spline will be kept as well.

See Figure A.4.1.

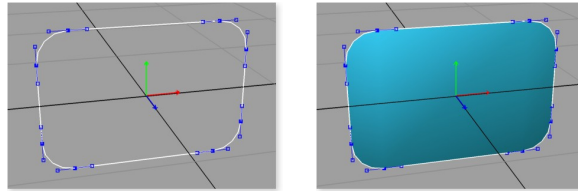


Figure A.4.1. Converting a Spline to a Face

Attach hole to Face

Attaches the selected Spline(s) to the selected Face(s) as hole(s). The Splines must be closed.

The resulting Face will have its own copy of the Spline(s), and the original Spline(s) will be kept as well. See Figure A.4.2 for an example.

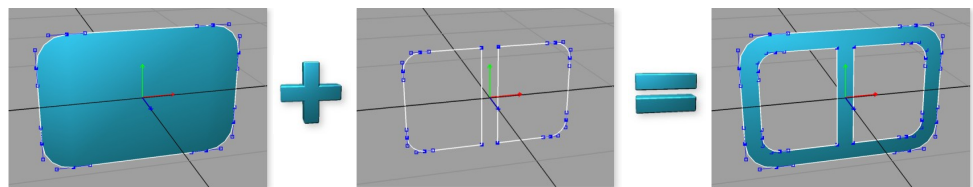


Figure A.4.2. Adding holes to a Face

Convert Face to Polygon

Converts the selected Face into a Polygon. This tool creates a new Model, Mesh and Polygroup for this Polygon.



Polygon

Edit Polygons

This is an interactive tool. Before activating it, select a PolyGroup to be edited. This tool lets you perform different operations, including:

- Adding new Polygons to a PolyGroup / Mesh
- Adding Edges (splitting Polygons)
- Deleting Edges (merging Polygons)
- Deleting Vertices

This tool is context-sensitive, so the type of applicable operations will depend on what is under the mouse pointer.

Read the StatusPanel for further information.



Surface

Extrude



This tool takes a “profile” Geometry that is either a Spline or a Face and extrudes it along a straight line, creating a surface (e.g. a Polygon Mesh).

The extrude tool maintains a construction history on the resulting surface and is fully interactive. You can, for example change the shape of the profile Face and the extruded surface will change interactively.

The direction of the extrude can be specified and the front and back faces can be beveled.

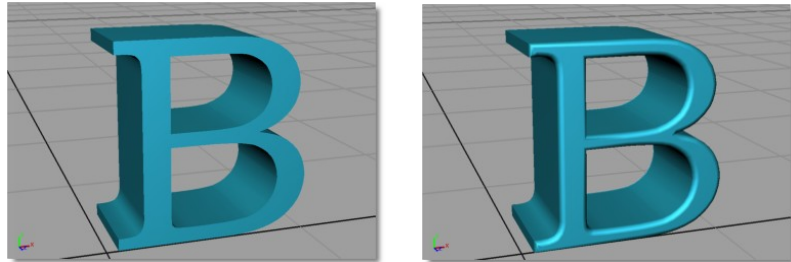


Figure A.5.2. Extruding a Face with holes. Without bevel and with bevel.

Extrude along Spline



This tool takes a “profile” Geometry that is either a Spline or a Face and extrudes it along a “path” Spline, creating a surface (e.g. a Polygon Mesh).

This tool maintains a construction history on the resulting surface and is fully interactive. You can, for example change the shape of the profile Face or the path Spline and the extruded surface will change interactively.

You can also go back and change the options of the tool by selecting the surface Geometry and hitting the 'E' key (**Menu->Info->Edit on selection**).

Figure A.5.1. and A.5.2 show examples of extruding a Spline and a Face along a path Spline.

