

# Conoa 3D

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## Overview

Conoa 3D is an Adobe After Effects-style plug-in that allows 3-D geometric shapes to be placed in a true three-dimensional space and animated through the After Effects interface. The geometric shapes are rendered with a powerful raytracing engine. Raytracing is a method of computer graphics rendering that simulates a wide range of real world materials, such as metal or glass. Conoa 3D employs raytracing to produce images with reflection, refraction, specular highlights, texture mapping and more.

## Coordinate System

Conoa 3D employs a left-handed coordinate system. In a left handed coordinate system, if the thumb is aligned with the X-axis and the fingers are aligned with the Y-axis, then the palm faces in the direction of the Z-axis, which in this case points into the screen or page.

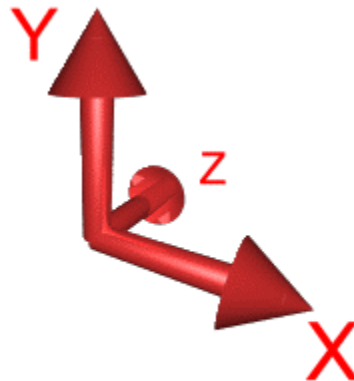


Figure 1 – Conoa 3D's coordinate system

The angles of rotation are similarly left-handed. By pointing the thumb in the direction of the axis of rotation, the fingers curl in the direction of the rotation. Figure 2 shows the angles of rotation with respect to the coordinate system.

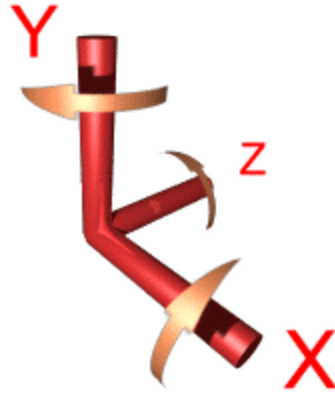
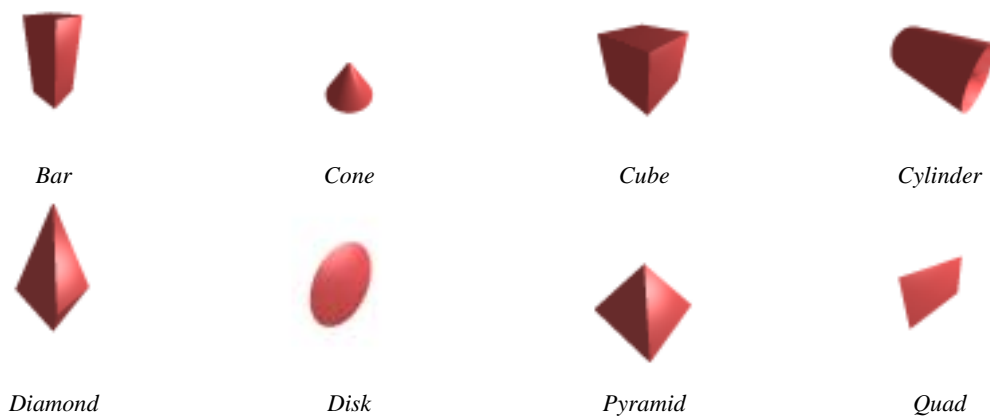


Figure 2 – Conoa 3D’s angles of rotation

**Note:** Conoa 3D’s coordinate system differs from the After Effects coordinate system in that Conoa 3D’s origin is centered in the composition window and the positive Y-axis points up. After Effect’s coordinate system has the origin in the upper left corner of the composition window and the positive Y-axis points down.

## Objects and Shapes

Conoa 3D supports twelve different geometric types. They are: bar, cone, cube, cylinder, diamond, disk, pyramid, quad, rod, sphere, triangle and video layer. The video layer is a shape that adjusts its aspect ratio to match that of the layer that has been set as its texture map. Conoa 3D supports six simultaneous objects on the screen at a time, and each object can be any of the twelve supported geometric types. Objects can be positioned and rotated independently, or the entire set of objects can be positioned and rotated using the position and rotation controls associated with the *World* group.





