REAL 3D

USER MANUAL
Version 3

Scanned
by
Thallon

REAL 3D

version 3

User Manual

Realsoft

REAL 3D User Manual for version 3.

Copyright© 1995 Realsoft Oy. All rights reserved.

REAL 3D is a trademark of Realsoft Oy. All other brand and product names are trademarks of their respective companies.

Printed in Finland by WSOY.

First edition.

CONTENTS

1. TUTORIAL

Getting started with Real 3D v.3 7
Modelling 10
- Rounding 10
- Surface coordinates 11
- Freeform modelling 12
- Fractals 15

Materials 16
- Glow example: a space ship 16
- One way mirror 17

Animation 18
- Path animations 18
- A simple keyframe animation 20
- Creating hierarhical animations using keyframing 20
- Pivot points 22
- Animated fade-out 23
- Skeletons 24
- Fidelity 26
- Hierarchical skeletons 27
- Morphing skeletons 29
- Surface method 30
- Shrink wrapping 32

2. MENU FUNCTIONS

File/ 33
- Objects/Load 33
- Project/Insert Sections, Save Sections, Replace Sections 33
- Materials/Window 33
  - Edge X/Y 33
  - Freq X and Y 33
  - Texture antialiasing 34
  - Glow 34
  - Depth scope handler 34
  - Angle scope handler 34
  - Roughness bump handler 34
  - Dither color handler 35
  - Material color 35
  - Relative texture coordinates 35
  - New image formats 36

Materials/Purge 36
Windows/ViewTool 36
Create/ 38
Structure/Link 38
Structure/Group 38
Structure/Method 39
Controls/Helix 40
Controls/Skeleton 40
Friction 41
Fidelity 41
Angle Constraints 41
Sub skeletons 42
Fractals/Landscape 43
Fractals/Tree 43
Modify/ 43
Properties/Attributes 43
Properties/Animation 43
Properties/Skeleton Attr. 44
Properties/Geometry 44
Properties/Fade 46
Special/Reflect 46
Freeform/Type 46
Freeform/Round 47
Freeform/Convert to Triset 47
Freeform/Surface to Groups 47
Freeform/Fidelity 47
View/ 48
Type/Surface 48
Camera/Camera View 48
Render/Settings 48
Auto Box Rendering 48
Interlace fields 48
Super sampling 49
Alpha channel output in IFF file rendering 49
JPEG support 49
Saving and loading render settings 49
Post effects 50
Glow 51
Distance anti-aliasing 51
Render/Export DXF 51
Drawing Settings 51
Animate/ 52
Create/Keyframe 52
Create/Inverse Kinematic 52
Create/Skeleton 52

Create/Shrink wrapping 53
Edit 53
Extras/ 53
Vectors/Deselect Group 53
Repeat Last 54
Show selected objects -hotkey 54
Settings/ 54
Attributes 54
General 54

3. ANIMATION SYSTEM

The key editor 55
Envelopes 57
Path animations 59
Keyframe method 59
Morphing method 60
Skeleton method 63
Simple skeleton method 63
Inverse kinematics method 63
Surface method 64
Shrink wrapping method 64
Transform method 66

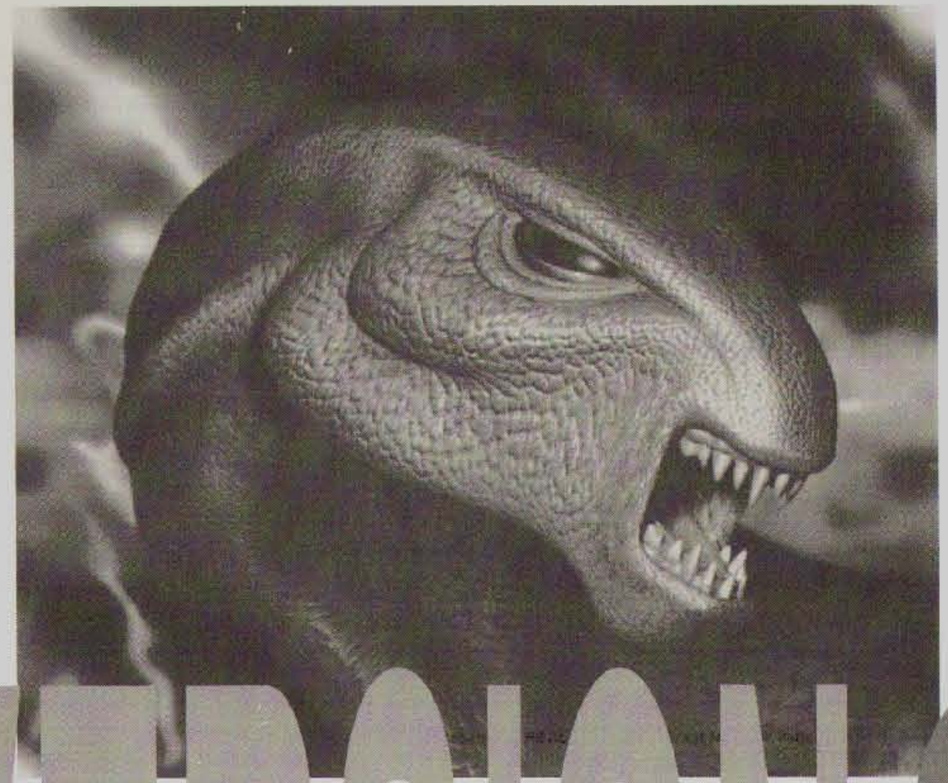
4. RPL

Local Variables 67
Parameters 67
New RPL words 68
CS_TRANSFABS 69
Changes to RPL specification 81
A complete GUI programming example 82

5. MISCELLANEOUS

Compatibility 87
Comparison of Amiga / Windows specific features 88
Installation 88
Naming conventions 88
Menu function differences 88

INDEX 93



VERSION 3

1. TUTORIAL

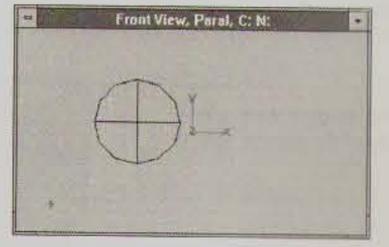
Real 3D V3 contains many new features and improvements. This chapter presents some basic examples to demonstrate these. See the reference section for more detailed descriptions.

GETTING STARTED WITH REAL 3D V.3

Welcome to Real 3D v.3. This first tutorial example will take you step-by step through the process of creating an animation. If you are unfamiliar with Real 3D, the tutorials will show you how easy it is to create animations, but no attempt will be made here to explain the various functions you will be using in any detail. The reference section of the manual is the best place to look for detailed function descriptions of the actions you will perform in these tutorial examples.

So, let's create a simple animation: a moving wooden sphere.

1. Start Real 3D by clicking the 'TutorEnv' icon.
2. First we create a sphere:
   - Select Create/Visibles/Sphere from the menu.
   - Click the left mouse button once on the large 'View' window with the label 'front view'.
   - Move the mouse to see how Real 3D draws a spherical shape.
   - Click the left mouse button again to create a sphere.



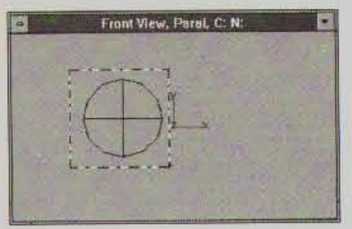
Defining a sphere.

3. Next, we need to change the material of the sphere to wood.
- Click on the image of the pine wood material in the material select window at the right of the screen.
- Click the 'Parallel' button at the bottom of the same window.

Now Real 3D will wait for you to draw a 'material mapping' rectangle in the view window:
- Move the mouse to a point above and to the left of the sphere and click the left mouse button.
- Move the mouse down and right until the rectangle drawn by Real 3D covers the sphere.
- Click the left mouse button again to finish the rectangle.

This will now map the wood grain pattern onto the sphere.

Defining a material mapping.



4. To make sure we have created a wooden sphere:
- Select the menu View/Render/Window.

Real 3D renders a shaded image.

A wooden sphere.

5. The 'Select' window at the top right corner of the display shows you the hierarchical structure of the wooden sphere. The 'Root' object consists of two sub objects: a sphere and a wood mapping.

The select window shows the hierarchy of the wooden sphere.

The name of the previously created 'wood' mapping object is highlighted. This means it's in a 'selected' state. We're going to animate both the sphere and the wood mapping together, therefore:
- Select the 'Root' object by clicking its name with the left mouse button on the select window.

Selecting the 'Root' object.

6. We'll use the keyframe technique to animate the sphere. Animation operations can be carried out in the key editor window.

The key editor.

- Pick 'Keyframe' from the 'Method' list of the key editor.
- Make sure the 'Root' object is still selected
- Click the 'Create' button in the key editor to start keyframing.

7. Next we will define a second keyframe.
- Move the mouse on top of the last frame index '49' displayed in the key editor and click the left mouse button.

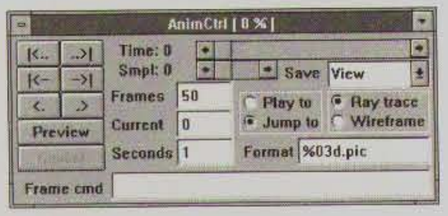
A thin vertical line jumps to that frame. This shows the current time. Now we will create the second key frame
- Click the 'Create Key' button.

A new, small rectangle which represents the second key frame, appears at the end of the horizontal 'time line' of the key editor.
- Select the function Modify/Linear/Move from the menu.
- Click in the middle of the sphere.
- Move the object to a new position and click again.

8. The second key frame was defined at the end of the animation.
- Play the animation to the beginning by clicking the '<<' button in the key editor.

The sphere moves to its original position.

9. Let's make the motion more interesting by creating a third keyframe.
   - Click on frame '25'.
   - Create a new keyframe by clicking the 'Create Key' button.
   - Move the object to a new position with the menu function Modify/Linear/Move.
10. The final step is to preview the animation.
   - Open the Animation window by selecting the menu File/Windows/Animation.
   - Make sure that the 'Ray trace' option, not 'Wire frame', is selected.
   - Set the Save field to 'View'.
   - Click the 'Preview' button.



The animation window

V3samples\firsttut.prj

This renders and shows the animation automatically.

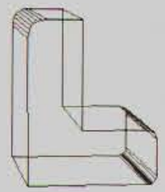
MODELLING

Rounding

V3samples\round.prj

The Modify/Freeform/Round function, despite its name, may be applied not only to freeform curves but also to polygon and polyhedron primitives. Let's experiment with this:

1. Select Create/Visibles/Polyhedron and draw an 'L' shape.
2. Select by shift-dragging the top left corner points of the polyhedron.
3. Select the menu Modify/Freeform/Round.
4. Enter 0.1 into the radius field.
5. Enter 6 into the point count field.
6. Click OK. The top left corner becomes rounded.
7. Shift-drag all the points at the right edge of the polyhedron.
8. Hit the '5' key (it's the hot key for 'repeat last action').
9. Enter a radius of 0.05.
10. Enter 3 as the point count for rounding and click OK. Two corners more become rounded.



A rounded polyhedron

Surface coordinates

This example demonstrates the View/Type/Surface coordinate mode, which makes it possible to draw curves directly onto object surfaces.

1. Start a new project with menu item File/Project/New.
2. Select View/Viewcam/Reset all.
3. Select View/Input Plane/Reset Hot Point.

   Let's first create an object to project surface coordinates onto later. We'll use the lathe tool.

4. Select the menu Create/Compound tools/Lathe.
5. Draw a vertical axis in the middle of the view window.
6. Shape a candle stick. Use the right mouse button twice when you have finished with the lathe tool.
7. Activate the View/Type/Surface option from the menu.
8. Select Create/Controls/B-spline Knot.

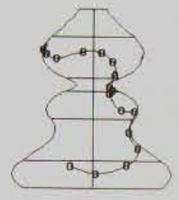
   It is important to define the curve with knot points instead of control points, because otherwise the typical B-spline rounding nature may dislocate the actual curve shape from the candle stick surface.

v3samples\surfcrd.prj

9. Draw a curve in a view window.

   Make sure every mouse button click hits the candlestick. You can also use the cursor keys to rotate around the candlestick while you are drawing. It is best to define curve points quite densely to ensure that the created curve follows the surface as well as possible.

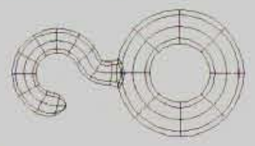
10. Finish the curve definition with a right mouse button click.



Freeform modelling

In this example, we'll create a freeform object consisting of a ring and a hook which is smoothly joined to the side of the ring. This example isn't intended as an introduction to B-spline modelling; read the freeform modelling section of the main manual first.

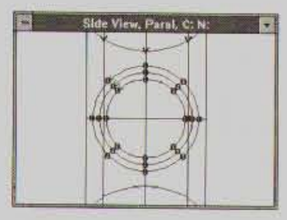
A freeform object.



1. Let's start by taking a front view:
- Select menu View/Viewcam/Set XY.
- Select View/Type/Parallel, which is a suitable mode for accurate modelling.
2. The ring shape is easy to create:
- Select Create/Freeform/Torus.
- Accept the default 8*8 point count for the mesh.
- Shape a small circle and then a larger one.
3. Now take a suitable side view:
- Select menu View/Viewcam/Set YZ.
- Zoom in either by pressing '+'key several times or use the function View/Viewcam/Pos&Zoom in, until the area to which the hook will be attached is displayed in a scale which allows accurate working.
4. We'll define a smooth blend from the ring to the hook with cross-sectional building. Therefore, we need some cross section curves.
- Select Create/Controls/B-spline Circle
- Draw a circle in the middle of the ring.

   The radius of the circle should be almost as big as the diameter of the ring (see the picture below).
5. To create the second cross-section:
- Use Modify/Structure/Duplicate to duplicate the circle.
- Select Modify/Linear/Size 2D.
- Click in the middle of the circle, then at its edge.
- Make the copied circle slightly smaller.
6. Apply the Duplicate and Size 2D functions once more. The result should be three equally centered circles as shown in the figure below.

Cross-sections for surface blending

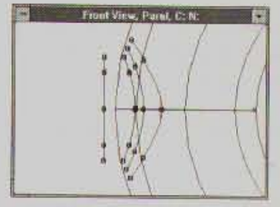


7. Duplicate the smallest circle, but don't resize it this time. Rename the copy as 'circle' to make it easily identifiable.
8. Take a front view. Move all the circles to the left side of the ring.
9. Now we will project the first three curves onto the surface of the ring with the parallel shrink wrapping function. Let's define the parameter objects carefully:
- Select the ring mesh from the select window.
- Press the shift key down and select the first three circles in the order they were created.
- Release the shift key.

   If you did everything correctly, there should now be four objects selected.
- Then select menu Modify/Special/Parallel Shrink.
- Draw a line from the middle of the circles to the right, far enough so all the points of the circles, when moved the amount defined by the line, would hit the ring.

   For example, you can draw the line all the way to the middle of the ring. After the line has been defined, the circles move to the right and bend along the surface of the ring as they hit it.

Shrink wrapped circles

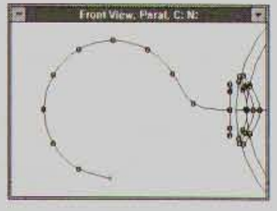


10. Parallel shrink actually projects the control points onto the surface, and the curves may now be slightly inside the ring. For the outermost curve, this is OK, because it guarantees there won't be a gap between the hook and the ring.
- Select the two smaller projected curves
- Apply the Modify/Freeform/Invert function to them.

   This converts the control points to knot points and we get a more accurate result.

11. The actual hook will be created with orthogonal sweeping. For that purpose, we need a new curve.
    - Select Create/Controls/B-Spline knot.
    - Draw a hook-like curve starting from the middle of the unmodified circle (see the picture below).
    - Use knot point editing (Modify/Freeform/Move Knotpoint) to fine tune the shape if necessary.
    - Rename the curve as 'hook'.

A spline curve for the hook.



12. Multi-select the two curves, first 'circle' and then 'hook'. Select menu Create/Build Freeform/Orthogonal.

    A hook-like mesh is created.

13. Delete the 'hook' and 'circle' curves.

14. Actually, the orthogonal sweeping was used only as an intermediate step:
    - Select the hook mesh
    - Apply the function Modify/Freeform/Surface to Curves to it.

    A set of cross section curves is created.

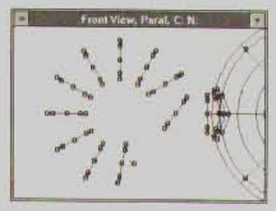
15. Delete the hook mesh. We don't need it any more.

16. Let's analyze what kind of curves we have. First there are the three curves which were projected to the ring. After that follow cross sections from the hook mesh. Since the cross sections generated by the Surface to Curves operation represent the control polygon structure of the hook mesh, the first cross section may be partly inside the ring. If this is the case, delete it. The purpose is to get a nice ordered sequence of cross sections.

17. Continue as follows:
    - Select the last curve in the hierarchy.
    - Duplicate it twice.
    - Multi-select the last three curves, and use Modify/About COGs/Size 3D to squeeze them into a single point.
    - Move them slightly to the front of the last unsqueezed curve.

    The last three curves will generate the closing cap for the hook mesh.

Cross-sections for the hook.

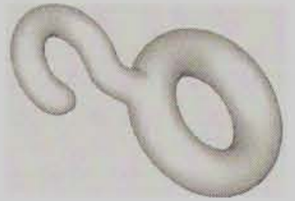


18. All the curves should now be in the correct order in the hierarchy, so select them all by dragging over their names on the select window.

19. Use the menu Create/Freeform/Build from Curves. A hook mesh is recreated, this time with a smooth blending to the ring and a closing cap.

20. Delete all the curves and the object is ready.

v3samples\hookobj.prj



Fractals

The project file v3samples\fractal.prj contains some predefined fractal trees. To use them, do the following:

1. Select File/Project/Insert sections from the menu.
2. Press the 'None' button of the opened file selector to clear all sections. Then activate the 'Fractal Trees' gadget. Click on OK.
3. Select the file 'examples/fractal.prj' using the file dialog.
4. After the file has been loaded, select Create/Fractals/Tree. This opens the fractal tree dialog.
5. Click the 'Load' button. A list dialog is opened. Select one of the predefined trees, then click OK and define the first branch for the tree by drawing first a sphere, which defines the diameter of the first branch and then a line, which defines the length and the direction of the branch. The fractal tree is then created.

6. You might also want to use a leaf object in which case create and select the object to be used as the leaf prior to activating this function.

   NOTE: Delete the created tree before trying to create the next one. Otherwise you could inadvertantly use the previously created tree as a leaf object for the new tree, which will lead undoubtedly to a not-enough-memory situation.