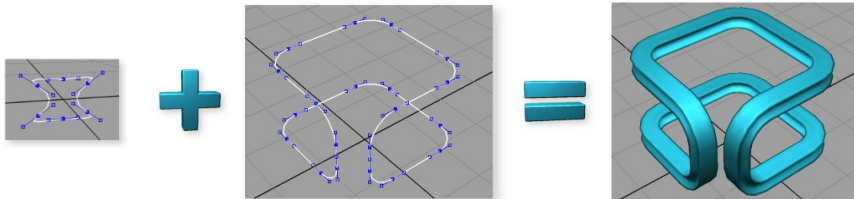


Figure A.5.1. Extruding a Spline along another Spline

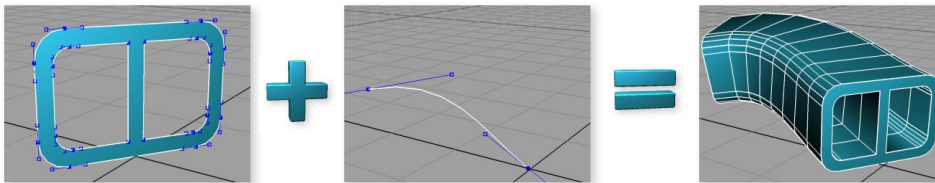


Figure A.5.3. Extruding a Face with holes along a Spline

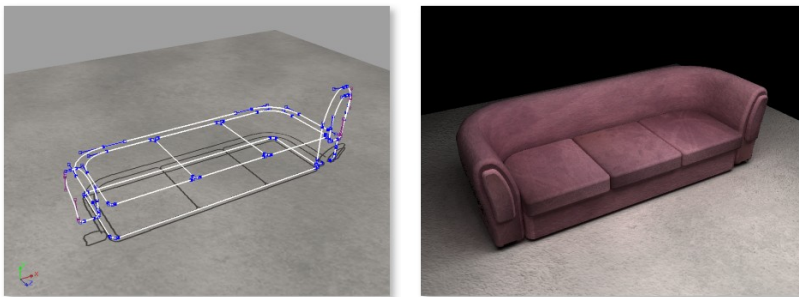


Figure A.5.4. *Extrude along spline* with bevel is a powerful modeling tool. For example, it allows you to quickly build a couch just from a few Splines.

Revolve



This tool revolves a Spline (the “profile”) around an arbitrary axis to create a surface (e.g. a Polygon Mesh).

Typical use:

- Create a Spline and make sure it's selected
- Click on the Revolve icon on the Tool Panel: (left button: no dialog box, right button: dialog box.), or
- Select **Menu->Surface->Revolve** either the main button or the little dialog box icon besides it.

Dialog box options:

- Triangles: the resulting surface will be made of triangles or rectangles
- Smooth: average the normal vectors at the Polygon Vertices to create a smooth surface appearance
- Start and End angle: it allows for a non-complete (less than 360°) revolution.
- Sides: the number of sides on the surface

The tool maintains a construction history, so you can change the shape or the parameters of the profile Spline at any time and the surface will change interactively.

You can also go back and change the options of the tool by selecting the surface Geometry and activating **Menu->Info->Edit on selection**.

Note: make sure that the contour Spline is drawn counter-clockwise and to the right of the Y axis, as seen on the Front view, otherwise the revolved surface will be inside-out.

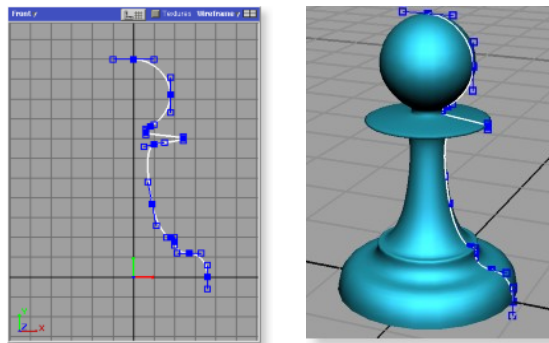


Figure A.6.1. Revolving a Spline

Skin



This tool “stretches” a surface on a set of a Splines (the “cross-sections”), much like the skin of an airplane wing covers the “ribs”.

- Create a set of Splines and make sure they are selected
- Click on the Skin icon on the Tool Panel: (left button: no dialog box, right button: dialog box.), or
- Select **Menu->Surface->Skin** either the main button or the little dialog box icon besides it.

Dialog box options:

- Triangles: the resulting surface will be made of triangles or rectangles
- Smooth: average the normal vectors at the vertices to create a smooth surface appearance
- Weld closed cross-section ends: merge the two Vertices on the surface that correspond to the beginning and the end of a closed Spline cross-section
- Sides: the number of steps along the cross-section Splines

The tool maintains a construction history, so you can edit the cross-section Splines, change the Skin parameters etc., and the surface will change interactively.

You can also go back and change the options of the tool by selecting the surface Geometry and activating **Menu->Info->Edit on selection**.



Geometry

Tessellate

This tool converts all "complex" Polygons in the selected Meshes into triangles. A complex Polygon is one that is either concave or has holes in it.

Triangulate

Convert all Polygons in the selected Meshes into triangles. This might be necessary when using a 3D object in a real-time renderer (such as in a 3D video game), as most of those renderers only support triangles.

In EQUINOX-3D, Polygons can have any number of sides, they can be concave or even have holes on them.

Separate Geometries

Collect all the selected Geometries (Meshes, Splines etc.) and move them into a newly created Model.