Rod



Sphere



Triangle



Video Layer

Table 1 – Conoa 3D’s supported shapes.

Each object can be sized with the width and height controls. The following table describes the effect of the width and height controls for each geometry type:

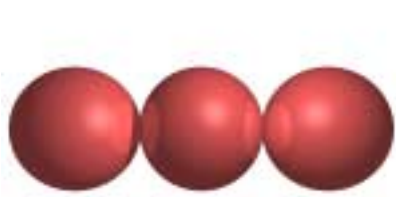
Geometry	Width	Height
Bar	Width and depth of bar	Height of bar
Cone	Radius of cone base	Height of cone
Cube	Width, depth and height	Unused
Cylinder	Radius of cylinder	Height of cylinder
Diamond	Width and depth of center	Height of pyramid
Disk	Radius of disk	Unused
Pyramid	Width and depth of base	Height of pyramid
Quad	Width of quad	Height of quad
Rod	Radius of rod	Height of rod
Sphere	Radius of sphere	Unused
Triangle	Width of triangle base	Height of triangle
Video Layer	Scaled size of video layer	Scaled depth of video layer

Table 2 – Effect of width and height controls on geometry shapes.

## Object and World Coordinates

Conoa 3D supports both object, also known as local, and world coordinates. Objects are able to be translated and rotated relative to their centers. Additionally, all objects, collectively known as the world, can be moved and rotated in unison. World translation and rotation is relative to the world origin, which, when the native camera is in its default position, is in the center of the composition window. World translation and rotation sliders are part of the *World* group of controls.

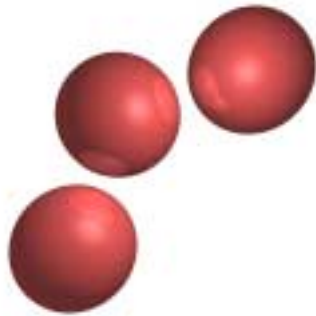
It is important to remember that these coordinate systems are hierarchical and the object coordinate systems are always relative to the world coordinate system. For example, if a world Z rotation of +45 degrees is set, then the up direction, or positive Y, for an object, relative to the world, would point to the upper left corner, assuming the default camera settings. The following images illustrate this.



Three spheres, *Radius = 3.0*



Middle sphere *Y Translate = 3.0*



Middle sphere *Y Translate = 3.0, World Z Rotate = 45.0*      Middle sphere *Y Translate = 6.0, World Z Rotate = 45.0*

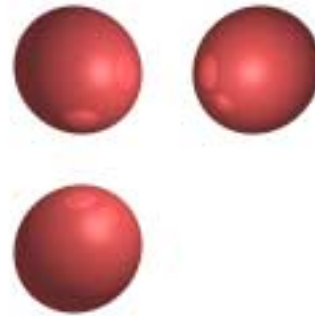


Figure 3 – Effect of world transformations on object coordinate changes.

## Camera

Conoa 3D supports two camera models: its own camera model and the camera model of After Effects 5.0. The control *Camera Source* chooses between the two models. By default, Conoa 3D's native camera model is used.

Conoa 3D's native camera model employs a spherical coordinate system. With spherical coordinates, two rotation angles and a distance from the center of the coordinate system define the camera's position. The camera's default position is along the negative Z-axis. *Camera Azimuth* rotates the camera around the Y-axis and *Camera Declination* rotates the camera around the X-axis. *Camera Radius* moves the camera towards or away from the origin. The camera is always pointed at the origin.

If the camera were to move freely, its motion would be in the shape of a sphere centered at the origin. The following figure is a depiction of that motion.



Figure 4 – A representation of the camera’s spherical motion. The arrows point in the direction of positive rotation.

Choosing *Use Comp Camera* for *Camera Source* selects the After Effects 5.0 camera as the source for camera location and orientation. Only camera position and orientation are currently supported.

**Note:** It is recommended that Auto-Orientation in the layer’s transform properties be set to ‘Off’, when choosing the After Effects camera model.