MATERIALS

v3samples\
glow.prj

Glow example: a space ship

In this example, glow feature is used to make windows of a space ship to glow and to create a smoothly glowing exhaust flame behind the ship.

1. Draw two texture maps in a paint program. The first one, 'panels' will be used as a color map to represent surface details of the ship, so it may consist of rectangular areas of grayish blue shades. The second one, 'lights', should contain suitable groups and rows of bright yellow dots (used for windows) against a black backround. Save the textures to Real 3D's 'textures' drawer.

2. Model a simple space ship in Real 3D. For example, use Create/Compound tools/Lathe to create a suitable shape. The color of the ship does not matter. Rename the created object as 'ship'.

3. Use Create/Structure/Level to create a new level. Rename it as fire, and make it the current level. Create a bright orange sphere (Create/Visibles/Sphere) behind the ship, and use Modify/Linear/Extend to make it a flame like elliptic shape. The ellipsoid will be the source of the exhaust flame glow.

4. Use File/Materials/Window to open the material editor. Define a new material with the following properties:
   - Name 'panels'
   - Texture 'panels' (the texture map you just created)
   - Tile X and Y on
   - Color map and Bump map on
   - Specularity 20, Specular brightness 30-40 (to get a metal-like effect)

   Press Apply to create the material.

5. Press Reset and define another material with the following properties:
   - Name 'fire'
   - Unshaded option on (the exhaust flame doesn't require shading)
   - Glow size 90, Glow brg. 100 Press Apply.

6. Press Reset and define a third material:
   - Name 'lights'
   - Texture 'lights' (the second texture map you created)
   - Tile X and Y on

   - Color map on
   - Unshaded option on, to make the windows behave as if they are lights inside the spaceship
   - Transp. Color option on, and the Transp color should be black R=0, G=0, B=0
   - Exclusive and Scope mask on; Scope mask is important, otherwise the whole ship will glow.
   - Glow size 80, Glow brg. 50

   Hit Apply to create 'lights' material. Close the material editor.

7. Use Create/Mapping/Default, select 'fire' and click OK to create a mapping inside the 'fire' hierarchy level (see the hierarchy diagram below).

8. Make 'ship' the current level. Select a view so that the ship is 'end on'. Then create/Mapping/Cylinder twice and shape two cylinder maps around the ship; the first one should refer to 'panels' and the second one to 'lights'. Now the ship hierarchy should be as follows:

```
root
    ship
      part1
      part2
      ...
      panels(T)
      lights(T)
    fire
      ellipsoid
      fire(T)
```

9. Take a suitable view to the ship scene. Then open render settings. Select Environment or Lampless mode (you can also use Shadowless or Normal mode if you've added some light sources). Set background color to black.

10. Press POST EFFECTS button. This opens the post effect editor. Select 'Glow' from the Post effect list at the left. Then press 'CREATE' button, so that a new effect called 'Glow' is inserted to the effect list. Press EXIT to close the dialog. Then press OK to exit the render settings dialog.

11. Render the scene.

    Using similar techniques to those described above allow you to add glows to either an entire object or just sections of it.

v3samples/
oneway.prj

One way mirror

Here is an interesting use for the new angle scope handler.

Just load the ONEWAY.PRJ and render to see a transparent rectangle, then use the mouse in the view window (Viewcam Pos.) to swing around to the other side. Render and the rectangle is a mirror.

This opens up some interesting possibilities for animations or tricky lighting effects.

The effect is created like this:

1. Create a rectangle in parallel XY view
2. Create the following materials with only these settings:

mirror		**transp**	
"mirror"	(name)	"transp"	(name)
0	(specularity)	0	(specularity)
25	(specbright)	25	(specbright)
100	(brilliancy)	100	(brilliancy)
0	(transparency)	100	(transparency)
0	(turbidity)	0	(turbidity)
0	(refraction)	100	(refraction)
0	(currindex)	0	(currindex)
100	(effectiveness)	100	(effectiveness)
ANGLE scope handler		ANGLE scope handler	
a=-1.1	b=0	a=0	b=1.1

3. In XY parallel view, parallel map 'mirror' onto the rectangle.
4. Rotate horizontally using the arrow keys so you are looking at the rectagle from behind.
5. Parallel map 'transp' onto the rectangle.
6. Select render settings LAMPLESS, SHADOWLESS or NORMAL
7. Set the background and environment colours to the same values.
8. Render

ANIMATION

Path animations

Path animations contain one major improvement: now the user can control over how the time is distributed along the path curve. This is done through the key editor window (Animate/Edit).

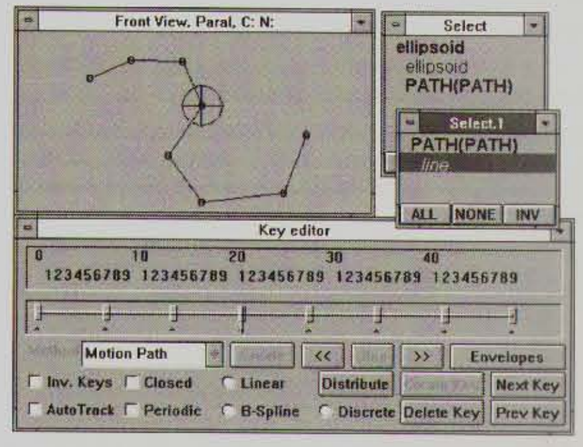
v3samples\path1.prj

'V3samples\Path1.prj' example contains a simple 'move along a path' animation with a non-uniform knot-time distribution. To recreate a similar animation:

1. Create a sphere.
2. Select Animate/Edit to open the key editor.
3. Set the 'Method' selector in the key editor to 'Motion Path', make sure that the sphere is selected and click the 'Create' button. This opens the same window as the function Animate/Create/Path. Select a 'Polygonal' path and draw the curve on a view window.

4. Use select window to make the created path method the current level. The time line of the path method displays as many knots as the defined path has points.
5. Play the animation to the end using the '>>' button of the key editor.
6. Pick some knots on the time line and move them to new frame numbers. For example, if you would like the object to reach the third point of the path at frame 20, just move the third knot to the frame 20. Then play the animation back to the beginning using the '<<' button. Note how the sphere reaches each point of the line at given knot times.

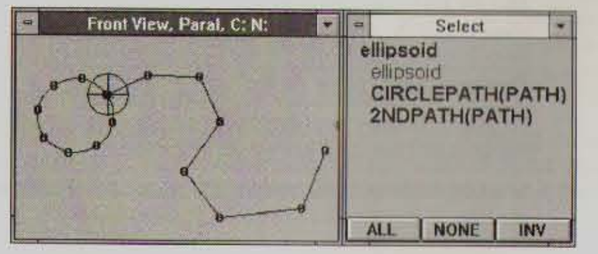
v3samples\path1.prj



The animation methods recognize one new attribute 'Inherit'. This defines whether or not the time transformations applied by the method in question are inherited to successive methods.

The example 'V3samples\Path2.prj' demonstrates how two path methods can be used on the same hierarchy level. The 'Inherit' attribute of the first method is not set, so it is possible to modify the time line of the first method without affecting the behavior of the second one.

v3samples\path2.prj



v3samples\
keyf1.prj

A simple keyframe animation

This example contains a simple keyframe animation. The animation consists of four keyframes. In the first frame the object is on the top left edge of the view window. In the second frame the object is in the middle of the window. In the third frame the object is rotated 90 degrees. In the last frame the object is moved to the bottom-right edge of the window and has doubled in size.

To create a key frame animation:

1. Select File\Project\New to clear all objects from the scene.
2. Create a rectangle to the top left edge of a view window.
3. Open the key editor window by selecting the menu Animate/Edit.
4. Set the 'Method' selector to 'Keyframe'. Make sure that the rectangle is selected and click the 'Create' button. This initializes a keyframe animation.
5. Press the 'Edit' button of the key editor. The select window will refresh and display the contents of the newly created keyframe method. You can see a copy of the rectangle and a coordsys in the select window. The copy of the rectangle stores the original state of the target, and the coordsys represents the first key frame.
6. Click on the last frame number displayed on the key editor window. Time is changed to that frame.
7. Click the 'Create Key' button. This creates a new key frame. Now select Modify/Linear/Move and move the rectangle to the right botton corner of the view window. Then rotate the object and change its size.

   Note: the correct items are automatically selected by the key editor, so don't select objects yourself while working with the key editor window unless you fully understand the way the keyframing system works.
8. Go to a new position in time by clicking the desired frame, click Create Key, modify and so on until all keyframes are defined.

v3samples\
keyf2.prj

Creating hierarhical animations using keyframing

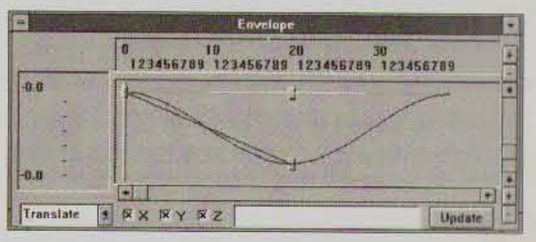
The basic idea of hierarchical animation is simple. For example, a bouncing ball can be constructed hierarchically so that the 'up-down' motion is defined first, and another motion moves the entire system forwards.

Also the keyframe animation method can be applied to all objects including those already animated by using any of the available animation techiques. A good example is an arm of a robot: the keyframe method can first be applied to the forearm. For example, the forearm can be rotated about the elbow. Then keyframing can be applied again to the complete arm in order to rotate it about the shoulder.

Let's create a simple bouncing ball animation first. In addition to hierarhical animation issue, this also demonstrates how to create closed loop motions.

1. Select the function Create/Visibles/Sphere and define a sphere near the top left edge of the view window.

2. Open the animation window and set 'Frames' to 40. Close the window.
3. Make sure that the sphere is selected (if not, select it using the select window), select 'Keyframe' from the method list of the key editor window and click the 'Create' button. This initializes a keyframe animation which consists of one keyframe.
4. Click the 'Edit' button. This prepares the key editor for editing the created keyframe method, and the select window is updated to show the hierarchy inside the keyframe method.
5. To keep this example short, let's create only two keyframes for the up-down motion. So, move to frame 20 by clicking on that number in the frame list at the top of the key editor, click on the 'Create Key' button and finally move sphere downwards so that it is near the bottom edge of the view window.
6. Set the 'Closed' checkbox of the key editor to get a closed motion, this means the sphere will return back to its initial position between frames 20 ... 39.
7. Use >> and << buttons to play the animation and to make sure it works as expected.
8. Let's get acquainted with the envelope window. Click the 'Envelope' button to open the envelope editor. Set Envelope to 'Translate' and check the X, Y and Z check boxes. You will see three curves which show you how the sphere moves in all three coordinate directions as a function of time. Note that these curves are measured in the object's own local coordinate space, not in the absolute space.



The envelope window shows how the object moves. If you are not satisfied with the motions, there are two ways of editing the animation: by modifying the key objects, or by modifing the envelope curves directly. Let's try both approaches. Leave the envelope window open so you can see how the envelope curves change when you move the key objects.

9. So, let's modify the second key frame object. Jump to the second key frame object by clicking the 'Next Key' or 'Prev Key' button (depending on what frame you are currently on). The keyframer automatically selects the correct objects; therefore you can apply modify functions without having to worry about object selection. So, select the function Modify/Linear/Move and move the sphere to a new location. The the curves in the envelope window will be moved accordingly.
10. Then modify any of the curves through the envelope window by clicking on one of the small rectangles denoting the knots of the curve and by moving it. If you want to see what impact this has to the sphere, click the 'Update' button. You can also multi-select several knots by dragging a box around the knots.

11. As a final step, we will apply keyframing again to the bouncing sphere object. Using the select window find the level object containing the original ellipsoid and the keyframe method. Select it and click the key editor's Create button to define a new keyframe method. Go to the last frame by clicking on it in the editor's frame scale. Click the Create Key button and move the bouncing sphere to the right edge of the view window. Play the animation and the bouncing sphere moves sideways while it bounces up and down.

Pivot points

v3samples\ keyf3.prj

As long as you only move objects in key frame animations, you don't have to worry about pivot points. As soon as rotation or scaling is applied, pivot points start to play an important role.

The reason for this is that keyframer rotates and scales objects relative to the pivot point. For example, in a finger, pivot points should be located to the joints of the finger, because otherwise keyframe interpolation might pull joints apart from each other.

So, let's create a simple animated arm to demonstrate usage of pivot points. 1. First create a forearm. For the sake of simplicity, we'll use a rectangle to represent the forearm. Select Create/Visibles/ Rectangle and define a suitably shaped rectangle.

2. Open the key editor with Animate/Edit

3. Create a keyframe animation by setting the key editor's method selector to 'Keyframe' and clicking on the Create button. This initializes the animation with one keyframe.

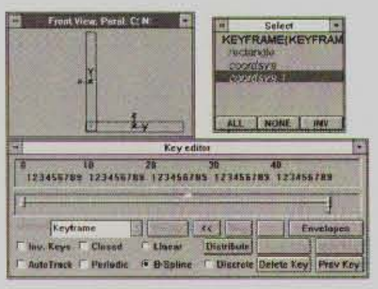
4. Move to the last frame and click the Create Key button. This creates the second key frame.

   Now its time to think of what kind of motion we would like the forearm to take. Let's rotate it around its elbow. At this point, pivots become important. Because we want the forearm to rotate around the elbow, the pivot point must be positioned at the elbow.

5. To redefine the position for the pivot point, just click the 'Pivot' button and set the new position by clicking in the View window where the pivot should be, in this case at the elbow.

6. Activate the Modify/Linear/Rotate function and rotate the forearm, say, 90 degrees about its elbow.

   Note: the pivot point is actually the COG for the object so using Modify/About COGs/Rotate, Scale, etc would ensure any modifications are centered on the pivot point.



The rectangle is rotated 90 degrees about its elbow in the second key frame. The pivot point is marked with '+' sign.

7. Now play the animation back to the beginning (click the '<<' button). The forearm rotates towards its initial position and the elbow is fixed to the pivot point.

8. Now the forearm is completely animated and it is time to create the upper arm. Make 'Root' object the current level and create another rectangle representing the upper arm. The hierarhical structure of the animation should look as follows:

   Root
   level
   forearm
   KEYFRAME
   ...
   upperarm

9. Animating the upper arm doesn't differ from animating the forearm. This time we don't want to rotate the upperarm only, but the complete arm. So, select the 'Root' object and click key editor's 'Create' button. Then move to the last frame and click 'Create Key'.

10. Click the Pivot button and click on the shoulder, because we want the whole arm to be rotated at the shoulder.

11. Select Modify/Linear/Rotate and rotate about the shoulder.

12. Play the animation.

Animated fade-out

v3samples\ fade.prj

In this example we will see how to make an object fade during an animation.

1. Create an object. For example, a simple primitive such as a ellipsoid. For this example rename it as 'fadeobj'.

2. Use Modify/Properties/Fade function to define the initial fade level for the fadeobj. The fade value can be left at zero. It is necessary to open the window even though the default settings has been used as this gives the object an IFAD TAG. Unless this TAG is present the program won't be able to complete the animation correctly.

3. Select Create/Structure/Method. Select MORPHING from the method list and click OK.

4. Make the morphing method the current level.

5. Use Create/Controls/Attribute to create two attribute objects. These are simplest possible objects and will be used just to hold fade attribute values in a morph.

   The hierarchy is now:

   fadeobj
   MORPHING(MORPHING)
   attribute
   attribute.1

6. Select the first attribute, then the menu Modify/Properties/Fade and set fade=0. Click on OK.

7. Select the second attribute, select Modify/Properties/Fade and set fade=255 (maximum). Click on OK.

8. Select Animate/Edit. This opens the method editor. The editor displays the morphable object properties. This time we are going to morph only the IFAD tag which defines the fade attribute, so make sure Color, Materials, Geometry are not selected and that Tags button is.

Now the hierarchy is ready. If you render the animation, you will note that fadeobj fades out completely by the end of the animation. You may easily change the time interval during which the fade happens by setting the start and end time of the MORPHING method using Modify/Properties/Animation or by using the time line editor.

Skeletons

v3samples\skelfide.prj

Real 3D V3 skeletons contain many new improvements which makes them an extremely powerful and easy to use tool for many different kinds of jobs. So, let's take a look at how the new skeleton system of Real 3D works.

Let's create a freeform leg and attach a skeleton to it. A good leg can be found in the objects directory as 'leg.obj', so load it in by using the function File/Objects/Insert.

A B-Spline leg.

The first step is to create a skeleton and attach it to the leg. This can be done by using the function Animate/Create/Skeleton. Select it from the menu.

Before you start drawing the skeleton, let's consider another new feature introduced by V3 called 'constraints'. Constraints consist of four angles associated with each joint of a skeleton. These angles define the minimum and maximum limits for the bones.

These constraints can be defined interactively while you are drawing the skeleton. So, let's try this now by creating a skeleton consisting of three bones: the first bone is short and represents the lower part of the spine. The two remaining bones represent the thigh and shin bones.

Make sure that the leg is selected, then click the first point near the sacrum and the second point over the hip bone. Now move the mouse towards the knee but don't fix the position for the knee yet. We will have to define proper constraints for the thigh bone first. So move the mouse 'forwards' so that it represents the knee in its uppermost position. Then move the mouse in the opposite direction so that it shows the position of the knee in its farthest back position. Then move the mouse back over the knee of the leg and fix the third point by clicking the mouse.

Define constraints by showing the frontmost and farthest back positions for the thigh bone.

Then move the mouse towards the ankle and repeat the steps above in order to define constraints for the shin bone as well. Then click the right mouse button, which terminates the skeleton creation.

A B-Spline leg and a skeleton.

To make sure the skeleton is properly positioned inside the leg, take a look at it from different directions. If the skeleton doesn't match the leg properly, you can freely modify the skeleton at this point. Just find the skeleton primitive from the hierarchy and apply a suitable modification to it.

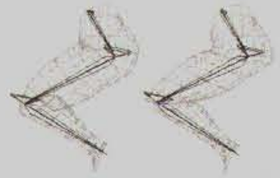
Now hit the 'u' key (or select the menu Animate/Control/Refresh). This attaches the skeleton to the leg so that when you later modify the skeleton, the leg will also be modified accordingly.

So, let's modify the skeleton primitive. When you created the skeleton by using the function Animate/Create/Skeleton, the proper object hierarchy was automatically set up for you. The skeleton primitive can be found under the 'SIMPLE SKELETON' level. So, select the 'skeleton' primitive, activate the function Modify/Special/Inverse Kinematic and move the ankle to a new position by first clicking near the ankle and then clicking at its new position. Hit the 'u' key and the leg is bent accordingly.