Separate PolyGroups

Collect all the selected PolyGroups within a Mesh and move them into a newly created Mesh.

Separate Polygons

Collect all the selected Polygons within a PolyGroup and move them into a newly created PolyGroup.

This allows for assigning and changing a common Material on these Polygons.



Transform

Reset

Set the transformation values of the selected Model(s) to:

Scaling: 1.0, 1.0, 1.0

Rotation 0.0, 0.0, 0.0

Translation: 0.0, 0.0, 0.0

Freeze to world

Perform the local-to-world transformation of every Geometry in the selected hierarchies and reset the transformation values of the Models in those hierarchies.

This effectively puts the origins of the local coordinate systems of every affected Model into the world origin. The position of the objects will remain the same.

Freeze branch to its parent

Perform the local-to-branch-parent transformation of every Geometry in the Models of the selected branches.

This puts the origins of the local coordinate systems of every affected Model into the origin of the parent of the branch root, and resets their local transformations.

If the branch-root has no parent (it is the root of the hierarchy), this operation is equivalent to “**Freeze to world**”.

Freeze branch to its root

Perform the local-to-branch transformation of every Geometry in the descendant Models in the selected branches.

This puts the origins of the local coordinate systems of every affected Model into the origin of the branch root, and resetting the local transformations.

Freeze scaling on branch

Perform the local-to-branch scaling of every Geometry in the descendant Models descendant Models in the selected branches.

This operation is similar to “**Freeze branch to its root**”, but it only affects the scaling values.

All the affected Models will have a scaling of: 1.0, 1.0, 1.0, but will retain their original shape.

Snap tagged points to grid

Move all tagged points to the closest grid cell. The grid settings used are of the main 3D window (usually top-right).



Hierarchy

Connect node or branch



Connect a Model or a branch to a parent Model to make a hierarchy. You need to select a Model or a hierarchy branch before activating this tool.

You can pick a parent or a child for the selected Model. You can connect multiple selected Models to a parent at once. Of course, if you pick a child for a 'parent to be' Model, you should have only one Model selected.

Disconnect node or branch



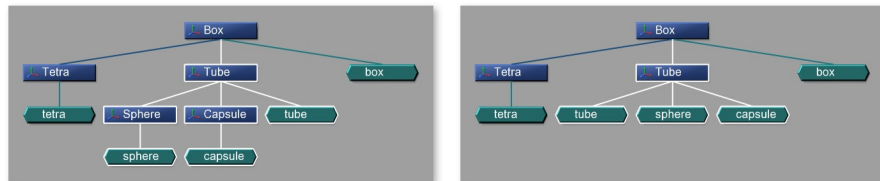
Disconnect the selected Model(s) or branch(es) from their a parents.

Collapse branch

Collects all the Objects from the Models in a branch (hierarchy sub-tree), then

- performs the appropriate transformations on them
- adds the Objects to the root Model of the branch-
- then removes all descendant Models from the branch root

Example:



The Model, called “Tube” will contain the *tube*, *sphere* and *capsule* Objects. The 3 Objects will now all use the same transforms, defined by “Tube”.

However, their shape was modified by the collapse tool to compensate for the different transforms (the Vertices of the Meshes were transformed the “opposite way”), so the 3D view will look the same after the operation.



Material

Add/edit on selection

Edit the Material of the selected objects (Models, Geometries etc.). When activated, this tool first looks for an object that has a Material.

If it finds one, it assigns that Material to all selected objects, then pops up the dialog box for editing.

If none of the selected objects has a Material, the tool creates a new Material and assigns that to all selected objects, then pops up the dialog box.

If an object has no Material of its own, but is in a hierarchy, it will inherit a Material from its parent or its parent's parent etc. This inheriting is automatically updated when a Model is connected or disconnected from a hierarchy.

Assign from another object

Assign (share) the Material of another object to all selected PolyGroups. You can also pick the Material to be shared from the Material lister.

Copy from another object

Copy the Material of another object to all selected PolyGroups.



Clone

Immediate

Create a clone (copy) of the selected Models, including their Geometries.

If only Geometries are selected on a Model, this tool creates a new Model and adds a duplicate of each selected Geometry to this new Model.

If only PolyGroups are selected, new Meshes and Models will be created accordingly.

Options

Duplicate shares Materials If this option is selected (default), the new Geometries will share Materials with the originals, so the Materials can be edited simultaneously.

Otherwise each new Geometry will have its own copy of the Materials it is using.

Clone construction history If this option is selected (default), the new Geometries will have a copy of the construction history of the originals.