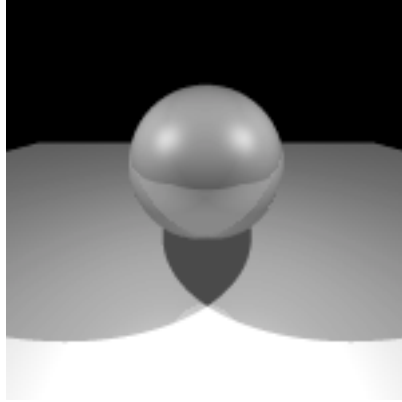
## Lights

Conoa 3D supports two types of lighting controls: its own lights and those of After Effects 5.0. In both cases, only point lights are supported. Conoa 3D’s own lights are automatically regarded as point light sources. When using After Effects 5.0’s lights, “Point” should be selected as the light type.

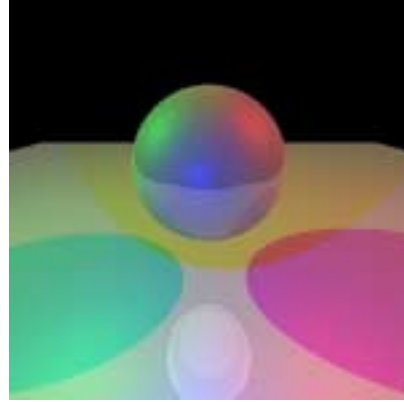
Conoa 3D supports one or two of its native lights. *Light 2 Toggle* will turn the second light on or off. Conoa 3D’s lights are always white and always cast shadows.

Choosing *Use Comp Lighting* for *Light Source* selects After Effects 5.0 lights as the lighting source. Conoa 3D supports the position, color, intensity and ‘casts shadows’ properties of After Effects lights. Additionally, Conoa 3D supports up to 10 layer lights. Only the first 10 layer lights in a composition will be rendered; the rest will be ignored. A user should use the lights of After Effects 5.0 if color is desired, or shadows are not.

In the following images, a gray sphere and quad are used to show the differences between Conoa 3D’s white lights and After Effects’ colored lights.



Conoa 3D's native lights

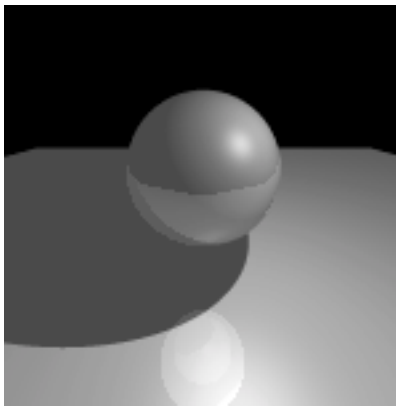


After Effects 5.0 lights

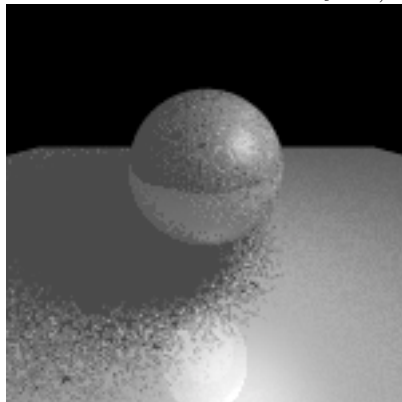
Figure 5 – Conoa 3D's lights vs. After Effects 5.0 lights

With the Conoa 3D lighting model, Conoa 3D supports area light sources. Area light sources produce soft shadows. The *Size* control sets the radius of light source. The larger the radius of the light source, the softer the shadow that is produced. A size of 0 produces a point light, which creates a sharp shadow. The *Light Supersampling Factor* controls how many shadow rays are used to calculate the shadow. The higher the sampling factor, the smoother the shadow gradient will be.

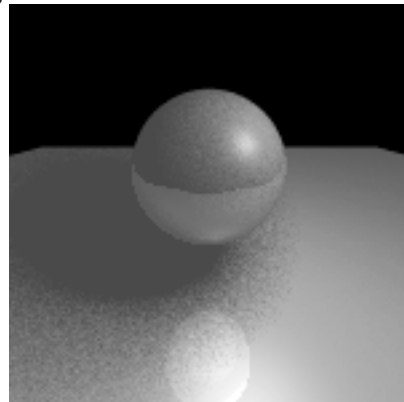
**Note:** Increasing the *Light Supersampling Factor* can drastically increase render times.