If you modify the skeleton to its limits, you can see that the leg may not look that good any longer because the skin near the joints doesn't behave as a real skin in the real world.

This problem can be solved by editing the so called 'fidelity' attribute of the bones. So, select the skeleton primitive and activate the function Modify/Properties/Skeleton Attrs. Go through all the joints and set fidelity to 40 %. Click Ok and refresh the animation system by hitting the 'u' key. The leg starts to look much better.

The effect of fidelity.



Fidelity

v3samples\ pointfid.prj

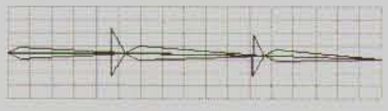
Because of the importance of the subject, let's go through another example demonstrating the use of the fidelity attribute. Get rid of the leg example by selecting the function File/Project/New.

In this example, we will create a rectangular polygonal mesh and attach a skeleton to it. When the skeleton is bent, it is very easy to observe what actually happens to the mesh and how the fidelity changes its behavior.

So, let's create a long and narrow horizontal mesh as shown in the figure below. Select the function Create/Build Freeform/Mesh and define the resolution as 18 by 8 points. To make the created mesh polygonal, select the function Modify/Freeform/Type and set the type to 'Polygon'.

Then select the function Animate/Create/Skeleton and draw a skeleton consisting of four points, as shown in the image below.

A polygonal mesh controlled by a skeleton.



Hit the 'u' key which causes the skeleton to be attached to the mesh.

Now find and select the skeleton primitive (can be found inside the 'SIMPLE SKELETON' level). Then bend it by applying Modify/Special/Inverse Kinematic to its last point. Hit 'u' to see how the mesh is modified.

Points near the joints cause problems.

Although we already know a way to solve problems related to points near the joints, let's do it once again so that we can analyze what actually happens to the mesh when the fidelity is changed. So, make sure the skeleton primitive is selected and activate the function Modify/Properties/Skeleton Attrs. Set the fidelity for all joints to 50 % and click Ok. Hit the 'u' key and you should see something like the following figure.

When fidelity is set to 0 %, position for each point is determined only by one bone of the skeleton i.e. all points attached to a certain bone are treated equally. The higher the fidelity the more the position of the point in question is also influenced by the next and the previous bone.

The 'fidelity' scroll bar in Modify/Properties/Skeleton Attrs. dialog allows you to define fidelity separately at each joint. But what if one needs more accurate control over fidelity? Say, one would like to define higher fidelity only for one point.

Real 3D also supports 'pointwise' fidelity i.e. the fidelity attribute associated with each bone can be overriden by a value associated with a target object. If the target object is a freeform mesh, a line or a triset, the fidelity attribute is actually associated with all points comprising the target object.

The check box 'Fidelity from targets' determines whether the fidelity is fetched from the target objects or from the skeleton.

Let's try this. Make sure the skeleton primitive is selected and activate the function Modify/Properties/Skeleton Attrs. Check the 'Fidelity from targets' check box and click Ok.

Refresh the animation system by hitting the 'u' key. This causes all the fidelity to be lost. The reason for this is that we switched the 'fidelity from target' option on and the default target fidelity is 0 %.

So, let's change the fidelity for all those points that are near the joints. Now, select the mesh and hold down the shift key while dragging points from it. When all the desired points have been selected, activate the function Modify/Freeform/Fidelity and enter the value 50 %.

Refresh the animation system by hitting the 'u' key and the fidelity effect is back.

Hierarchical skeletons

v3samples\ skelbody.prj

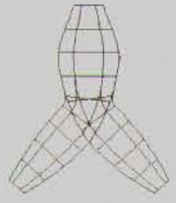
In this example, we will go through the idea behind hierarchical skeletons i.e. what they are and how they work in practise.

A hierarchical skeleton is a skeleton which contains one or more child skeletons. A good example of a hierarchical skeleton system is an arm and five sub skeletons, fingers.

Another example is a spine and its two sub skeletons, legs.

So, let's try this in practise by creating a simple body. We have created a suitable body just for this example. The body can be found in the objects directory as 'body.obj'. So, load it in by using the function File/Objects/Insert.

So, a 'body' object was loaded. Make the body the current working level by double clicking its name on a select window, and then multiselect both the meshes.



Then select the menu Animate/Create/Skeleton and draw a three point yyskeleton representing the spine as shown in the figure below.

Note that we have to multiselect both the meshes. The reason for this is that then and only then the skeleton system treats the points of the freeform objects as individual objects. If you applied the 'Skeleton' function to the level containing the meshes, it would have been treated as a solid single object and the skeleton would have never been able to bend it.

Now it is time to create skeletons for the legs. So find the SIMPLE SKELETON method. It should contain one skeleton primitive i.e. the spine we just created. Select it and rename it as 'spine'.

Now, make the spine skeleton the current level by double clicking its name on a select window. In other words, sub skeletons are created inside the parent skeleton level just like meshes representing the body were created inside a level object named 'body'.

Then create two skeleton primitives by using the function Create/Controls/Skeleton. Both the skeletons should start from the second point of the spine and correspond the legs of the body. Use dragging to get an exact match and notice how constraints are defined relatively to the bones of the spine. Rename the skeletons as 'leftleg' and 'rightleg' to reflect their purpose.

A spine and two sub skeletons i.e. legs.

Now our hierarchical skeleton system is ready. Make sure that the skeleton matches properly the b-spline body by observering it from other directions. If so, refresh the animation system by hitting the 'u' key.

The skeleton is now attached to the body and we can try to modify the skeleton and see how the body behaves.

Note that in order to treat the hierarchical skeleton system as a whole, the parent skeleton must be selected. So, select the skeleton representing the spine and activate the function Modify/Special/Inverse Kinematic. Click near the ankle and move the mouse slowly down. When the leg gets its full stretch, it starts to pull down the spine and the other leg.

When done with inverse kinematics, hit the key 'u' and the body is modified accordingly.

Morphing skeletons

v3samples\ skelmorp.prj

Now that we have created a skeletonally controlled body, let's animate it by using morphing. If you have already deleted the body we created in the last example, it can be found as v3samples/skelbody.prj, so just load it in.

At this point, let's take a look at the hierarchical structure of the created object.

```
body
   level
      mesh1
      mesh2
      SIMPLE_SKELETON
         spine
            leftleg
            rightleg
```

Find the 'SIMPLE SKELETON' object and make it the current level.

Select the 'spine' skeleton and duplicate it by using the function Modify/Structure/Duplicate.

Now modify the duplicated skeleton by using the function Modify/Special/Inverse Kinematic.

Create a third key object by duplicating the modified skeleton and again use inverse kinematics to modify the last duplicated skeleton.

Three key skeletons

Select all the skeletons inside SIMPLE SKELETON method and activate the function Animate/Create/Morphing.

The object hierarchy should now look as follows:

```
body
    level
        mesh1
        mesh2
        SIMPLE_SKELETON
            spine
                leftleg
                rightleg
            MORPHING
                spine1
                  leftleg
                  rightleg
                spine2
                  leftleg
                  rightleg
                spine3
                  leftleg
                  rightleg
```

Play the animation and, as you can see, the skeleton is bending through the key skeletons you created, and the actual body is bending with it.

Surface method

v3samples/ rollcube.prj

The following examples demonstrate the new powerful 'surface' method. This method makes rotating, walking etc. objects automatically travel along surfaces.

The hierarchy syntax of a surface method looks like the following:

```
Root
    target
        SURFACE(SURFACE)
            gravity
            surface
            links
                link1
                link2
                ...
```

This perhaps looks complicated, but is not that difficult to use. Let's make a cube roll along a table.

1. Start a new project and create a new level called 'rotator'. Make it the current level.
2. Take a front view (View/Viewcam/Set XY). Create a cube.

3. Select Create/Controls/Offset. Drag a box around the top left corner to create an offset exactly at that corner. Duplicate the created offset and move it to the top right corner. Create two more copies and place them to the remaining two corners of the cube.
4. Multi-select the four offsets and select Create/Structure/Link; four links are created. We will need them later in another part of the hierarchy, so select Modify/Structure/Cut to cut them to the clip buffer.
5. Make root the current level. Select Create/Structure/Method and pick 'SURFACE' from the method list. Then click OK.
6. Make the created surface method the current level. As we see in the hierarchy diagram above, the first parameter defines the direction of the gravity. Select the menu Create/Controls/Axis and draw a vertical line pointing downwards. The length and position of it does not matter, onluy the direction.
7. Next we create the surface on which the cube travels. Take a top view, select Create/Visibles/Rectangle and draw a rectangle. Select Modify/ Properties/Attributes, check Infinite and click OK. Now the cube can safely continue rotating forever.
8. Take a front view and move the rectangle below the cube if it is not there yet.
9. Create a new level using Create/Structure/Level. Make it the current level.
10. Select Modify/Structure/Paste. The links which you cut in the step 4 above are pasted back to the hierarchy.
11. Now the surface method is finished. There is one more thing to do: the cube itself is still static. Go to the root level, select Animate/Create/ Rotation, select the 'Normal' and 'Periodic' options and click OK. Draw the rotation coordsys in the middle of the cube.
12. Find the rotation method from the hierarchy (it is inside the level 'rotator') and select it. Pick the menu Modify/Properties/Animation, check Frequency and enter a value of 5. Click OK.
13. Play the animation. The cube makes 5 revolutions and travels quite far away.

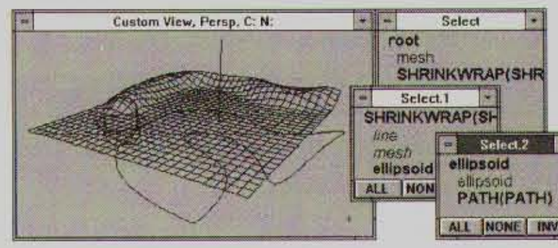
Other examples of this subject are:

- v3samples\surface1.prj A walking robot was created by using the sweep method. The surface method causes the walking robot actually move because of the friction between the floor and the feet of the robot. The friction points are placed into the feet of the robot.
- v3samples\surface2.prj Another surface method example. A walking robot goes upstairs. NOTE: Before playing this animation, set File/Windows/Animation/Frames to at least 120.
- v3samples\surface3.prj This is another 'place walking robot on the floor' example. However, one extra sweep method rotates the robot causing the robot to wander to different directions as if he couldn't make up his mind about the direction.
- v3samples\surface4.prj This one is quite crazy; a rotating 'thing' on a floor.
- v3samples\surface5.prj In this example, a walking robot was placed on a non-planar B-Spline surface.

Shrink wrapping

This example demonstrates the 'shrink wrapping' animation method. A sphere moves under a mesh deforming it.

1. We start the example by creating a sphere (Create/Visibles/Sphere).
2. Take a top view. Select the sphere and the menu Animate/Create/Path. Select for example the B-Spline, Closed, Periodic and Auto phase options. Click OK, and draw a path for the sphere on a view window.
3. Select Create/Build Freeform/Mesh. When the program asks the point count of the mesh, enter 20 * 20 points and click OK. Then shape a rectangular mesh covering most of the sphere and its path.
4. Take a front view and lift (Modify/Linear/Move) the mesh above the sphere.
5. Multi-select the animated ellipsoid and the mesh, and then pick Animate/ Create/Shrink wrapping from the menu. A dialog is opened; select 'Parallel' and 'Cumulative' options. Click OK. Now the program waits you to draw a line on a view window. The line will define the amount and direction of shrinking. Click in the middle of the mesh and draw a line downwards to the level of the middle point of the sphere.
6. Make sure that either undo is on or save the project at this point. Then play the animation. Animated, cumulative shrink wrapping cannot be played backwards to the original state, the shape changes are permanent.



Animated shrink wrapping

v3samples\ shrink1.prj

v3samples\ shrink2.prj

7. Use undo to restore the animation after the playback or reload it from disk. Let's experiment with non-cumulative shrink wrapping, too. Select the SHRINK WRAPPING method object from the hierarchy. Then select Animate/Edit and switch the cumulative option off. Replay the animation.

When using shrink wrapping, it is important to ensure that the density of the mesh to be shrunk corresponds the level of detail of the target object. Otherwise small objects may get through the mesh. A good trick is to surround the target object (a sphere in the example above) with another, bigger one, and make it RT-invisible so that it does not affect rendered images.

2. MENU FUNCTIONS

File/

Objects/Load

The function File/Objects/Load can also load 3D Studio files. The imported data is represented as triset primitives. Triset shading can be controlled with the Modify/Freeform/Type function.

Project/Insert Sections, Save Sections, Replace Sections

The sections dialog contains three new checkboxes 'Landscapes', 'Trees' and 'Rendering settings'. These controls can be used for saving and loading fractal and render settings libraries.

Materials/Window

Edge X/Y

Edge X and Y buttons give additional control of the texture gradient feature. Normally the Grade X/Y function interpolates the texture map color to the object color at the edges of the texture map. If Edge X is set, the gradient is computed inside the texture map, but the vertical edge appears sharp. Edge Y does the same to the top and bottom edges of the texture.

Freq X and Y

In previous versions of Real 3D, setting a non-zero Frequency value for a texture map made the texture appear the given amount of times inside the mapping, i.e. it made the texture map denser. This denser tiling was always finite.

Now you can enter a negative frequency value, which works in a similar way, to define the amount of repetitions inside the mapping geometry by taking the absolute value of the fields, but infinite tiling is used in this case. This has one immediate advantage: if, for example, a spherical mapping is used with a negative, non-default frequency, and either bump mapping or texture gradient is also used, then the 'seam' where the mapping reaches the full 360 degrees disappears, because the tiled texture sequence is repeated again over the seam.

Texture antialiasing

The texture antialiasing feature improves rendering quality, for example, when rendering infinite, chequered planes so the texture gets dense at the horizon where bad aliasing problems could arise.

Glow

The material editor now contains two new material properties: glow size and glow brightness. As the name indicates, these properties may be used to simulate glowing materials like fire, laser beams and coronas.

Glow size controls the width of the glowing area around the edge of the material. Glow brightness defines the intensity of the glow.

Glows are computed as a post processing effect. Therefore, in order to activate glow processing, you must use the Post effect editor of the Render Settings dialog to insert a 'Glow' effect to the post effect list. For further details, see the chapter 'Post effects'.

The RPL variables to control glow are 'gs' for glow size and 'gb' for glow brightness. Their values can be between 0 and 100. The variables can be set in Scope handler formulas and RPL procedures.

Depth scope handler

The 'Depth' scope handler limits the material scope in the 'z' (depth) direction to the interval specified by the 'a' and 'b' scope handler parameters. For example, if a=0 and b=0.1, a parallel mapping maps the material 0.1 abs. space meters deep into the target objects from the mapping rectangle level in the direction specified by the small peak. This handler may be used for example to map a texture onto one side of a cube only.

Angle scope handler

Another new scope handler is 'Angle'. It defines the scope of the material as a function of the viewing angle to the surface. The angle is described with a value between -1 and 1. The values -1 and 1 correspond to directions perpendicular to the viewed surface, and 0 corresponds to viewing along the surface.

The parameters 'a' and 'b' specify the range, inside which the scope is unchanged. Outside the interval, scope is set to zero. Typically, this handler can be used to create 'one-sided' textures. For example, a texture map on a rectangle can be set to paint only one side of the rectangle by selecting the Angle handler with a=0, b=1.1 (the extra 0.1 is to eliminate accuracy problems). If a is set to -1.1, and b is set to 0, then the opposite side will become textured.

Roughness bump handler

The roughness material property has also been removed. Instead, there is now a more flexible bump handler called 'Roughness' available.

The parameter 'a' defines the density of bumps on the surface. The smaller the value, the less bumps you get, and small values like 0.1 produce small amount of isolated bumps. If 'a' is left at zero, Real 3D uses a default value 1.0 automatically. This value creates a random bump on every position on the surface.

The parameter 'b' defines the height of the bumps. The default value, used when 'b' is left at zero, is 1.0.

Note: because of the removal of the original roughness parameter, the RPL variable 'ro' is no longer available.

Dither color handler

The Dither material property slider has been removed. It has been replaced by a more versatile color handler called 'Dither'.

The 'a' parameter defines the density of random color spots on the surface. The smaller the value, the less spots you get, and small values like 0.1 produce quite isolated spots. If 'a' is left at zero, Real 3D uses a default value of 1.0 automatically. This value creates a random spot on every position on the surface.

The 'b' parameter defines the intensity of the spots. The color of a spot is obtained by modifying the brightness of the original color randomly. The default value, which is used when 'b' is left at zero, is 1.0.

Note: because of the removal of the original Dither property, the RPL variable 'di' is no longer available.

Material color

A new color handler called 'Col.repl' is included. This handler uses values entered into the materials window transparent RGB fields to specify the color of a material. In other words, the color replaces any other color definition like object's color or color from a texture map.

For example, you may create a specular, reflective material called 'gold'. If you apply it onto a red object, the result is something shiny but red. If you use FromTran handler and define Transparent RGB to be yellow, the material makes the target objects yellow, which looks more like gold.

Relative texture coordinates

Relative bitmap-size independent texture coordinates have been implemented. They can be accessed from RPL and formula handlers with variables 'relx', 'rely' and 'relz'.

Relative coordinates have the following ranges:

Parallel mapping:
The Horizontal mapping edge corresponds to an interval of [0,1] in relx. The Vertical mapping edge corresponds to an interval of [0,1] in rely. Mapping plane normal whose length is the average of mapping edges corresponds to an interval of [0,1] in relz.

Cylinder mapping:
Circumference of the mapping cylinder corresponds to an interval of [0,2*PI] in relx. Axis corresponds to an interval of [0,1] in rely. Radial distance from axis to circumference corresponds to an interval of [0,1] in relz.

Sphere mapping:
Circumference of the mapping sphere corresponds to an interval of [0,2*PI] in relx. The arc between the poles corresponds to an interval of [0,PI] in rely. Radial distance from center to circumference corresponds to an interval of [0,1] in relz.

Disk mapping:
Circumference of the mapping disk corresponds to an interval of [0,2*PI] in relx. Radial distance from the center to the circumference corresponds to an interval of [0,1] in rely. The mapping plane normal whose length is the radius of the disk corresponds to an interval of [0,1] in relz.

Default mapping:
relx, rely, and relz are the absolute space coordinates.

Spline mapping:
relx and rely are the 'natural' surface parameters: the edges of the mesh correspond to an interval of [0,1] in relx and rely. relz is always zero.

New image formats
It is now possible to use PPM and JPEG images as texture maps.