Instance

Create copies of the selected Models, but instead of making copies of their Geometries, those will be shared between the original Model and the new one.

When a shared Geometry changes (e.g. when you move a Vertex of a Mesh), all of its instances will change simultaneously.

This allows for creating copies of objects, placing and orienting them and later editing their shape all at once without having to copy and position them again.

Instancing can also save a significant amount of memory, as only one copy of the instanced Geometry will need be stored.



Animation

Simple path animation

Animate an object along a path defined by a Spline.

Example:

- Create a Spline (for this tool, only Bezier or Linear are supported at the moment).
- Create, say a cube
- Select the cube
- Activate **Animation->Simple path animation**
- The message on the Status Panel will ask you to pick a path, click on the Spline
- Hit PLAY on the Time Panel

If you close the spline and turn on looping in the Time Panel, the cube will keep flying around the closed path.

Since there is no function-curve editing yet, this tool simply assigns the start and end frame set in the Time Panel for the starting and ending point of the path.

For a closed path, you can try the example file:

`Examples/Animation/Path/FunkyPath.hrc`

For the technically inclined: this tool uses correct *arc-length parameterization* on the Spline, so objects will move at an even speed regardless of the shape of the Spline.

Appendix B

Glossary

Construction history	<p>A high level description of a Geometry. It describes how that Geometry was created.</p> <p>This lets the user edit a Geometry at a higher level than its physical representation (e.g. a Polygon Mesh). For example, simply changing the radius of a sphere (e.g. by moving a slider), the user can have the "Sphere tool" re-build a different polygonal approximation of a sphere.</p>
CV	<p>Control Vertex, also known as Spline Key. A point of a Spline that affects the shape of that Spline.</p>
Geometry	<p>A type of point-list, line, surface or volume that represents a shape. EQUINOX-3D supports the following Geometry types:</p> <ul style="list-style-type: none"> - Point set - Spline (Linear, B-Spline, Bezier and Cardinal) - Face (flat surface defined by Splines) - Polygon Mesh
Material	<p>The description of a surface and internal properties of an Object that (along with the shape) makes it possible to render an image of that Object or for other Objects to interact with this Object (physics simulation).</p> <p>Material descriptions may range from a single color, or the traditional Ambient/Diffuse/Specular colors (plus transparency, refractive index etc.) to complex, physically-based models that describe how light interacts with a certain Object. Materials may contain <i>textures</i> and <i>shaders</i>.</p>
Mesh	<p>Also called Polygon Mesh. A type of Geometry that has an array of points (Vertices) and Groups of Polygons (PolyGroups). The Polygons index the Vertices from the array on the Mesh.</p>
Model	<p>Also called <i>transformation-node</i> or <i>transform-node</i>: the element that "brings" (instantiates) Objects into the scene and defines their size, orientation and location in <i>world-space</i>.</p>

Object-space	<p>Also called <i>local-space</i>: the coordinate system in which the shape of an Object is defined.</p> <p>The relationship between the <i>local-space</i> of that Object and <i>world-space</i> is specified by the Model(s) that instantiate that Object, via coordinate-system transformations (scale, rotate, translate).</p>
PolyGroup	<p>A group of Polygons in a Mesh that share a Material (and its Textures).</p>
Plugin	<p>A piece of software (program and data) that can be inserted and removed from an application while the application is running.</p> <p>Plugins allow anyone with programming knowledge and familiarity with the API (Application Programming Interface) of a particular application to add custom functions without needing to re-build the whole application.</p> <p>EQUINOX-3D has a relatively small core and a large number of plugins, providing flexibility and scalability.</p>
Shader	<p>A mathematical model that simulates a light-surface or light-volume interaction and its program implementation. Shaders are associated with Materials.</p> <p>On top of the built-in shaders, such as “Lambert”, “Phong”, “Ward’s anisotropic”, EQUINOX-3D also has a programmable shader interface. People familiar with basic computer rendering can implement their own shaders in a plugin and use them in the ray-tracer (you don’t need to understand how the whole ray-tracer works). For example: a physically correct skin or hair shader.</p>
Status Panel	<p>A horizontal bar that displays information about the current state of EQUINOX-3D. These include the function of the mouse buttons, undo stack indicator and the time code for the current frame.</p>
Transformation	<p>An operation to convert an Object from one coordinate-system to another. Usually consist of scaling, rotating or translating (moving). See: Model.</p>
World-space	<p>Also called <i>global-space</i>: the common coordinate system that defines a 3D scene. See local-space.</p>

Appendix C

Abbreviations

LMB	- Left Mouse Button
MMB	- Middle Mouse Button
RMB	- Right Mouse Button