Size = 0, Light Supersampling Factor = 1



Size = 1.3, Light Supersampling Factor = 1



Size = 1.3, Light Supersampling Factor = 25

Figure 6 – Effects of Size and Light Supersampling Factor



## Material Properties

Conoa 3D's material parameters define the visual characteristics of the surfaces of the objects. *Ambient Light* defines the amount of ambient light reflected off the surface. Ambient light is the background light of the scene, and is not dependent on either the position of the light source or the viewer. *Diffuse Light* defines the amount of diffuse light reflected off the surface. Diffuse light is light from the light source that is reflected off the surface. It is not dependent on the position of the camera. *Specular Light* defines the amount of specular light reflected off the surface. Specular light is usually seen as highlights on a surface and is dependent on the position of both the light and the camera. It is usually described as the 'shininess' of the surface. *Opacity* defines the opacity of the surface. The following figures show examples of different material parameters.

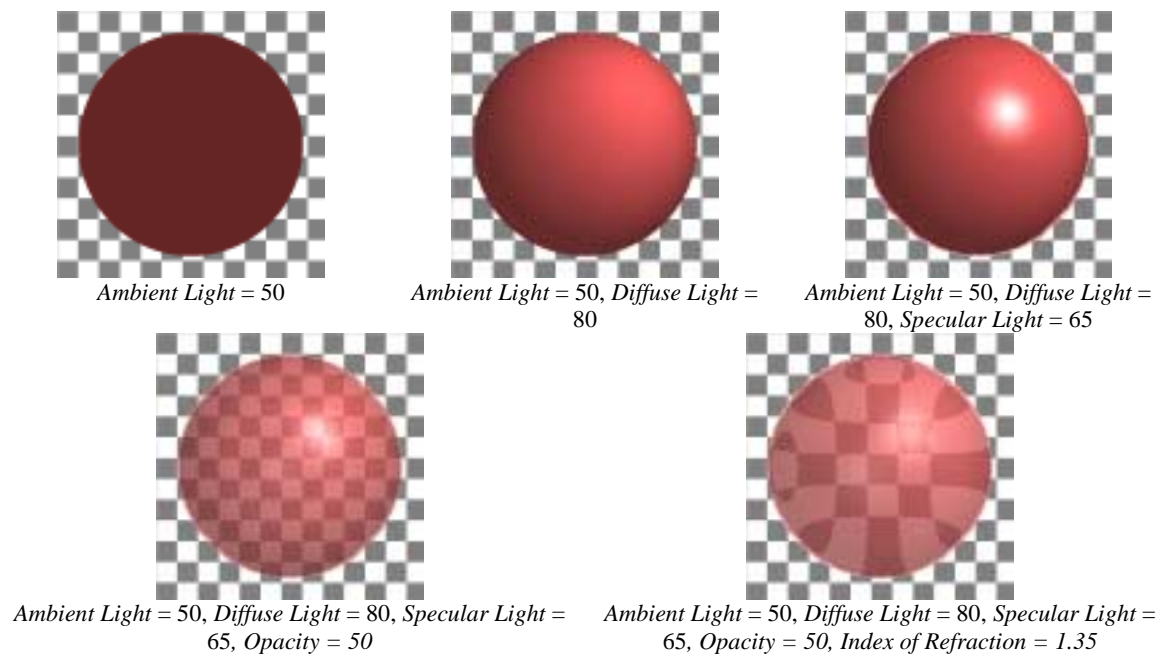


Figure 7 – Effects of the various material parameters

**Note:** Conoa 3D is not able to refract the layers below the layer to which it has been applied. Conoa 3D is only able to reflect and refract shapes that exist within its 3D space. To produce the images above, the grid pattern was applied to a quad placed in the same space as the sphere.

## Image Rendering and Quality

Conoa 3D supports draft and high quality rendering. Draft quality rendering produces images faster, but edges often have a jagged look. High quality rendering eliminates this

problem. The layer's quality control can be used to select the rendering style, and thus the image quality.