Materials/Purge

This function scans the object hierarchy for SMAT tags (material references) and any materials not appearing after the scan are deleted. This means that any defined materials which are not currently in use by the project are removed. This is a convenient way to clean up a large project which has too many accumulated, and possibly duplicate extraneous materials.

Windows/ViewTool

This window can be opened by selecting File/Windows/ViewTool from the menu.

The window consists of a number of buttons which can be used to control creation and modification tools, such as 'Create/Visibles/Cube'.

The main purpose of this window is to allow faster access to the functions and provide greater functionality in the editing environment.

Buttons:

Create
Displays the next buffered action if it is the creation of a primitive found in the Create/Visibles menu. Clicking on this button opens a floating menu which duplicates the Create/Visibles menu.

Note: Implemented in Windows version only.

Modify
Displays the next buffered action if it is a modification as found in the Modify/Linear menu. Clicking on this button opens a floating menu which duplicates the Modify/Linear menu.

Note: Implemented in Windows version only.

Done
Completes the current phase of the creation process. For example, when creating a polymid, press this button, click on this button when all the points of the base polygon have been defined.

Cancel
Cancels the current creation/modification operation.

Undo
Removes the last point.

Open/Close
When creating a line or b-spline curve, this button toggles the curve between open and closed.

Angle
During the execution of Modify/Linear/Rotate, this button can be used to enter the angle (in degrees) of rotation. The button only becomes active after the rotational axis has been defined. When creating sector primitives, the open angle (in degrees) of the sector can be entered numerically. The button only becomes active when the first two points of the creation have been defined.

Position
Can be used to enter the coordinates of a point numerically.

Depth
When creating a primitive with depth (e.g. cube), this button opens a dialog where the depth can be entered in metres. This button is only active during the creation of a suitable primitive.

Outl. Depth
When creating a primitive which has a depth, this button allows the depth to be defined visually by drawing a line in a view window. This button is only active during the creation of a suitable primitive.

Center
This button places the next point in at the center of the points defined already in a creation process. For example, the second end of a cutcone can be defined to be centered over the first.

Example 1: Create a cube with a depth of 0.1:
- Select the function Create/Visibles/Cube
- Start cube definition by clicking once in a view window
- Click the 'Depth' button of the ViewTool window and enter the desired depth of the cube
- Complete the cube definition by entering the second point on a view window.

Example 2: Create a cone with a depth equal to the width of the previously created cube.
- Select Create/Visibles/Cone
- Define the center and radius in a view window.
- Click the 'Outl.Depth' button of the ViewTool window. This allows you to define the depth of the cone by entering two points in a view window. The distance between defined points will be used as a depth for the primitive to be created. So, drag two points from the previously created cube.
- Define the apex for the cone with a left mouse button click.

Example 3: Create a cylinder sector of 45 degrees:
- Select Create/Sectors/Cylinder
- Define center and first angle on a view window.
- Click the 'Angle' button of the ViewTool Window and enter the desired angle (45) degrees.

Example 4: Rotate objects 45 degrees:

- Select objects to be rotated
- Select the function Modify/Linear/Rotate
- Start rotating objects as usual by defining two points by clicking in any view window.
- Click the 'Angle' button of the ViewTool window and enter the desired rotation angle in degrees.

Example 5: Create a cone whose apex is positioned exactly at the center of the base circle.

- Select Create/Visibles/Cone
- Define the center and radius by clicking two points in a view window.
- Click the 'Center' button of the ViewTool window.

Example 6: Move objects exactly -0.5 space units along the 'x' axis.

- Select objects to be moved
- Select the function Modify/Linear/Move
- Start moving objects by clicking a point on a view window
- Click the 'Position' button of the ViewTool window. This opens a dialog which shows you the coordinates of the last clicked point. for example:

  X: 0.43 Y: -0.03233 Z: 0

Add '-0.5' to the X: field

  X: 0.43-0.5

and click OK.

Example 7: Create a cone whose apex is located precisely at the point (1,1,1):

- Select Create/Visibles/Cone
- Define the base circle as usual
- Click the 'Position' button and enter coordinates x=1, y=1, z=1.

Create/

Structure/Link

See Structure/Group below.

Structure/Group

The system of how groups and links find their targets is based on the tag 'SIDE'. The target of a link reference is determined by finding the first object with the same SIDE tag identifier, then searching from a minimal sub hierarchy containing both the link and the target. In other words, the target is first searched for in the same hierarchy level, then in its parent level and so on.

Duplicate identifiers usually don't cause problems because the object hierarchy determines how the references are resolved. For example, the RightLeg could be created by duplicating the LeftLeg:

```
Legs
    LeftLeg
        mesh SIDE=leg
        group SIDE=leg
    RightLeg
        mesh SIDE=leg
        group SIDE=leg
```

Problems may arise if a link and its target are duplicated into the same level as the originals:

```
Legs
    mesh1  SIDE=leg
    group1 SIDE=leg
    mesh2  SIDE=leg
    group2 SIDE=leg
```

In this case, both group1 and group2 refer to mesh1, although the intention has clearly been that group2 refers to mesh2.

If a situation arises where a link/group points to another target as intended, the problem can be solved by defining a new, unique SIDE tag for both the target and the link: select the link, then menu Modify/Properties/Tags, select the SIDE tag and change it, for example, to 'SIDE=noproblem', click OK, and then do the same for the target.

Structure/Method

The Create/Structure/Method dialog contains a new option 'Inherit', which is set by default. If the option is unselected, time modifications defined by the method are not inherited to successor methods, but are visible only inside the method. For example:

Hierarchy	Time lines
Root	PATH1 |----------|
cube	PATH2 |----------|
PATH1	
curve1	
PATH2	
curve2	

If the Inherit option is set and you modify the time line of the PATH1, PATH2 will be affected as well. If you don't want this effect, just reset the Inherit attribute for PATH1. Then you may modify the time line, phase, frequency etc. attributes of PATH1 freely without changing the behavior of PATH2 in any way.

The time inheritance feature is controlled by the tag IINH, which can be associated with all animation methods. If the value of this tag is 0, time isn't inherited. If the tag is not zero or missing, time is inherited.

For a list of new and changed methods, see the chapter 3 about the Animation system.

Controls/Helix

Angles are now used for all 'high level' functions, such as Create/Controls/Helix. However, radians are still used internally, and all functions which directly reflect internal data structures (such as Modify/Properties/Tags) deal with radians.

Controls/Skeleton

A skeleton is a special purpose primitive, which can be used to control other objects in combination with the skeleton method.

A skeleton creation is started by selecting the Controls/Skeleton menu. It is defined by clicking the positions of desired amount of joints in a view window; a right mouse button click finishes the creation. During skeleton creation, initial angle constraints of joints are also defined. An angle constraint appears as a triangle at the beginning of the bone; the bone can be bent only so far that the previous bone stays inside the sector defined by the triangle. The angle constraints of the first bone can't relate to a previous bone, so they are defined in absolute space, unless you are creating a sub skeleton. In this case, the constraints are defined in relation to the end of the nearest bone end of the parent skeleton.

When the skeleton has been defined, the skeleton attributes dialog is opened.

The skeleton attributes dialog

The dialog includes controls for joint names, frictions, fidelity, angle constraints and bone orientation. The controls are:

Skeleton type

If the type of a skeleton is 'Free', the whole skeleton will be moved if inverse kinematic requires the skeleton to reach further than its length allows.

Name

The dialog displays a list of joints. When you select a joint from this list, its name appears in the name edit box. You can rename a joint, for example, to call a middle joint of a 3 point skeleton 'elbow'. This helps to identify it quickly later. By default, the first joint (the point you clicked first when drawing the skeleton) is called joint 0. The end point of the skeleton has the highest ordinal number.

Friction

You can define a friction value for each joint of a skeleton primitive. If the value is zero in all joints and you pull the skeleton from the end point, the last segments of the skeleton are affected first, and inverse kinematics modification uses a minimal amount of segments to relocate the end point of the skeleton. If the value is greater than zero in all joints, all the skeleton parts become affected immediately. The maximal friction value 100 makes a joint rigid: the joint bends only if bending in other joints isn't enough for relocating the point modified by inverse kinematics. The friction is meaningless in three point skeletons, because there is only one point where the skeleton bends.

Fidelity

Fidelity can be used to control the orientation of skeleton targets with respect to the direction of the skeleton. The value of 0 causes the orientation of the target object to exactly match the orientation of the corresponding bone of the skeleton. The higher the value, the more the orientation is determined also by the next and previous bones of the skeleton. This can be used to simulate skin behaviour, for example, when using skeletons for character animations.

Note: the fidelity value of the last joint doesn't have any effect, because there is no bone starting from that joint.

Another way to control fidelity is to use the FSKF tag. FSKF defines the same 'fidelity' property as the value in the skeleton attributes dialog, but the tag defines fidelity for each target separately, thus allowing more accurate control. The value range of the tag is from 0 to 1, 0 corresponds to a situation where the orientation of the target follows the bone totally.

For example, a spline-modelled arm, subdivided into cross-sections (point groups) which are controlled by a SKELETON method can be made to bend smoothly at the elbow by adding the tag 'FSKF=0.5' to the cross-sections at both sides of the elbow joint.

Angle Constraints

Four angles are used to define constraints for each joint. **MinA and MaxA** define the minimum and maximum angles of a sector in the plane in which the skeleton was created; the bone starting from the selected joint can bend only inside the defined sector. The angle of 180 degrees corresponds to the direction of the bone which ends at the selected joint.

MinB and MaxB define another sector which is perpendicular to the MinA-MaxA sector. Together they define a rectangular space cone inside which the bone can move.

The constraint angles are defined interactively when the skeleton is created, and they may be adjusted later with the sliders in the skeleton attributes dialog.

Note: MinB-MaxB sector can't be defined during the interactive creation process, and therefore MinB and MaxB are both set to 180 degrees by default. This allows the skeleton to bend only in the plane in which it was created.

Sub skeletons

Skeletons can contain sub skeletons. When a sub skeleton is modified by inverse kinematics, the parent skeleton is also affected.

Hierarchical skeletons can be created exactly the same way as non-hierarchical skeletons: just set up the hierarchy, and when the animation is played for the first time, the target objects are automatically fixed to the skeleton.

Sub skeletons can be attached to any joint of the parent skeleton and the number of sub skeletons isn't restricted in any way. A hierarchical skeleton system is 'glued' together automatically when the animation is refreshed/played for the first time. The sub skeleton is attached to the nearest joint of the parent skeleton.

Note: the sub skeleton isn't pulled to the joint of the parent skeleton but remembers its original displacement. If an exact match is desired, use dragging to position the first point of the sub skeleton on the desired joint of the parent skeleton.

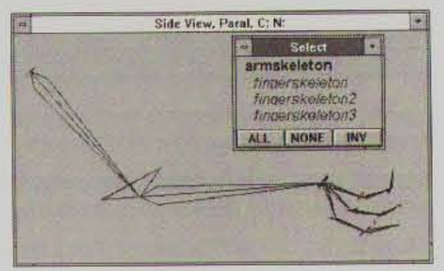
If the type of the sub skeleton is 'Fixed', the skeleton will always remain attached to the parent skeleton. If the sub skeleton is 'Free', it will be pulled away from the parent skeleton if the parent is fixed and the inverse kinematic requires the sub skeleton to reach further than its length allows. e.g. an arm can be made to leave the body in order to reach an object.

To modify hierarchical skeleton systems, the uppermost skeleton (root skeleton) must be selected.

When creating sub-skeletons, the constraints are automatically defined relative to the parent skeleton.

Example: Create a hand

- Create a skeleton to represent a shoulder, elbow and wrist.
- Make the created skeleton the current level (double click the name of the skeleton in a select window).
- Create five sub skeletons to represent the fingers. Note how constraints for the first joint are defined in relation to the parent skeleton.
- Select the 'shoulder-elbow-wrist' skeleton (the parent skeleton of fingers) and apply Modify/Special/Inverse Kinematics to the wrist.



A hierarchical skeleton.

Fractals/Landscape

Settings defined in the Landscape dialog can now be saved and loaded. The system is similar to material or grid handling. In other words, You can create a list or a 'library' of fractal settings. The File/Project/Save Sections dialog contains a checkbox 'Landscape', which can be used to save landscape libraries separately to disk. File/Projects/Insert, Replace and Save automatically load and save the contents of landscape libraries.

To create a collection of fractal settings:

Use the Fractals/Landscape function to experiment with parameters. When you get a suitable result, enter a name into the name edit box of the landscape dialog and press the Save button. This adds a new entry to the memory resident landscape library. Then continue experimenting, and whenever you get a good result, give it a new name and hit Create to store the parameters.

You can retrieve settings of a previously created landscape by pressing the Load button and by selecting the desired entry from the list. The Delete button allows you to remove entries from the landscape library.

When an appropriate landscape collection has been defined this way, select the menu File/Project/Save sections, clear all sections except 'Landscapes' from the section selector, click OK, then define a suitable file name to store' the collection with the file selector.

You can reload a landscape collection with, for example, the File/Project/Insert Sections function. Remember to check 'Landscapes' when using this function.

Fractals/Tree

The procedures to create, save and load fractal tree collections is similar to fractal landscape handling as described in the Fractals/Landscape section, but use the Fractals/Trees menu for tree creation, and when loading and saving tree libraries, use the Fractal Trees box in the project load and save sections selectors.

Modify/

Properties/Attributes

The Modify/Attributes dialog has a new checkbox 'Bounding Box'. Checking it replaces the wire frame representation of selected objects with a bounding box, which draws much faster. If the selected object is a level, then a single bounding box which surrounds the entire level is created.

Properties/Animation

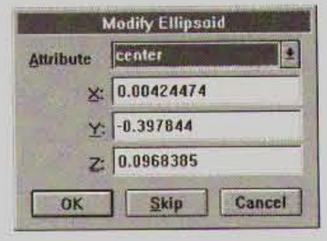
See Create/Structure/Method for information about new attributes.

Properties/Skeleton Attr.

See Create/Controls/Skeleton menu in this appendix for a detailed description of skeleton attributes.

Properties/Geometry

This function opens a dialog which can be used to view and edit the geometric properties of primitives. Absolute space units (meters) and degrees are used.



The geometry dialog

To use this function, select primitives and select this menu. This opens a dialog displaying a list of the geometric attributes of the first selected primitive. You can select the attribute you want to modify from the list and change its value using the XYZ fields. Clicking OK confirms the modification and the function proceeds to the next selected primitive. Pressing 'SKIP' ignores modifications of the currently displayed primitive and the function proceeds to the next primitive. CANCEL stops the function.

When a primitive type which may include a variable amount of point data is modified, the dialog displays either one 'U' slider or two 'U' and 'V' sliders. With these sliders, you can select the point to be modified.

Example: to move a sphere to a new position, say x=0.5, y=0, z=0:

- Select the sphere
- Select the function Modify/Properties/Geometry
- Select the attribute 'Center' from the attribute list and enter the desired coordinates for the center point.

The primitive type specific attributes which can be modified with this function, are:

Rectangle:
- depth - 'dvect' vector (direction and size)
- p0, p1, p2 - three points defining a rectangle

Cube:
- depth - extrusion vector
- p0, p1, p2 - three points defining the base

Pyramid:
- apex - position for apex
- p0, p1, p2 - three points defining the base of the pyramid

Ellipse:
- depth - 'dvect' vector
- center - center
- a, b - axes

Cone:
- apex - the top of the cone
- a, b, c - axes
- p, m, n - point p and two vectors m,n define a plane which cuts the infinite cone to a finite solid (m cross product n is the normal vector of this plane).

Ellipsoid:
- center - center point
- a, b, c - axes. If these are perpendicular to each other and have equal lengths, the shape is a sphere.

Hyperboloid, Cutcone, Cylinder, Ellipseg:
- center - center point
- a, b, c - axes defining a quadric
- p1, m1, n1, p2, m2, n2 - two planes defining the end faces.

Offset, Aimpoint:
- position - clear

Viewpoint:
- position - position of the camera
- horiz - horizontal 'tilt' direction vector
- direction - camera direction.

Coord.sys:
- origin - position
- a, b, c - axes

Line:
- p0, p1, ... pn - the points of the line

Spline:
- p[0,0], p[0,1], ... p[n,n] - control polygon points

Polygon:
- stick - 'dvect' boolean volume direction
- p[0], p[1], ... p[n] - the shape

Polyhedron:
- depth - Extrusion vector
- p[0], p[1], ... p[n] - the base shape

Polymid:
apex - the top
p[0], p[1], ... p[n] - the base shape

Cutpolymid:
base[0], base[1], ... base[n] - base points
top[0], top[1], ... top[n] - cover points

Triset:
p0, p1, ... pn - the points of the mesh

Properties/Fade

Real 3D's Rendering engine now recognizes a new object attribute 'Fade'. This attribute can be defined with the Modify/Properties/Fade menu or with the Tag editor. The attribute is stored as an integer tag 'IFAD nnn' where nnn is in the range between 0 and 255.

The Fade attribute makes an object translucent. The minimum value 0 doesn't affect the object at all, whereas the maximum value 255 makes the object completely disappear from the rendered image, as if it did not exist at all. Also, the object's shadows and reflections are faded.

The Fade attribute may be used for example to easily fade objects in and out in animations, by morphing the tag value. Using the fade attribute is different from using transparent materials:
- Translucency created by fade renders much faster than real 'optical' transparency.
- Fade has no refractions or reflections.
- 100 % full transparency can also be achieved with colored objects.

Special/Reflect

This function moves selected objects so their reflections will be seen on a surface at a position on the object surface pointed to with the mouse.

For example, when you want to move a light source to where it's specular highlight will appear in a certain position, select the light source, then select this function and click in the position where you want to have the center of the highlight. If the click doesn't hit any object, the light source will not move.

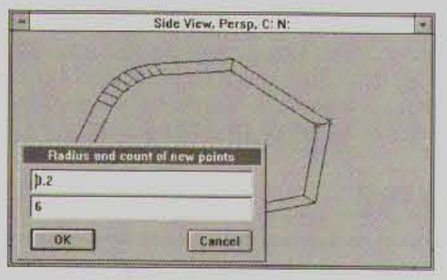
Freeform/Type

This is a useful feature when handling converted (imported) objects. The Modify/Freeform/Type dialog contains a 'Clockwise normals' option, which may sometimes produce better shading than the default automatic orientation method, which tries to set the face normal directions by checking the adjacent face normals. Which method is better depends on the modeller which created the object and the conversion software used.

Freeform/Round

The function Modify/Freeform/Round can be used to round polygonal lines, b-spline curves, polygons, polyhedrons, polymids and cutpolymids.

To use this function, select the desired points by placing them on the vector stack (drag around them while holding down the shift key). Then select the function Modify/Freeform/Round and define the rounding radius and the number of points to be used for rounding.



Rounding a polyhedron

Freeform/Convert to Triset

The Convert to Triset function converts the selected objects to trisets, which can then be exported to 3DS for example. Unlike the old 'Triset from mesh' function, this one is based on the real shape (B-Spline, quadric etc.) and can handle all kinds of objects.

Note: Boolean Operated objects are not yet supported. They are exported as if they were not operated at all.

Freeform/Surface to Groups

This function can be used to subdivide a mesh or a line to suitable sub groups. To use the function, select freeforms and then this function from the menu. Enter the size of groups to the U and V fields, and click OK.

When you modify lines with this function, the 'V' size is not used.

For example, you can subdivide a 8*8 pixel mesh to sixteen sub groups of 2*2 points each.

Freeform/Fidelity

Skin behaviour of freeforms controlled by skeletons can be defined using so called fidelity attribute, which can be attached both to skeleton joints and to skeleton targets. See the description of skeletons for details.

Freeform/Fidelity function defines the fidelity attribute for the selected points of the selected freeforms. To use the function, select some freeforms, then Shift-Drag some points (you can also use Lasso selector) and select this function from the menu. Define the fidelity value and click OK.

View/

Type/Surface

When this mode is set, 3D coordinates are automatically defined by mouse input. The mouse position is actually moving along object surfaces instead of along the input plane. This function is very powerful. For example, the Type/Surface function makes it easy to position objects accurately on freeform surfaces or blend B-Spline surfaces.

Camera/Camera View

Camera view is now updated interactively when you move camera objects provided the View/Camera/Camera View option is set and the window with camera view isn't the active one.

Previously, camera view was updated only during animation playing.

In this example, we will use two view windows. The camera object is modified through one view window, while another view shows how the scene looks through the camera.

- Open two view windows.
- Create a camera object with View/Camera/Define Camera.
- Set View/Camera/Camera View for the second view window.
- Modify the viewpoint or the aimpoint object through the first view window. The orientation of the second view is automatically updated while you move the mouse.

Render/Settings

Auto Box Rendering

The Render settings dialog contains an 'Auto Box Rendering' option. This switches on the new box rendering feature and tries to optimize the use of the processors internal cache memory. The higher the image resolution, the larger the time saving obtainable by this optimization. The speed improvement can be significant, especially on a PC, delivering up to twice the rendering speed. It should be noted that when rendering simple scenes to a disk file, the overhead of extra disk operations may actually slow rendering.

Interlace fields

The Render settings dialog contains a new control for field rendering. If the 'Interlace Fields' option is selected, Real 3D automatically interlaces every two fields into a frame which is saved, and then deletes the fields.

Super sampling

This is another new render setting. When this option is selected, the X- and Y-resolution fields define sampling density on sub-pixel level. Instead of rendering several pixels by one sample, which is the normal function of the X- and Y-resolution fields, several samples are taken from one pixel when Super sampling is selected.

For example, if super sampling is set and X- and Y-resolution are both two, the result is the same as if you rendered a 4 times higher resolution image and then scaled it afterwards by averaging each 4 pixel group into one pixel.

This feature can greatly improve image quality when the scene contains small details or dense texture maps. The disadvantage is slower rendering time: it takes almost four times longer to render an image with 2*2 super sampling.

Note: if you use super sampling to improve image quality, you may safely lower the normal anti-aliasing level. Typically anti-aliasing factor two is enough when super sampling is applied.

Alpha channel output in IFF file rendering

Iff rendering to a file with Alpha output selected now produces an 8 bit alpha file instead of 1 bit mask file.

JPEG support

It is now possible to render JPEG format images.

Saving and loading render settings

Render settings can be named, saved and reloaded in a similar way as grids, fractal settings and materials. You can define a memory resident collection of individual, named render settings, which may be saved to disk as a render settings library. Whenever you need good render settings, you can reload this kind of library and select a suitable entry from it instead of redefining the settings from scratch.

The render settings dialog contains a 'Name' edit box where you can define a name for the currently edited render settings. Pressing the Save button adds a new entry to the settings library. You can use the Load control to load previously defined settings back to the dialog. The Delete button is to remove entries from the library.

A render settings library can be saved to disk with the File/Project/ Save sections function if you check only the Render settings section. Settings can be reloaded with File/Project/Insert, Replace, Insert sections or Replace sections functions.

Pressing the OK button in the render settings dialog doesn't update previously loaded render settings. Use the Save button to write modified settings to the settings library.

Note: it is usually not necessary to define render setting libraries. Each view window includes its own render settings and when you save a project, the settings are saved with view windows. Render setting libraries are necessary when you intend to re-use carefully defined settings from other projects or want to copy settings from one view window to another one.

Post effects

Real 3D's post effect system makes it possible to build a list from 'post effect modules' which each manipulate the rendered image. This way, a variety of easily controllable, interesting effects can be added to images quickly.

Some post effects are computed automatically by Real 3D. You can add extra 'plug in' post effects to the program. This happens by placing a library which defines such effects into the 'Classes' directory in the Real 3D home directory. This way, the post effect library is automatically installed whenever Real 3D is started. Of course, the 'Classes' directory may contain several post effect libraries. It is also possible to open a new library without auto installation at program startup time with the File/ Windows/External Classes window. This window can be used to select and open extension libraries for Real 3D.

The render setting dialog contains a 'POST EFFECTS' button. This button opens a dialog where the post effect list can be constructed and edited. Each view window can have its own post effect list.

The post effect dialog

The Post effect dialog has two list boxes. The left one displays all installed post effect libraries. You can select a library from this list. If you then press the 'Create' button at the bottom left corner of the window, a new effect is created and inserted to the view window's post effect list. You may then edit its properties by pressing the 'Edit' button. This opens a new dialog, whose contents depends on the effect in question. See the effect library specific documentation for details.

The list selector at the right side of the window displays the post effect list created so far. You can activate a list item and edit it, or delete it with the 'Delete' button. The image which the renderer computes is processed by the effects in this list. The topmost effect receives the image data first, manipulates it, sends it to the next effect and so on. This means the order in which the effects are computed may have some importance. When you create a new effect, it is inserted after the currently selected effect. If none of the effects are selected (e.g. when the post effect dialog has been just opened), the newly created effect is inserted to the beginning of the list.

If a particular post effect has been inserted to the post effect list, but the corresponding effect library isn't opened when rendering starts, the effect will not be active. For example, this may happen if you send a project to another Real 3D user who doesn't have the same effect libraries installed on his/her system.

Glow

The glow effect processes glow size and brightness material properties.

Glow effect has two global attributes: an Additive option and a Fixed size option.

Additive:
When this button is set, the brightness of overlapping glow areas is combined to a higher brightness value. Additive glow usually creates a brighter glow effect, but sometimes strong glow brightness variance may be undesirable. Note also that additive glow makes the object to which it is applied brighter, so usually the color of the glowing object may be quite dark.

Fixed size:
When this option is set, the glow is computed as a 'camera effect', and glow size doesn't depend on glow source position, distance from camera or image scale. This kind of glow is slightly faster to compute than the default 'space volumetric' glow.

Distance anti-aliasing

Distance blur is a simple post effect, which can be used to improve anti-aliasing of distant objects. The effect smoothens the image output depending on the distance from the camera.

This effect has one attribute, 'Distance blur'. It defines the blurring sensitivity. The higher the value, the closer objects become blurred. A good default value is 30.

Render/Export DXF

This function exports polygonal objects and freeforms as surfaces in DXF format. Quadric primitives are exported as curve data corresponding to the wireframe representation.

Drawing Settings

The new, fast backdrop image blitting feature is enabled by the "Blt Backdrop" checkbox in the Drawing Settings dialog.

To use this feature, use the Render Settings dialog to define the Backdrop image file name. Set the "Blt Backdrop" checkbox in the Drawing Settings dialog. After that, Real 3D will draw the defined image in the view window before wireframe refreshes. The image is rendered in a similar way as the backdrop image is in ray trace rendering. In other words it is rescaled to match the dimensions of the view window.

This function can handle all kinds of images supported by Real 3D. If the display mode doesn't correspond to the image, conversion is applied.

The purpose of this feature is to allow accurate perspective matching, rotoscoping, etc.

Animate/

Create/Keyframe

Builds up a hierarchy required for keyframe animations:
- Creates a new level, and puts the selected object into the level.
- Creates a keyframe method
- Defines the first key to represent the current state of the selected object for the keyframe method.

Select the object to be animated before you activate this function. After you apply the function, you can continue by making the created keyframe method the current level and use the key editor (Animate/Edit) to define more key frames.

See the tutorials, Animate/Edit and chapter 3 'Animation system' for more information.

Create/Inverse Kinematic

Select a skeleton and then this function. Select suitable path options and draw a motion path for a joint. The function creates a new level, copies the skeleton into it and creates an inversed kinematics method with the defined parameter curve. The defined path is automatically associated with the nearest joint.

If you need to define more than one inversed kinematic curve, don't apply this function again to the skeleton, but make the newly created inversed kinematic method the current level and create more curves inside the method level.

Create/Skeleton

Builds a hierarchy where the selected objects are controlled by a simple skeleton method.

To use this function:
- Select the objects you want to control with a simple skeleton method.
- Pick the menu Animate/Create/Skeleton.
- Draw a skeleton primitive in a view window.
- Define suitable skeleton attributes in the opened skeleton dialog.

This function automatically maps targets which are freeforms onto the skeleton as one point sub groups. The purpose of this is to allow 'skin' like control of freeforms (usually some fidelity needs to be added to the points near the joints). If you want to control a freeform as a one single block, put it under a level object before you apply this function to the level.

The function doesn't immediately fix the targets to the skeleton. The targets become attached the first time the animation is played/refreshed. The reason the function operates in this way is to allow editing, fine adjustments of the defined skeleton primitive and definition of possible sub skeletons before the targets become attached.

Create/Shrink wrapping

This menu function creates an animated shrink wrapping effect. Use the function in the following way:
- Select the object, against which you want to shrink another object.
- Multi-select (keep the shrink target selected!) the object to be shrunk, for example a freeform mesh.
- Pick this function from the menu.
- A dialog is opened. Select the shrink wrapping type. If you use parallel shrink, you may also select the cumulative option. Click OK.
- Depending on the shrink wrapping type, Real 3D waits you to define some parameter information. If you selected cylindrical or spherical shrink wrapping, define first the shrinking center by a mouse click and then draw a line defining the amount of shrinking. If you selected normal or parallel shrink wrapping, just draw a line defining the amount of shrinking (and the direction in parallel wrapping).

Edit

You no longer have to select a animation method prior to using the function Animate/Edit. The function still attempts to open a method sensitive editing window, but if selected objects don't contain any animation methods, the key editor is opened instead.

For more information about the key editor, see chapter 3 of this appendix - 'Animation system.'

Extras/

Vectors/Deselect Group

This function removes any points from the vector stack which are also in selected groups when the function is used. The purpose of this function is to make it easier to subdivide complex freeform objects into sub groups so all points of the freeform object in question belong to one, and only one group.

Example: let's subdivide a B-Spline object into two separate groups:
- Load or create a b-spline object
- Shift-drag or lasso select some points of the B-Spline object and create a group with the function Create/Structure/Group.
- Now select all points from the b-spline object, for example by Shift-dragging. Make sure the previously created group is selected and then use the Deselect Group function.
- Select Create/Structure/Group. The new group contains all points except the points of the first group.

Repeat Last

The function Extras/Repeat Last re-executes (re-activates) the previously executed function. The hot key is '5'.

Show selected objects -hotkey

Selected objects can be shown in a view window as flashing wireframes by pressing the '0' hotkey on the numeric keypad. This key binding is built-in.

Settings/

Attributes

The Settings/Attributes function can now be used to define default names and depths for all objects. Sometimes this may be extremely useful. For example, if you are designing kitchen cabinets, it might be a good idea to set the initial depth of the cube primitive to 15, because 15 mm. is the thickness from which the kitchen cabinets are most commonly manufactured.

The changed primitive attributes can be saved with a project, or to an environment file (for example to startup.r3d), with for example File/Project/Save sections (Primitive Attributes section should be checked).

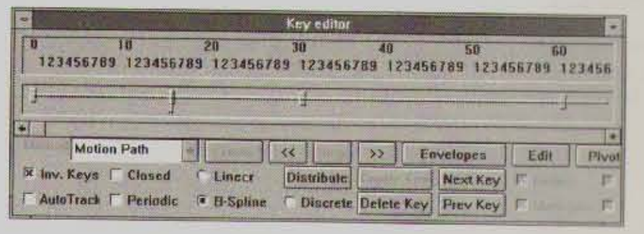
General

A "No RPL busy requester" checkbox has been added to Settings/General. If it is checked, no busy requester is opened when a named macro is executed, or when an RPL file is otherwise loaded.

3. ANIMATION SYSTEM

THE KEY EDITOR

Many of the new features have been integrated into the key editor window, which is opened with the menu Animate/Edit.



The key editor

The window consists of the following fields:

Frames:
It is now possible to move in time by clicking the desired frame number with the left mouse button.

Knot sequence:
This is the raised bevelled box just below the 'frames' field. It shows the knot sequence of the method currently being edited. In v.2, this was only used to control the morphing method. Now handles all path oriented methods and the new keyframe method.

Invisible:
This check box makes the method and any other objects within the method hierarchy either Wireframe Visible or Wireframe Invisible.

Auto Track:
This check box enables Auto scrolling within the key editor window during animation playback.

Close:
Closes the evaluation of a motion. For path animations, this is equivalent to applying the Modify/ Freeform/Open/Close function to the parameter curves.

Periodic:
Defines periodic evaluation, which makes closed motions smoothly repeatable. See Animate/Create/ Path/Periodic.

Linear/B-Spline/Discrete:
This defines the type of interpolation used.

Method:
This cycle gadget defines the method to be created. If the method is 'Transform', a time transformation is created and inserted at the beginning of the current level.

Create:
Creates a method defined by the 'Method' cycle gadget. The function is identical to items found in the Animate/Create menu.

Envelopes:
Opens the envelope editor. See the description later in this section.

Distribute:
Redistributes the knot sequence uniformly over the time and causes target objects to spend equal time between all subsequent keys/knots. This also handles closed motions appropriately.

Create Key:
This creates a new key object/knot point. If the method is keyframe or morphing, a new key object is created. If the method is one of the path oriented methods, a new knot point is created for the parameter curve.

Note: this function can only be applied when there is no key object/ knot point which corresponds to the current time.

Delete Key:
This deletes the current key object/knot point. This function can be applied only when the current time matches an existing key object/knot point.

Next:
Plays the animation to the next key-object/knot point. If the animation is played to the end, this button is disabled.

Prev:
Finds the previous key object/knot point.

<< STOP >>:
These buttons can be used to play the animation backwards and forwards, and to stop playback at any point.

Edit:
When editing keyframe or morphing methods, the 'Edit' button prepares the system for key editing. If the current time matches an existing key, this button selects the key so the modifications are performed for the correct object. If the time doesn't match any key, no keys will be selected and only the target object will become selected.

Pivot:
Selects the first object in the current level, and calls the Modify/Properties/ COG function, so you can redefine the COG with a left mouse button click. This is convenient when creating keyframe animations. The keyframe method rotates the target object around the COG (pivot) point.

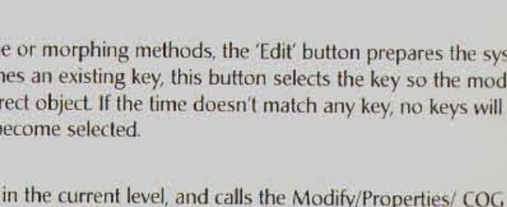
Whenever full rotation control is needed, it is best to define the pivot point, because the default pivot may not be suitable. The pivot point should be defined before the keys have been created, because otherwise, redefinition of the pivot may change the animation quite radically, requiring a lot of re-editing. The pivot point definition may be done conveniently with this button immediately after a keyframe method has been created with the Create button of the key editor.

To edit an animation method with the key editor, make the method the current level.

ENVELOPES

The envelope editor is opened by clicking the 'Envelope' button in the key editor window. Dimensions (x, y, z) can be switched on separately with X, Y and Z check boxes. The envelope editor shows envelopes of the current level, provided it is a path oriented or a keyframe method.

The envelope editor



+/- buttons on the right corners are used to change the minimum/maximum limits the envelope editor is displaying.

To modify an envelope, just click the desired 'knot point' and move it to a new position.

Note: you can't modify knots in the horizontal (time) direction. Use the key editor for this purpose.

While editing knot points, you can enter the position numerically in the 'Value' string gadget.

It's also possible to move more than one knot by dragging.

The 'Update' button updates the animation system so you can see the effect of the envelope modification in the actual scene.

Four envelopes are available for the keyframe method:

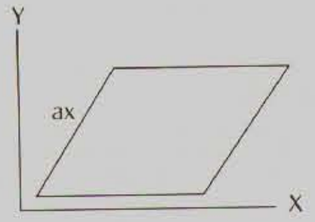
- Translate (move)
- Scale
- Rotate
- Shear (skew).

Translate shows the relative motion in object's space, i.e. how much the object is displaced from its original position.

Scale defines how much the size of the object is changed. A value of 1 means no change. A value of -1 means object is mirrored. A value of 2 means the size is doubled.

Rotate is expressed in degrees and is relative (it shows how much the object is rotated from its initial state).

The following figure shows how shear is defined.



Shear is defined by three angles:

ax – defines how much the 'y' component of the object is skewed towards the 'x' axis.

ay – y towards the 'z'

az – z towards the 'x'

The envelope window may also be used to modify paths of all path oriented methods such as:

- sweep
- size
- stretch
- inversed kinematics
- move
- direction

Only the translation envelopes of the abovementioned methods can be edited.

PATH ANIMATIONS

Polygonal and B-spline curves now contain so called 'knot sequence', which can be used to define how the time is distributed over the curve. In other words, you can define the frame in which the target object reaches each knot point of a curve.

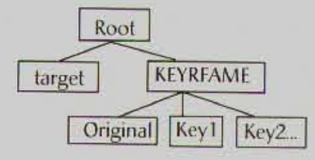
The key editor can be used to create path oriented animation methods and to edit knot sequences. A suitable animation method can be selected from the 'Method' list and the 'Create' button activates a method creation process, in which a curve is defined and drawn in a view window.

To edit a path method with the key editor:

- Open the key editor from the menu Animate/Edit. Make sure the path method isn't the current level, otherwise you will get a path edit dialog.
- Make the path method the current level.
- Next and Prev buttons of the key editor can be used to jump from one knot point to another.
- Create Key and Delete Key buttons can be used to create/delete knot points to/from motion paths.
- The timing can be adjusted by moving the knots along the time line.