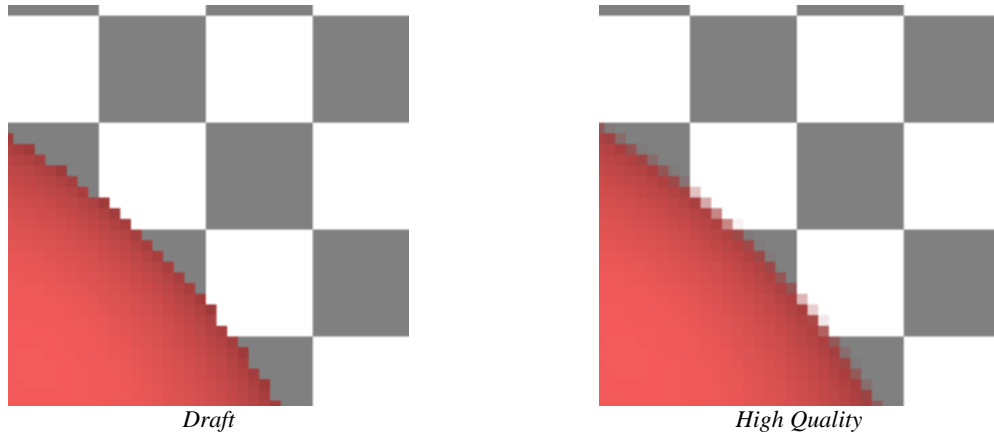


Figure 8 – Draft and High Quality rendering

Conoa 3D supports four levels of high quality rendering. These are *Coarse*, *Medium*, *Fine* and *Super Fine*, and are set with the pull-down control *Anti-aliasing quality*. These choices affect the level of anti-aliasing that Conoa 3D performs. Anti-aliasing is the algorithmic method by which Conoa 3D removes jagged edges from the images. The levels represent the level to which each pixel is examined by the algorithm. *Super Fine* is the highest level of quality, but the slowest to render. *Medium* is adequate for most situations and is the default.

The images below show the difference between the *Coarse* and *Super Fine* levels of anti-aliasing quality. The difference is subtle, but can be best observed along the edge of the sphere.

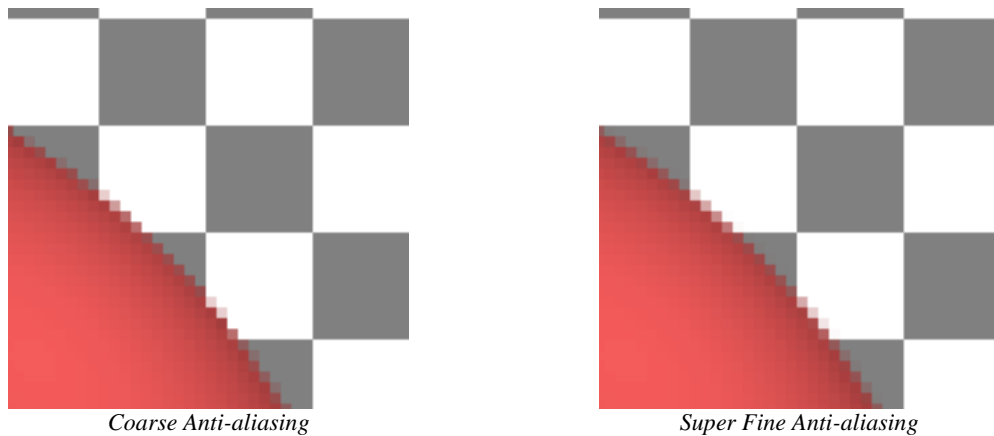


Figure 9 – Anti-aliasing quality

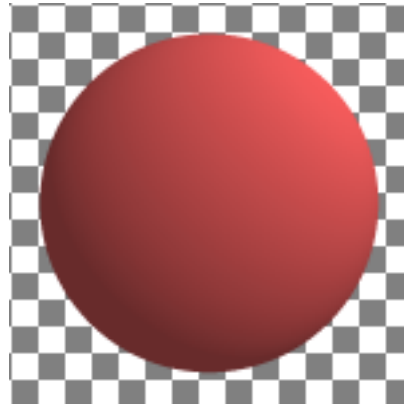
The *Compositing* toggle controls whether the objects will be rendered onto the layer to which Conoa 3D is applied. If the toggle is set, signifying *Composite On Original* is on, then the plug-in will render its objects “above” the layer to which it’s applied. Any pixel not covered by an object will show the corresponding pixel from the layer to which the plug-in is applied. If the *Compositing* toggle is not set, signifying *Composite On*

*Original* is off, then Conoa 3D takes over the entire layer to which it's applied. Any pixel not covered by an object will be set to transparent black.