KEYFRAME METHOD

The syntax for the keyframe method is as follows:



In other words, the shape of the 'target' is defined by applying a transformation to the 'original' object. The transformation is defined by interpolating a number of keyframe method specific tags associated with 'key1, key2, ...keyn' objects.

Four tags are used to store the required transformations to key objects:

VMOV – This tag defines how much the target object is displaced from the 'original' object in x, y and z directions.

VROT – This tag defines how much the target object is rotated in 'x', 'y' and 'z' directions.

VSCA – This defines how much the target object is scaled in its 'x', 'y' and 'z' directions.

VSHE – This defines how much the object is sheared (skew transformation).

IMIT tag defines whether to use linear, B-spline or discrete interpolation. The IFLG tag selects open/closed interpolation. See the morphing method description for more information.

The pivot point about which rotations are interpolated is defined by the COG of the original object i.e. the first parameter object of the keyframe method. The default COG value can be redefined by applying the Modify/Properties/COG function.

Note: the easiest way to create keyframe animations is to use the key editor, and normally you don't have to worry about the tags mentioned above.

To create a keyframe animation:

- Open the 'Key Editor' window by selecting the menu Animate/Edit. Set the 'Method' selector to 'Keyframe'.
- Select an object to be animated (or create it) and click the 'Create' button. This creates a keyframe system which consists of one key frame.
- To create more key frames, move to a desired position in time by clicking the desired frame, click the 'Create Key' button and modify the new key object.
- In order to modify other key frames, use the 'Next' and 'Prev' buttons to select the desired key. Note that these functions automatically select the target object and the correct key frame object, so you can instantly start editing the key.
- Only linear transformations (Modify/Linear menu) can be used to modify key objects. Functions such as 'Bend' and 'Twist' can't be used (use morphing, if you need non-linear transformations).
- If you want to edit a previously created key frame method, make it the current level and press the 'Edit' button.

MORPHING METHOD

The MORPHING_CLOSED method no longer exists. There is only one Morphing method available. Open morphing is used by default. Closed morphing can be selected by editing the method with the key editor (Animate/Edit), which contains a 'Close' button for this purpose.

Internally, the IFLG tag is used to define whether or not open evaluation should be used. If the first bit (value 1) is set, closed interpolation is used.

The morphing method recognizes a new interpolation type: discrete. The discrete interpolation changes the target object only at key frames. This could be used, for example, to create 'camera cut' effects. The tag IMIT defines which interpolation type is used. Possible values of the IMIT tag are:

0 - Linear interpolation
1 - Cubic B-Spline interpolation
2 - Discrete

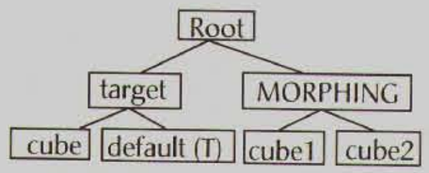
The interpolation type can be selected in the key editor.

Another improvement is that all tags are now morphed (light source brightness etc.). Furthermore, you can selectively morph geometry, color, tags and materials. This is controlled by the tag IFLG associated with the method object. Again, the key editor includes the necessary controls.

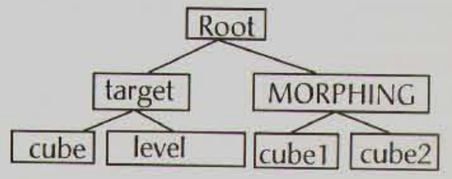
IFLG flag bits are:

0 - Set for closed, reset for open evaluation
2 - If set, materials are morphed
3 - If set, geometry is morphed
4 - If set, tags are morphed
5 - If set, object colors are morphed

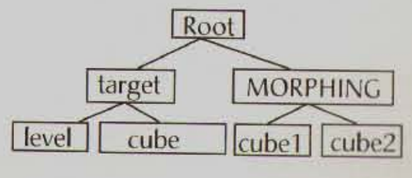
Depending on which data is selected by the abovementioned bits, the hierarchy of the target object and key objects need not match exactly. If geometry morphing is selected, then the primitives of keys and their hierarchical grouping must match the target object exactly, although there may be e.g. additional default mappings in the target object, because there is no geometry associated with that mapping type. For example, the following hierarchy is valid:



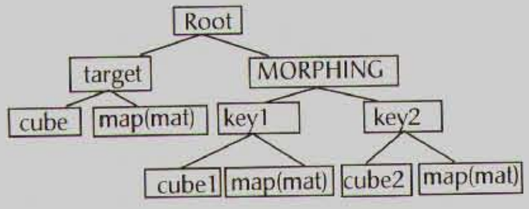
If color morphing is selected, the primitive hierarchy must match exactly, except there may be additional level objects at the end of hierarchy levels, because level objects don't contain color data. So this is again a valid hierarchy:



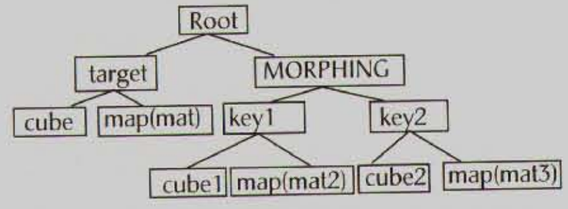
This doesn't work if either geometry or color morphing is selected:



Material morphing can usually be switched off, because if the keys are copies of the target object, all the mapping objects refer to the same materials in the material library, and morphing doesn't have any effect. So the only consequence of switching material morphing off is faster animation playback. For example, in the following hierarchy, all mapping objects 'map' refer to the same material 'mat':



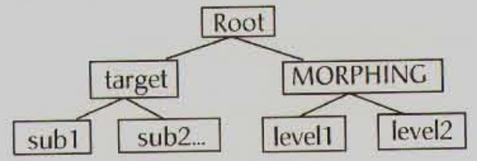
Morphing materials makes sense only if each of the materials is different, i.e. three separate materials mat1, mat2 and mat3 are used:



Tag morphing has no requirements for hierarchy matching. The animation system scans the hierarchy, picks objects according to their position in the hierarchy and morphs their tags. This process is continued until a key doesn't define the currently morphed target tag, i.e. a hierarchy difference is detected. A possible difference doesn't produce an error message, the rest of the tags of the target are just left unmodified.

Note: string tags (of the form Sxxx=...) can't be morphed.

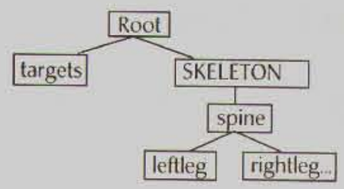
For example, tags of the root level of a compound object can easily be morphed as follows:



In this hierarchy, level objects 'target', 'level1' and 'level2' contain the tags to be morphed. Level1 and level2 can be empty levels. A useful application is morphing the fade attribute defined by IFAD tag this way.

SKELETON METHOD

The skeleton method handles hierarchical skeleton primitives. The actual syntax is exactly the same as in v.2.



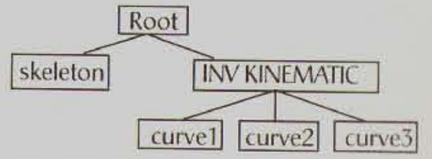
SIMPLE SKELETON METHOD

In this version, the simple skeleton method automatically maps target freeforms as one point sub groups onto the skeleton.

The parameter of a simple skeleton method may be a hierarchical skeleton.

INVERSE KINEMATICS METHOD

The inverse kinematics method can now take several parameter curves which are automatically attached to the nearest joints of the target skeletons.



The tag IIND, when associated with parameter curves of the inverse kinematics method, defines the joint to be affected by the curve in question. In addition to this, inverse kinematics also needs to know to which skeleton the joint index refers (thanks to the new hierarchical skeleton feature, the target skeleton may be hierarhical; in which case there are actually several skeletons). The SIDE tag is used for that purpose. For example, if 'curve1' should define a motion for the third joint of 'skel21' there should be the following tags associated with 'curve1':

IIND=2 (third joint, 0 is the last = default)

SIDE=xxx.x

and the tag 'SIDE=xxx.x' must also be attached to 'skel21'.

Note: these tags are defined automatically when the animation is played or refreshed for the first time. If you don't want automatic definition, add an ISKE=2 tag to the method before you play the animation. If you want the program to redefine these tags, delete the ISKE tag.

SURFACE METHOD

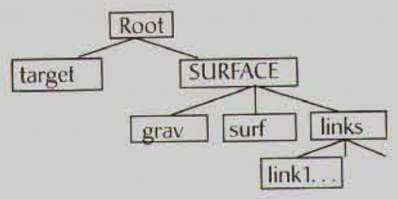
This new method is based on collision detection. The method makes an animated object automatically travel along a surface. The motion is generated by user defined 'friction points': the method doesn't let these points slide along the surface, but moves the target object instead.

The surface method takes three parameter objects:

1. Gravity:
This defines the direction for gravity. For example, you can draw an axis (Create/Controls/Axis) to define the direction. Note that this parameter may be animated so the direction of gravity doesn't remain the same.

2. Surface:
This represents the ground. This could be any object, such as a mesh surface.

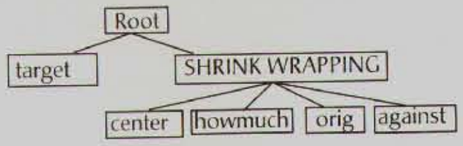
3. Links:
A level object which consists of a number of links. Links must refer to offset primitives in the target object. These offsets are taken as 'friction points'.



SHRINK WRAPPING METHOD

This method is the animated version of Modify/Special/Shrink wrap functions.

The syntax of cylindrical or spherical shrink wrapping is as follows:



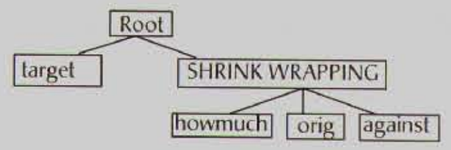
center - This can be any evaluable object (such as an offset or a curve) and defines the center for shrink wrapping. This corresponds to the first mouse click in the interactive shrink wrapping functions.

howmuch - This defines how much the object to be shrunk is 'scaled'. Normally, this should be an axis. The end points of the axis correspond to the second and third mouse clicks in the interactive shrink wrapping functions.

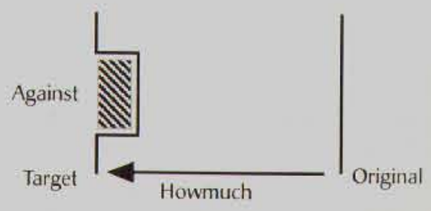
orig - This defines the 'original shape' of the target object. The hierarchical structure must match the target object exactly.

against - this corresponds to the first selected object in the interactive shrink wrapping. In other words, 'orig' object is shrunk around this object.

Parallel and normal shrink wrapping are animated with the following, slightly simpler hierarchy:



In parallel and normal shrinking, there is no 'center' object. The 'howmuch' curve just defines how much and in which direction the original object is moved.



There are two possible ways of shrinking: cumulative and non-cumulative. In cumulative shrink wrapping, the deformation caused by the shrink wrapping is assigned back to the original object. In non-cumulative shrink wrapping, the shape of the original object isn't affected and remains the same.

The tag ITRA is used to select the type of shrink wrapping:

50 - parallel
54 - cylinder
55 - sphere
45 - normal

If the tag isn't defined, parallel is used as a default.

The tag IFLG selects cumulative shrink wrapping:

0 - non-cumulative (default)
1 - cumulative

These tags are attached to the shrink wrapping method object.

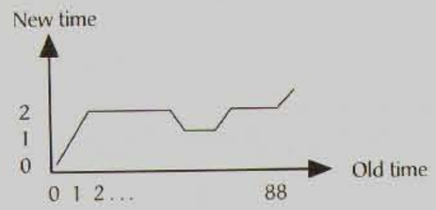
TRANSFORM METHOD

A Transform method can now be easily created from within the key editor. Just set the 'Method' selector to 'Transform' and click the 'Create' button. This creates a transform method with the necessary parameters: a coordsys and a b-spline curve. Then the envelope editor can be used to modify the default curve.

Note: the created transform method is inserted ahead of all the existing objects in the current hierarchy level, so the defined time transformation affects all objects in the current level.

There are currently two envelopes available for this method:

- Translate This shows the curve components in absolute space.
- Time This shows how the time is mapped to a new time. The old time is represented by the 'x' axis and the new time is represented by the 'y' axis.



Example:

Let's imagine the situation where a sphere moves along a straight line. Required accelerations/ decelerations are created by a transform method.

- Open the key editor by selecting the function Animate/Edit.
- Create a sphere and make it follow a path by setting the method in the key editor window to Path and click the Create button. Select 'Polygonal' from the path dialog and draw a straight, two point line as the path.
- Create a transform method by setting the cycle gadget in the key editor window to Transform and then click the create button.
- Open the envelope editor by clicking the Envelope button in the key editor window.
- Set the Envelope selector to 'Time' and modify the 'X' curve.

4. RPL

LOCAL VARIABLES

RPL now supports local variables (automatic variables). A variable is 'local' if it is defined inside a word definition.

```
: test
   VARIABLE tmp1
   VARIABLE tmp2

   10 tmp1 STORE
   ...
;
```

A local variable is visible and defined only inside the word in question.

PARAMETERS

Another new feature introduced by V3 is 'parameters'. Parameters are listed at the beginning of a word definition:

For example, the following word:

```
: TEST
   PARAM
      VARIABLE iAge
      VARIABLE aName
      FVARIABLE fMass
   ENDPARAM
   ...
;
```

can be called as

```
21 "Joanna" 65.5 TEST
```

NEW RPL WORDS

V3 contains a small but powerful set of words for manipulating windows, buttons and other display elements. In order to use these words, the file rpl/sys/ui.rpl must be loaded first.

Each word takes certain number of fixed parameters plus some optional tag-value pairs. A tag list must be terminated by UI_Done.

Also many other new RPL words have been included.

ADDMENU

SYNTAX aWord sName ADDMENU

DESCRIPTION Adds a new menu item to the menu strip. When the menu is selected, the associated RPL word is called.

If the name string contains the character '/', a new sub item is created. Otherwise a new menu item is created.

EXAMPLE This example creates a new menu item 'MyTools' consisting of two sub items: 'Fancy Tool' and 'Cool Tool'.

```
: myFancyTool
   "Fancy Tool selected" PUTS
;

: myCoolTool
   "Cool Tool selected" PUTS
;
& myFancyTool "MyTools/Fancy Tool" ADDMENU
& myCoolTool  "MyTools/Cool Tool"  ADDMENU
```

COMPARE

SYNTAX sFirst sSecond COMPARE iCmp

RETURNS The return value indicates the lexicographic relation of sFirst to sSecond, as follows:

iCmp < 0	sFirst is less than sSecond
iCmp = 0	sFirst is equal to sSecond
iCmp > 0	sFirst is greater than sSecond

PARAMETERS sFirst, sSecond - strings to be compared

DESCRIPTION Compares two strings lexicographically and returns a value indicating their relationship.

CS_DEFINE

SYNTAX vX vY vZ vOrigin CS_DEFINE

PARAMETERS vX vY vZ - Three axes defining the orientation of the coordinate system
vOrigin - Origin

DESCRIPTION Defines the current coordinate system for CS_ROTATE, CS_SCALE, CS_TRANSLATE and CS_TRANSFABS words.

EXAMPLE
```
0 0 0
1 0 0
0 1 0
0 0 1
CS_DEFINE
```

CS_ROTATE

SYNTAX 0 ... aObj vDir fAngle CS_ROTATE

DESCRIPTION Rotates objects about a given axis that passes through the coordinate origin. Rotation is applied in the current coordinate system.

O_GETSEL

EXAMPLE 1 0 0 90 CS_ROTATE

SEE ALSO CS_DEFINE

CS_SCALE

SYNTAX 0 ... aObj vScale CS_SCALE

DESCRIPTION Scales the given objects in the current coordinate system.

EXAMPLE
```
O_GETSEL
0.5 1 1 CS_SCALE
```

SEE ALSO CS_DEFINE

CS_TRANSFABS

SYNTAX 0 ... aObj CS_TRANSFABS

DESCRIPTION Modifies the given objects so that their object spaces will match the current coordinate system.

SEE ALSO CS_DEFINE

CS_TRANSLATE

SYNTAX 0 ... aObj vMove CS_TRANSLATE

DESCRIPTION Moves the given objects. The transformation is applied to objects in the current coordinate system.

EXAMPLE 0.1 0 0 CS_TRANSLATE

SEE ALSO CS_DEFINE

DATETIME

SYNTAX DATETIME iSec iMin iHour iMday iMon iYear

RETURNS Current date and time

DESCRIPTION Returns the current date and time as follows:

iSec	- seconds after the minute (0-59)
iMin	- minutes after the hour (0-59)
iHour	- hours since midnight (0-23)
iMday	- day of month (1-31)
iMon	- month (1-12, january = 1)
iYear	- current year

FCLOSE

SYNTAX aFile FCLOSE iSuccess

RETURNS 0 if FCLOSE succeeds

PARAMETERS aFile - pointer to a file

DESCRIPTION Closes the file opened by FOPEN.

FEOF

SYNTAX aFile FEOF iAtEof

RETURNS nonzero if at end of file, 0 otherwise

PARAMETERS aFile - pointer to a file

DESCRIPTION Returns a nonzero value after the first read operation that attempts to read past the end of the file. It returns 0 if the current position is not end-of-file.

FGETS

SYNTAX sString iMaxLen aFile FGETS iSuccess

RETURNS sString if FGETS succeeds, NULL otherwise

PARAMETERS sString - buffer for data to be read
iMaxLen - maximim number of characters to read
aFile - pointer to a file

DESCRIPTION FGETS reads a string from the file to the buffer. Characters are read from the current file position up to and including the first newline character, up to the end of the file, or until the number of characters read is equal to iMaxLen-1, whichever comes first. The result is stored in sString, and a null character is appended. The newline character, if read, is included in the string.

FOPEN

SYNTAX sFilename sMode FOPEN aFile

RETURNS Pointer to the opened file or NULL if failed

PARAMETERS sFilename - Filename
sMode - Access type

DESCRIPTION Opens the file specified by filename.

The sMode parameter specifies the type of access requested for the file:

"r"	Opens for reading only. If the file does not exist or cannot be found, the FOPEN word will return NULL.
"w"	Opens a file for writing. If the given file exists, its contents are destroyed.
"a"	Opens for writing at the end of the file (appending); creates the file first if it doesn't exist.
"r+"	Opens for both reading and writing. The file must exist.
"w+"	Opens a file for both reading and writing. If the given file exists, its contents are destroyed.
"a+"	Opens a file for reading and appending; creates the file if it doesn't exist.

When the "r+", "w+", or "a+" access type is specified, both reading and writing are allowed. When switching between reading and writing, there must be an intervening FSEEK operation. The following characters can be included in sMode to specify the translation mode for newline characters:

t
Open the file in text mode. In text mode, carriage-return-linefeed (CR-LF) combinations are translated into single linefeeds (LF) on input and LF characters are translated to CR-LF combinations on output. Also , CTRL+Z is interpreted as an end-of-file character on input. In files opened for reading/writing, FOPEN checks for a CTRL+Z at the end of the file and removes it, if possible. This is done because using the FSEEK and FTELL words to move within a file that ends with a CTRL+Z may cause FSEEK to behave erratically near the end of the file.

b
Open the file in binary mode. The translations are not carried out.

FPUTS

SYNTAX sString aFile FPUTS iSuccess

RETURNS a non-negative value if FPUTS succeeds

PARAMETERS
- sString - string to be written
- aFile - pointer to a file

DESCRIPTION Writes the string to the file.

FREAD

SYNTAX sBuffer iSize iCount aFile FREAD iRead

RETURNS number of items fully read

PARAMETERS
- sBuffer - buffer for data to be read
- iSize - size of one item
- iCount - number of items to be read
- aFile - pointer to a file

DESCRIPTION Reads up to iCount items from aFile file to sBuffer. Each item is of length iSize.

FSEEK

SYNTAX aFile iOffset iOrigin FSEEK iSuccess

RETURNS 0 if FSEEK succeeds

PARAMETERS
- aFile - pointer to a file
- iOffset - number of bytes from origin
- iOrigin - initial position

DESCRIPTION Repositions the pointer in a file. The iOrigin parameter can be any of the following:
- SEEK_CUR - current file position
- SEEK_END - end of file
- SEEK_SET - beginning of file

FTELL

SYNTAX aFile FTELL iPosition

RETURNS current file position

PARAMETERS
- aFile - pointer to a file

DESCRIPTION Returns the current file position.

FWRITE

SYNTAX sBuffer iSize iCount aFile FWRITE iWritten

RETURNS number of items written

PARAMETERS
- sBuffer - data to be written
- iSize - size of one item
- iCount - number of items to be written
- aFile - pointer to a file

DESCRIPTION Writes up to iCount items from sBuffer to aFile file. Each item is of length iSize.

LEN

SYNTAX sString LEN iLen

RETURNS The length of the string.

PARAMETERS
- sString - string whose length is to be measured

DESCRIPTION Returns the length of a string.

NCPY

SYNTAX sDest sSource iCount NCPY

PARAMETERS
- sDest - destination string
- sSource - source string
- iCount - maximum number of characters to copy

DESCRIPTION Copies the first iCount characters of sSource to sDest. If iCount is less than or equal to the length of sSource, a null character is not appended to the copied string. If iCount is greater than the length of sSource, the destination string is padded with null characters.

NCAT

SYNTAX sDest sSource iCount NCAT

PARAMETERS
- sDest - destination string
- sSource - source string
- iCount - maximum number of characters to append

DESCRIPTION Appends, at most, the first iCount characters of sSource to sDest. The initial character of sSource overwrites the terminating null character of sDest. If a null character appears in sSource before iCount characters are appended, NCAT appends all characters from sSource up to the terminating null

character. If iCount is greater than the length of sSource, the length of sSource is used in place of iCount. The resulting string is terminated with a null character.

NOISE

SYNTAX vPos fMin fMax fPower iOctaves NOISE vResult

PARAMETERS
- vPos - A parameter value for the noise function
- fMin, fMax - Clipping interval
- fPower - Defines variation speed. MUST be greater than 0.
- iOctaves - Level of detail of the noise. Must be greater than 0.

RETURNS vResult - A noise vector

DESCRIPTION A multi-purpose three dimensional noise function, which computes continouously and randomly varying vector value from the parameter vector. The parameter vPos can be any point in space. The result vector's x,y and z coordinate component values are always inside the range [0,1].

The 'Octaves' parameter defines the level of detail i.e. how many iterations of fractal noise is included in the result.

The fMin, fMax and fPower parameters define an output value filter for the result. The initial coordinate values of the computed noise are clipped to the interval defined by fMin and fMax and then rescaled back to the [0,1] interval. In practise this means that the smaller the difference between fMin and fMax, the larger constant value areas are created. Finally, the noise result components are raised to the power 'fPower'. The bigger the value, the more rapidly noise values change from one extreme to the other.

Good default values are for example:

- Octaves = 3
- fMin = 0, fMax = 1 (no clipping) or fMin = 0.3, fMax = 0.7 (some clipping)
- fPower = 1 (Linear variation speed) or fPower = 4 (rapid variations)

O_MAKENAME

SYNTAX aObj sName O_MAKENAME

DESCRIPTION Builds up a string consisting of a full object path name from the given object.

EXAMPLE
```
( print the name of the first selected object
400 STRING sName
O_GETSEL sName O_MAKENAME
sName PUTS
```

SEE ALSO O_FIND

PRJ_SETHOOK

TEMPLATE aHook PRJ_SETHOOK

PARAMETERS aHook - address of the RPL hook word

DESCRIPTION This words allows you to read and process input plane 3d coordinates directly.

The word sets a callback hook for all view windows. The hook procedure gets notification messages when the mouse is moved over any active view window or when a mouse button is pressed or released over a view window. The user must remove the hook when no longer needed. To remove a callback hook, call PRJ_SETHOOK with 0 as the callback address, i.e.

```
0 PRJ_SETHOOK
```

EXAMPLE
```
"ui.rpl" LOAD
100 STRING sBuf

: cbViewWindow
   PARAM
      FVARIABLE PosX
      FVARIABLE PosY
      FVARIABLE PosZ
      VARIABLE iEvent
   ENDPARAM
   UIWM_Move iEvent FETCH = IF
      PosX FFETCH PosY FFETCH PosZ FFETCH
      "View mouse pos %g %g %g" sBuf SPRINTF
      sBuf PUTS
   ENDIF
   UIWM_LMBDown iEvent FETCH = IF
      "View mouse button clicked" sBuf CPY
      sBuf PUTS
   ENDIF
   UIWM_LMBUp iEvent FETCH = IF
      "View mouse button released" sBuf CPY
      sBuf PUTS
   ENDIF
;
( set callback hook for view windows
& cbViewWindow PRJ_SETHOOK
```

REMOVE

SYNTAX sFileName REMOVE iSuccess

RETURNS 0 if REMOVE succeeds, -1 otherwise

PARAMETERS sFileName - name of the file to be removed

DESCRIPTION Deletes the file specified by sFileName

SCANDIR

SYNTAX sPaths sCallBack aData SCANDIR

PARAMETERS sPaths - paths to be scanned
sCallBack - name of the RPL word to be called for each file found
aData - any user specified data to be forwarded to the RPL callback

DESCRIPTION Scans the directories given in the sPaths parameter. For every file found the sCallBack RPL word is called. The directories in the sPaths parameter are separated by a semicolor (;). The callback function should leave a positive value on the stack to continue scanning. A value of 0 or a negative value terminates scanning. The callback function has two parameters, full path name of the file and the user specified data.

EXAMPLE VARIABLE count

```
: MyCallBack
   DUP FETCH 1 + SWAP STORE   ( add 1 to count )
   "File is " PUTS PUTS 10 13 EMIT EMIT
  1                           ( go on scanning )
;

"macro;rpl" "MyCallBack" count SCANDIR
count FETCH .
```

UI_WINDOW

SYNTAX ... aCallBack iLeft iTop iWidth iHeight sTitle UI_WINDOW aHnd

RETURNS Handle to the opened window or NULL if failed

FIXED PARAMETERS

aCallBack - Callback word for the window to be created
iLeft, iTop - Left top edge for the window
iWidth, iHeight - Size of the window
sTitle - String for the window title bar

TAGS None

DESCRIPTION Opens a window. Currently only the mouse events are reported to the callback. The callback takes the following parameters:


```
: cbWindow
   PARAM
      VARIABLE iEvent
      VARIABLE iMouseX
      VARIABLE iMouseY
   ENDPARAM
   ...
;
```

Callbacks must not return any values.

The iEvent parameter can be one of the following:

UIWM_Move (Mouse moved
UIWM_LMBDown (Left mouse button clicked
UIWM_LMBUp (Left mouse button released

iMouseX and iMouseY reflect the current position of the mouse.

UI_BUTTON

SYNTAX ... aWindow aCallback aLeft aTop aWidth aHeight sText UI_BUTTON aHnd

RETURNS Pointer to the created button or NULL.

FIXED PARAMETERS

aWindow - Pointer to the window created by using UI_WINDOW
aCallBack - Word which is called when the user clicks the button
iLeft, iTop - Left-top edge of the button in a given window
iWidth, iHeight - Size of the button.
sText - Text for the button.

TAGS UI_Disabled - 1 = disabled, 0 = enabled

DESCRIPTION Creates a button in the given window. When the user clicks the button, the word pointed by aCallBack is called. The callback doesn't take any parameters

```
: cButton
   "Button Clicked" PUTS
;
```

UI_CHECKBOX

SYNTAX ... aWindow aCallBack iLeft iTop iWidth iHeight sText UI_CHECKBOX aHnd

RETURNS Handle to the created checkbox

FIXED PARAMETERS
See UI_BUTTON

TAGS
UI_Disabled - 1 = disabled, 0 = enabled
UICB_Checked - 1 or 0 depending on the desired state of the check box.

DESCRIPTION Creates a checkbox. The default state is 'not checked'.

The callback is called with one parameter which defines whether or not the checkbox was set or reset:

```
: cbChecBox
   IF
      "Checked" PUTS
   ELSE
      "Not checked" PUTS
   ENDIF
;
```

UI_STRING

SYNTAX ... aWindow aCallback iLeft iTop iWidth iHeight sText UI_STRING aHnd

RETURNS Address of the created string gadget or NULL if failed

FIXED PARAMETERS
See UI_BUTTON

TAGS
UI_Disabled - 1 = disabled, 0 = enabled
UIST_String - String for the edit control

DESCRIPTION Creates a string gadget (edit control). When the callback word is called depends on the platform. In Amiga, the callback occurs when the user pressed either Enter or Tab in the string gadget. In Windows, the callback occurs when the user leaves the edit control (either by using the Tab key or by activating another control by using the mouse).

```
: cbString
   "The user entered the string: %s" PUTS
;
```

UI_TEXT

SYNTAX ... aWindow aCallBack iLeft iTop iWidth iHeight sText UI_TEXT aHnd

RETURNS Pointer to the created gadget

FIXED PARAMETERS
See UI_BUTTON.

TAGS
UITX_Text - Text to be displayed
UITX_Border - If 1, the text will be surrounded by a frame

DESCRIPTION Creates a 'read-only' text gadget.

NOTE Because this creates a 'read-only' gadget, the parameter 'aCallback' is unused and can be NULL. Also the general purpose tag UI_Disabled has no effect.

UI_SLIDER

SYNTAX ... aWindow aCallBack iLeft iTop iWidth iHeight sText UI_SLIDER aHnd

RETURNS Pointer to the created slider

FIXED PARAMETERS
See UI_BUTTON

TAGS
UI_Disabled - 1 = Disabled 0 on enabled
UISL_Min - Minimun value
UISL_Max - Maximum value
UISL_Level - Current value

DESCRIPTION Creates a slider. When the user plays with the slider, the callback is called with one parameter reflecting the current level of the slider.

```
: cbSlider
   "Current level=%d" PUTS
;
```

UI_MX

SYNTAX ... aWindow aCallback iLeft iTop iWidth iHeight sText UI_MX aHnd

RETURNS Address of the created gadget

FIXED PARAMETERS
See UI_BUTTON

TAGS
UIMX_Active - Currently active item
UIMX_Labels - Pointer array of strings terminated with null. For more information about how to create string pointer arrays using RPL, see rpl/ui.rpl.

DESCRIPTION Creates a 'Mutual Exclusive' gadget. The gadget consists of two or more choices and the user can select only one item at a time. In Amiga, the Cycle gadget is used. The Windows version uses 'Combo Box'.

The callback is called with one parameter which defines the ordinal number of the selected object.

```
: cbMx
   "You selected the item %d" PUTS
;
```

UI_DELETE

SYNTAX aHnd UI_DELETE

RETURNS None

FIXED PARAMETERS
aHnd - Address of the window to be deleted (closed)

TAGS None

DESCRIPTION Deletes the given window. All the gadgets created on the window will automatically be deleted as well.

UI_SETATTRS

SYNTAX .... aHnd UI_SETATTRS

RETURNS None

FIXED PARAMETERS
aHnd - Handle to the gadget to be manipulated

TAGS Possible tags depend on the type of the gadget.

DESCRIPTION This word is used for setting window and gadget attributes. The parameter list consist of a number of tag-value pairs defining attributes and new values for them.

For example, to change the current level of the slider to 10:

```
UI_Done
20 UISL_Level
aMySlider FETCH UI_SETATTRS
```

UI_GETATTRS

SYNTAX ... aHnd UI_GETATTRS

RETURNS None

FIXED PARAMETERS
aHnd - Handle to the gadget to be read

TAGS Tags depend on the gadget in question

DESCRIPTION This word can be used for reading attributes from the display elements. For example, to read the current value of the slider:

```
VARIABLE aStrPtr

UI_Done
aStrPtr UIST_String
UI_GETATTRS

aStrPtr FETCH "The user typed: %s" PUTS
```


UI_REALIZE

SYNTAX aHnd UI_REALIZE

RETURNS None

FIXED PARAMETERS
aHnd - Handle to a window to be realized

TAGS None

DESCRIPTION Displays all the created gadgets in the given window. The following example shows the basic structure of all GUI oriented programs:

```
( create a window
UI_Done ... UI_WINDOW aWnd STORE

( create number of gadgets
UI_Done ... aWnd FETCH UI_BUTTON aButton STORE
UI_Done ... aWnd FETCH UI_....
...

( Now the window is complete and must be realized
aWnd FETCH UI_REALIZE
```

A window needs to be realized only once.

CHANGES TO RPL SPECIFICATION

[&]

[&] word no longer exists. The word & can now be used everywhere where address of a word needs to be fetched.

SPRINTF

RPL word SPRINTF takes the parameters in a more natural order. e.g.

```
40 STRING temp
1 2 3 "one %d, two %d, three %d" temp SPRINTF
temp PUTS
```

now prints

```
one 1, two 2, three 3
```

not

```
one 3, two 2, three 1
```

as before.

PUTS

RPL word PUTS can now have a format string, e.g.

```
        "Hi there!" PUTS
prints
        Hi there!
and
        2 3 + "high %d" PUTS
prints
        high 5
```

A COMPLETE GUI PROGRAMMING EXAMPLE

```
( GUI EXAMPLE

"ui.rpl" LOAD ( This contains definitions required by gui words

( Define a new data type 'pointer array'. The PARRAY takes one parameter which
( defines the number of items in the array to be created.
( MX gadget requires string labels in this format. For example: 10 PARRAY
( creates array of ten items.

: PARRAY
     <BUILDS 4 * ALLOT DOES>
;

( This stores a 32 bit address to a given slot of the array. For example
( 555 2 PSTORE stores the value 555 to the third slot.

: PSTORE
     4 * + STORE
;

( Global variables for holding addresses of gadgets to be created

VARIABLE aWindow
VARIABLE aButton
VARIABLE aCheckBox
VARIABLE aSlider
VARIABLE aMx
VARIABLE aString
VARIABLE aText
```



```
VARIABLE aText2
VARIABLE aText3
100 STRING sBuf

( A general usage word which prints out a given string using aText2 gadget

: PrintMsg
   UI_Done SWAP UITX_Text aText2 FETCH UI_SETATTRS
;

( Callbacks for gadgets

: cbButton
   ( local variables
   VARIABLE aTmp
   100 STRING sTmp


   ( fetch a string from the string gadget
   UI_Done aTmp UIST_String aString FETCH UI_GETATTRS

   ( and print it out
   aTmp FETCH "Loading %s" sTmp SPRINTF
   sTmp PrintMsg

;

: cbCheck

   IF
        UI_Done  1  UI_Disabled  aSlider   FETCH   UI_SETATTRS
        UI_Done  1  UI_Disabled  aMx       FETCH   UI_SETATTRS
        UI_Done  1  UI_Disabled  aString   FETCH   UI_SETATTRS
        UI_Done  1  UI_Disabled  aButton   FETCH   UI_SETATTRS
   ELSE
        UI_Done  0  UI_Disabled  aSlider   FETCH   UI_SETATTRS
        UI_Done  0  UI_Disabled  aMx       FETCH   UI_SETATTRS
        UI_Done  0  UI_Disabled  aString   FETCH   UI_SETATTRS
        UI_Done  0  UI_Disabled  aButton   FETCH   UI_SETATTRS
   ENDIF

;

: cbSlider
   "Slider %d" sBuf SPRINTF
   sBuf PrintMsg
;
```

```
: cbMx
    "Mutual Exclude %d" sBuf SPRINTF
    sBuf PrintMsg
;

: cbString
    PrintMsg
;

( Callback for window

: cbWindow
    PARAM ( parameters )
        VARIABLE iEvent
        VARIABLE iMouseX
        VARIABLE iMouseY
    ENDPARAM
    UIWM_Move iEvent FETCH = IF
        iMouseY FETCH iMouseX FETCH "Mouse moved to %ld %ld" sBuf SPRINTF
        UI_Done sBuf UITX_Text aText3 FETCH UI_SETATTRS
    ENDIF

    UIWM_LMBDown iEvent FETCH = IF
        "Mouse button clicked" sBuf CPY
        UI_Done sBuf UITX_Text aText3 FETCH UI_SETATTRS
    ENDIF

    UIWM_LMBUp iEvent FETCH = IF
        "Mouse button released" sBuf CPY
        UI_Done sBuf UITX_Text aText3 FETCH UI_SETATTRS
    ENDIF
;

( create a window

UI_Done
& cbWindow 0 0 400 200 "RPL Example Window" UI_WINDOW aWindow STORE

( create a read-only text

UI_Done
"RPL gadgets" UITX_Text
aWindow FETCH 0 150 15 100 12 "Header Text:" UI_TEXT aText STORE

( create a check box

UI_Done
0 UICB_Checked
aWindow FETCH & cbCheck 100 30 50 12 "Check Box" UI_CHECKBOX aCheckBox STORE
```



```
( create a string gadget

UI_Done
"spline" UIST_String
aWindow FETCH & cbString 100 45 150 12 "String" UI_STRING aString STORE

( create a slider gadget

UI_Done
0   UISL_Min
100 UISL_Max
20  UISL_Level
aWindow FETCH & cbSlider 100 60 50 12 "Slider" UI_SLIDER aSlider STORE
( create a mutual exclude gadget

5 PARRAY aLabels

"Choice  1" aLabels  0  PSTORE
"Choice  2" aLabels  1  PSTORE
"Choice  3" aLabels  2  PSTORE
"Choice  4" aLabels  3  PSTORE
0           aLabels  4  PSTORE

UI_Done
2         UIMX_Active
aLabels   UIMX_Labels
aWindow  FETCH & cbMx 100 75 150 12 "Mx" UI_MX aMx STORE

( create a button gadget

UI_Done
aWindow FETCH & cbButton 100 90 150 12 "Button" UI_BUTTON aButton STORE

( This text gadget shows gadget events

UI_Done
"Welcome to RPL" UITX_Text
1 UITX_Border
aWindow FETCH 0 100 105 150 12 "Gadget:" UI_TEXT aText2 STORE

( window events are printed here

UI_Done
"This is cool" UITX_Text
1 UITX_Border
aWindow FETCH 0 100 130 250 12 "Info:" UI_TEXT aText3 STORE

( realize gadgets

aWindow FETCH UI_REALIZE

( END OF RPL EXAMPLE )
```

5. MISCELLANEOUS

COMPATIBILITY

The binary format of many data types of Real 3D has been changed, but the program can convert modified data items automatically. Version 3 can read all v2.x files. Version 2.x can not always read v.3.x files.