In the following images, Conoa 3D has been applied to a single layer that is a bitmap of a checkerboard pattern.



Compositing set Off



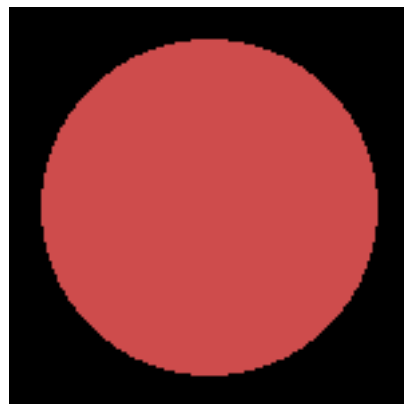
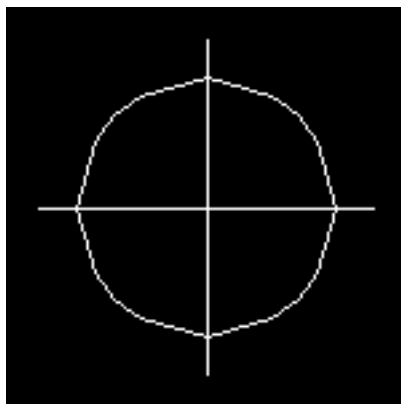
Compositing set On

Figure 10 – Compositing toggle switch

Conoa 3D also has a *Render Mode* control, which is useful for working with the plug-in interactively. The *Render Mode* control specifies which level of material effects will be rendered. Since wireframe views are often sufficient for object placement and diffuse lighting is usually sufficient for light placement, a user can work in these modes for keyframing, leaving the full set of effects for the final rendering. The *Render Mode* control has four choices: *Wireframe*, *Ambient*, *Diffuse*, and *Full*. *Wireframe* will generate a wireframe rendering of the objects. *Ambient* will only use ambient light to light the objects. *Diffuse* displays both ambient and diffuse lighting. *Full* renders the complete set of material parameters, including specular lighting and opacity.

It is important to remember that *Render Mode* does not set material parameters. It simply selectively renders using previously set material parameters.

**Note:** The *Render Mode* control is only active during draft rendering. It has no effect in high quality rendering.



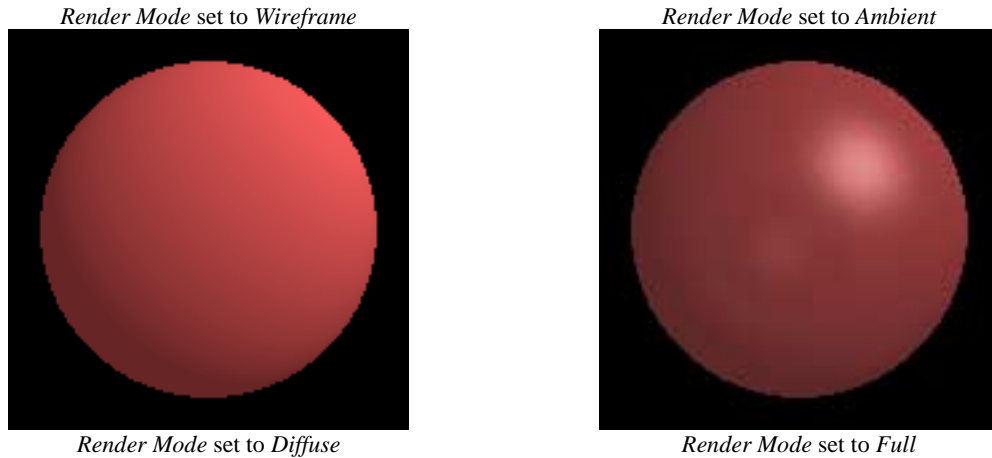


Figure 11 – Render Mode settings

## Controls

Below is a complete list of the Conoa 3D controls.