The major changes are:

- MORPHING_CLOSED method does not exist any more.
- The morphing method specific tags have been changed. Two new tags can now be associated with the morphing method:
  - IFLG (open/closed, selects also data to be morphed)
  - IMIT (Morphing Interpolation Type)
- Curves can now contain a knot sequence
- Fidelity added to bone description for C_SKELETON word.
- Freeform objects may contain skeleton fitting arrays.

The menu modifications mean that old RPL startup files are not fully compatible. If you have customized the RPL startup, take the modifications from the old file and add them to the file supplied with the new version. After that, verify that MENU word parameters match the new menu system.

The rendering engine algorithms have been modified, mainly for speed optimization reasons. This affects the image output. Therefore, do not render consecutive animation frames using different program versions, because even tiny changes may spoil the animation.

COMPARISON OF AMIGA / WINDOWS SPECIFIC FEATURES

This appendix and the actual Real 3D v.2.4 manual describe the version for Windows 3.1 and Windows NT platforms. The version for Amiga has almost identical functions. Nevertheless, there are some operating system specific features and differences, which are described in this chapter. See also the readme file of the Amiga version and the AmigaGuide help files for more information.

Installation

To install the Amiga version to hard disk, insert the disk 'Real3D_V3_Disk1' to a floppy drive, double click the 'Install' icon and follow the instructions. The full installation requires about 8 megabytes of hard disk space.

The installation procedure uses the standard Installer, (c) Copyright 1991-93 Commodore-Amiga, Inc. All Rights Reserved. Reproduced and distributed under license from Commodore.

Naming conventions

The File menu of the Windows version is called Project menu in Amiga.

The 'dialog' word is frequently used in the Windows environment instead of the word 'requester' which is more familiar to Amiga users.

Amiga's gadgets are often called as buttons, list boxes, edit boxes etc. in the Windows version.

Menu function differences

Project/Project/Insert Sections, Save Sections, Replace Sections
Amiga projects may contain multiple screens. Therefore, the sections requester contains an additional checkbox to control screen data IO operations.

Project/Materials/Window
In the Amiga version, some of the material window features can be accessed through menus, whereas the Windows version uses gadgets.

File/Materials/Material Select Window
The material select window which which allows material selection from preview images is not available in Amiga.

Project/Windows/View superbitmap

Project/Windows/View borderless

Project/Windows/View dbuffered
These are Amiga specific view window window types.

View_Superbitmap:
Open superbitmap View. This means the window can be moved over a much larger 'virtual' View using the scroll-bars at the bottom and right side. Objects can be created and modified, even rendered on any part of the superbitmap.

View_Borderless:
Open View covering the full screen. This has no visible borders and obscures the menu-strip. This window type is usually needed for rendering final images or animations where window borders are not desirable.

View_DBuffered:
Opens a double-buffered borderless View on a new screen. This enables wire-frame motion to be observed without seeing the intermediate drawing steps, so the image does not flicker. The new screen is always 4 color, 640 wide, maximum height and interlaced. This screen is a special private screen and no other windows can be opened on it. By default the View projection type is perspective.

Project/Windows/Animation
The automatic preview feature of the Windows version is not available.

In the windows version, you can select a view window to be saved using the 'Save' combo box. In the Amiga version, you can specify a screen to be saved with the following gadgets:

Screens & Saved
The list selector enables the one of the open Real 3D screens to be selected for saving to an IFF file after each animation frame. The name can also be typed directly into the Saved text gadget. If an external screen has been opened, then it can be selected and will be saved using the file settings selected with Project/External_Screen/Settings.

Save
If set, then the selected screen is saved to a file and Frame is incremented, after rendering of the current frame is completed.

Screen File
The name and path for the screen image files saved by the animation system.

In the Amiga version, it is possible to open the animation window to a separate screen. This is controlled by Settings/General/Anim. screen option.

Project/Windows/Palette
Opens a palette window. This is opened on its own private HAM screen. The Palette is used to control the R,G,B values of the current color and the 16 register color values. The current color is used whenever Real 3D requires a color value for a function e.g. Modify/Properties/Color.

The register colors give the user fast access to 16 different color definitions. Selecting one of the register color buttons makes the current color the same as the current value of the register color. The value of the register color is then changed using either the sliders or selecting from the color spectrum with the left mouse button. Holding the left button down while moving over the color spectrum changes the current color and the slider values continuously. There is no need to confirm these changes. The effects take place when the 'OK' gadget is pressed. It is also necessary to select the

settings required BEFORE using a function which uses the current color. If a Palette window is not currently open, then the last setting for the current color will be used.

Project/Windows/Screen

In the Amiga version, it is possible to use several screens at the same time. The screen window can be used to manage screens.

This opens a small window which enables control of the public screens used by Real 3D. It is opened automatically when a new screen is created to provide a 'handle' to the Real 3D menus, until other windows have been opened.

Gadgets of the screen window:

Default
Make active screen the default public screen.

Jump
Jump to next public screen. The control window will follow.

Close
Closes all Real 3D windows on the current screen then attempts to close the screen. If other windows prevent the closure, then a warning requester will be opened

Hijack
When enabled, windows and requesters opened for public screens will be hijacked and opened on the default public screen. This allows other applications which use public screens to be integrated into the Real 3D system. One possibility for this is to integrate a text editor for creating and editing the text for RPL.

Pop-to-front
When windows and requesters are opened on the default public screen, it will be brought to the front.

Project/Windows/Color Wheel

The standard color wheel window is also available in systems using Operating System v.39 or later. You can use it instead of the HAM palette window.

Project/Environment/Open screen

Open a new Real 3D screen using screen settings requester.

Project/Environment/Make Def. Pub.

Make currently selected screen the default public screen.

Project/Environment/Close screen

Closes the selected Real 3D screen.

Project/Environment/Close current

Closes any windows currently open on active screen and then attempts to close the screen. If other programs have opened windows on the Real 3D screen, then the screen cannot be closed and the user will be warned.

Project/Environment/Screen Palette

Opens a requester enabling the active screen colors to be changed. The screen register color to modify is selected from the color spectrum, then it can be adjusted using the RGB sliders. Two pre-defined palette definitions can be loaded by selecting either of the two button-gadgets. The 'COLOR SCALE' definition is used with Render Settings/'Color Shading'. Screen palettes are saved as part of the screens data section.

The screen palette requester contains two numerical gadgets. The purpose of the gadgets is to specify a range of palette entries to be used in greyscale shading. This way, the palette can be divided into two groups of colors: user interface colors and greyscale shading colors. The user interface colors can be freely modified without interfering the screen output quality.

The color range defined by the two gadgets is used when the GREYSCALE button is hit. Instead of spreading the greyscale gradient over the whole palette, only the colors within the range are modified. Also the greyscale rendering algorithms use colors in the range.

For example, you may set the 'Greyscale from' value to 4 and the 'To' value to 15 for a 4 bit plane (16 colors) screen. A press of the GREYSCALE button spreads the greyscale over the new range. After that, the first four colors can be modified to obtain a suitable user interface color combination.

Note: this feature is available only on screens opened by Real 3D. Note also that colorscale shading ignores the range definition, using all colors in the palette.

Environment/External screen

These functions enable a library for controlling an External screen, like a frame buffer, to be used. The sub menu items are:

Open
Open an external screen with its specified external screen library.

Close
Close external screen and its library.

Set_Modes
This function allows settings of an external screen to be modified. Not all libraries need this function, and so will not produce a requester.

Settings
Opens external screen requester allowing the user to select external screen library and file format.

Gadgets of the External screen requester:

Library	Name of External screen library.
IFF24	IFF 24 file format used.
TARGA	Targa file format used.
TARGA+A	Targa file format with alpha information used for saving.
CUSTOM	External screen's own format.

Save
Save image from external screen using format specified by settings.

Create/Build Freeform/Font curve extractor
The TrueType font extractor is not available in the Amiga version.

Modify/Properties/Color
The color of the selected objects becomes the RGB values of the current color. If the Shift key is held down when this function is activated, the modal color requester is opened and the color of the first selected object is shown.

Modify/Color
This menu and it submenues are available in the Windows version only. In the Amiga version, use Modify/Properties/Color to change the color of the selected objects.

View/Grid/Define
The grid requester of the Amiga version allows the user to define a 16 bit 'Pattern' value, which defines a bit mask for grid lines. This makes it possible to use dotted lines, etc.

View/Save Window
Not available in the Amiga version. Only complete screens can be saved using Project/Environment/ Save screen function.

Settings/View Window color
This menu does not exist in the Amiga version. Use the Project/Environment/ Screen palette function to set the background color (the first palette entry) to a desired value.

Tool/Icons
The Auto size option of the Windows version is not available.

INDEX

SYMBOLS

[&] 81
3DStudio files
  exporting to 3DS 47
  loading 33

A

Additive option (glow) 50
ADDMENU 68
Alpha channel output in IFF file rendering 49
Angle
  constraint of skeleton joint 40
  of helix 40
  of rotation 37
Angle scope handler 17, 34
Animate/ 52
Animation 18–32
  creating an animation, example 7
  rendering 10
  restoring after playback 32
Animation system 55–66
Animation window (Amiga/Windows) 89
Anti-aliasing 34, 50. *See also* Super sampling
Attributes
  geometric 44
  Modify/attributes dialog 43
  Settings/Attributes 54
  skeleton attributes 40
Auto Box Rendering 48
Auto Track 55

B

Backdrop image blitting 51
Blt Backdrop 51
Blurring sensitivity 51
Borderless view 89
Bounding Box 43
Brightness
  of glow 34, 50
Bumps
  density and height 34

C

Camera View 48
Canceling
  creation/modification operation 37
Center (view tool window) 37
Clockwise normals option (freeform type dialog) 46
Closed morphing 60
COG 60. *See also* Pivot (key editor)
Col.repl 35
Color
  dither color handler 35
  material color 35
  Modify/Color (Windows version) 92
  Modify/Properties/Color (Amiga version) 92
  morphing 61
  window color 92
COMPARE 68
Comparison of Amiga / Windows specific features 88
Compatibility 87
Controls/ 40–42
Convert to Triset 47
Create (key editor) 56
Create Key (key editor) 56
Create/ 38–43
Creating
  a primitive 36
CS_DEFINE 69
CS_ROTATE 69
CS_SCALE 69
CS_TRANSFABS 69
CS_TRANSLATE 70
Cumulative schrink wrapping 65

D

DATETIME 70
DBuffered view 89
Delete Key (key editor) 56

Depth
of a primitive 37
Depth scope handler 34
'di' Rpl variable 35
Discrete interpolation 60
Distance anti-aliasing 50
Distance blur 51
Distribute (key editor) 56
Dither color handler 35
Drawing Settings 51
DXF format
exporting in 51

E

Edge X/Y 33
Edit (key editor) 57
Editing animation 53
Envelope window 21
Envelopes 57
key editor 56
Export DXF 51
External screen (Amiga version) 91
Extras/ 53–54

F

Fade 46
animating 23
FCLOSE 70
FEOF 70
FGETS 70
Fidelity 41, 47
an example 26
File/ 33–38
Fixed
skeleton type 42
Fixed size option (glow) 50
FOPEN 71
FPUTS 72
Fractals 15
Fractals/ 43
Frames 55
FREAD 72
Free
skeleton type 40
Freeform 46–47
subdividing into groups 53
Freeform modelling
example 12–15
Freeform/ 51
Freq X and Y 33
Friction
of skeleton joint 41
FSEEK 72
FSKF tag 41
FTELL 72
FWRITE 73

G

General settings 54
Geometry
geometry dialog 44
morphing 61
Glow 34, 50
an example 16
Gradient. *See* Edge X/Y
Gravity (surface method) 64
Grid requester (Amiga) 92
Group 38
deselecting 53

H

Helix 40
Hierarchical skeleton 42, 63
an example 27
Hierarhical animations
an example 20

I

IFAD tag 23, 46, 62
IFF file rendering 49
IFLG tag 59, 60, 65
IIND tag 63
IINH tag 39
Image formats 36
IMIT tag 59, 60
Inherit option 19, 39
Installation (Amiga/Windows) 88
Interlace fields 48
Interpolation 56, 60. *See also* IFLG tag; IMIT tag
Inverse kinematics 52, 63
Invisible checkbox (key editor) 55

ISKE tag 64
ITRA tag 65

J

JPEG images 36
JPEG support 49

K

Key editor 18, 55
Keyframe animations 52, 59
an example 9, 20
Knot sequence 55. *See also* Distribute (key editor); Path animations

L

Landscape 43
LEN 73
Linear/B-Spline/Discrete (key editor) 56
Link 38
Links (surface method) 64
Loading
landscapes/ trees 43
render settings 49

M

Mapping 35
defining 8
Material 16–18
color 35
defining 8
morphing 61
Materials/Purge 36
Materials/Window 33–36
Menu function differences (Amiga/Windows) 88
Menu functions 33–54
Method
Create/Method menu 39
key editor 56
Modelling 10–16
freeform, an example 12
Modify/ 43–47
Modifying
a primitive 36
Morphing 60
an example 23
skeletons, an example 29

N

Naming conventions (Amiga/Windows) 88
NCAT 73
NCPY 73
Next (key editor) 56
"No RPL busy requester" checkbox 54
NOISE 74
Non-cumulative shrink wrapping 65

O

O_GETSEL 69
O_MAKENAME 74
Objects/Load 33
Outl. Depth 37

P

Palette window (Amiga version) 89
Parallel Shrinking 13
Path animations 59
an example 18
Periodic (key editor) 56
Pivot (key editor) 57
Pivot point 60
an example 22
Position coordinates 37
Post effects 17, 49
PPM images 36
Prev (key editor) 56
Project/Insert Sections, Save Sections, Replace Se 33
Properties/ 43–46
PUTS 82

R

Reflect 46
Relative texture coordinates 35
REMOVE 75
Render/Settings 48–51
Rendering
animation 10
Auto Box 48
IFF file 49
quality 34. *See also* Super sampling
time. *See* Auto Box Rendering; Super sampling
Repeat Last 54

'ro' RPL variable 34
Rotate (envelope editor) 58
Roughness bump handler 34
Round 47
  example 10

S

Sampling density 48
Saving
  landscapes/ trees 43
  render settings 49
Scale (envelope editor) 58
SCANDIR 76
Scope handler 34
Screen Palette 91
Screen window (Amiga version) 90
Settings/ 54
Shear (envelope editor) 58
Show selected objects 54
Shrink wrapping 53, 64
  an example 32
SIDE tag 38, 63
Simple skeleton method 63
Skeleton 40–43, 52
  an example 24
  method 63
  morphing, an example 29
SMAT tags 36
Special/Reflect 46
SPRINTF 81
STOP (key editor) 56
Structure/ 38–39
Sub skeletons 42
Super sampling 48
Superbitmap view 89
Surface coordinates 11
Surface method 64
  an example 30
Surface to Groups 47

T

Tags
  morphing 62
Texture
  antialiasing 34
  frequency 33
  gradient 33
  one-sided 34
Time
  inheritance 39
Transform method 66
Translate (envelope editor) 58
Tree 15, 43
Triset
  converting objects to trisets 47
  shading 33
Type
  of freeform 46
Type/Surface 47

U

UI_BUTTON 77
UI_CHECKBOX 77
UI_DELETE 80
UI_GETATTRS 80
UI_MX 79
UI_REALIZE 81
UI_SETATTRS 80
UI_SLIDER 79
UI_STRING 78
UI_TEXT 78
UI_WINDOW 76

V

Vectors 53
View/ 47–51
ViewTool window 36
VMOV tag 59
VROT tag 59
VSHE tag 59

W

Window color 92
Windows/ViewTool 36–38

REAL 3D V.3 Some highlights

Interface

- Several functions have been introduced to allow users easier access to commonly used functions.
- The view tool window provides quick access to object creation and modification tools.
- Object geometry can now be editited directly at any time. Points, depth, etc. can now be edited numerically through this new window.

Fast rendering

- The rendering engine has been improved and a new 'auto box' rendering mode introduced. On complex scenes this can reduce render time by half.

Pick at surface

- This is a new type of view mode, user can now draw curves on the surface of other objects. Using the new mode objects can be joined together with spline patches seamlessly or shapes extruded from a surface.

Background Blitting

- All view windows can have a full colour backdrop image in wireframe mode for rotoscoping, perspective matching, etc.

Post Processing Effects

- A new open interface for post processing has been included. Effects such as lens flares, glows, etc, can now be added to any scene. One of the included effects, Material Glow, allows the user to create all types of effects such as fire, laser beams, etc.

Animation

- The animation system has been extended, new methods include keyframing, drag, and shrink wrapping.
- The drag method allows easy creation of animation where objects need to 'walk' accross a surface. The user defines impact points on the object and REAL will 'walk' the objects across a given surface by those points.
- Animated shrink wrapping provides access to effects such as footprints in the snow. Any animated object can be moved across a mesh leaving an impression as it goes.
- Skeletons can now be nested allowing them to be branched. Constraints have been introduced so each join of a skeleton can be fully controlled by the user.
- Object fades. A new attribute 'fade' has been introduced allowing objects to have a transparency level which is independent to any materials. The fade level can be morphed allowing all kinds of effects to be created simply and quickly.

REALSOFT