For each of the objects:

*Geometry* – Select the shape of the object. The choices are: *Bar*, *Cone*, *Cube*, *Cylinder*, *Quad*, *Sphere*, and *Triangle*.

*X Translate* - Move the object along the world X-axis.

*Y Translate* - Move the object along the world Y-axis.

*Z Translate* - Move the object along the world Z-axis.

*X Rotate* - Rotate the object about the local X-axis.

*Y Rotate* - Rotate the object about the local Y-axis.

*Z Rotate* - Rotate the object about the local Z-axis.

*Width* - This parameter generally controls the width of the object. For the different geometric shapes, this parameter is interpreted differently:

*Bar* - Width and depth of base

*Cone* - Radius of base

*Cube* - Width of cube

*Cylinder* - Radius of cylinder

*Diamond* - Width and depth of diamond center

*Disk* - Radius of disk

*Pyramid* - Width and depth of pyramid base

*Quad* - Width of quad

*Rod* - Radius of rod

*Sphere* - Radius of sphere

*Triangle* - Width of base of triangle

*Video Layer* - Scaled width/height of video layer

*Height* - This parameter generally controls the height of the object. For the different geometric shapes, this parameter is interpreted differently:

*Bar* - Height (or length) of bar  
*Cone* - Height (or length) of cone  
*Cube* - Not used  
*Cylinder* - Height (or length) of cylinder  
*Diamond* - Height of diamond  
*Disk* - Not used  
*Pyramid* - Height of pyramid  
*Quad* - Height of quad  
*Rod* - Not used  
*Sphere* - Not used  
*Triangle* - Height of triangle  
*Video Layer* - Scaled depth of video layer

*Texture Map* – The texture map to apply to this object.

*Material* – Toggles whether the second material is applied to this object. The default is to use the first material.

World group:

*X Translate* - Move all objects along the world X-axis.

*Y Translate* - Move all objects along the world Y-axis.

*Z Translate* - Move all objects along the world Z-axis.

*X Rotate* - Rotate all objects about the world X-axis.

*Y Rotate* - Rotate all objects about the world Y-axis.

*Z Rotate* - Rotate all objects about the world Z-axis.

Camera group:

*Camera Source* - Toggles between Conoa 3D's camera model and that of After Effects 5.0.

*Azimuth* - Rotate camera about the world Y-axis, i.e. rotate the camera left/right.

*Declination* - Rotate camera about the world X-axis, i.e. rotate the camera up/down.

*Radius* - Move the camera towards or away from the world origin.

*Field Of View Angle* - The field-of-view of the camera. This control allows the camera to zoom in or out without moving the camera position. As the field-of-view is increased, the camera zooms out and perspective distortion is increased.

Light group:

*Light Source* - Toggles between Conoa 3D's light sources and those of After Effects 5.0.

*Light Supersampling Factor* – The number of rays to shoot toward each light source.

Higher numbers of samples of the light sources enable soft shadows. Also, higher numbers of samples produce smoother shadow areas. This parameter affects the number

of samples projected to all light sources. Lights that have a size of 0 are not sampled more than once.

*Position* – Position of the light in the world X-Y plane.

*Depth* – Position of the light along the world Z-axis.

*Size* – Radius of the light. A radius of 0 signifies a point light source, which will produce sharp shadows. Lights with larger radii will produce softer shadows.

*Light 2 Toggle* – Turns the second light on or off.

*Light 2 Position* – Position of the second light in the world X-Y plane.

*Light 2 Depth* – Position of the second light along the world Z-axis.

*Light 2 Size* – Radius of the second light.

Material group:

*Color* - The color of both surfaces.

*Refractive Index* - The index of refraction of both surfaces. This parameter is only taken into account if the opacity of the chosen material is less than 1.0. Otherwise, the material is completely opaque and refraction is not relevant.

*Bumpiness* - The amount that the bump map affects the surface. Note that this parameter affects bump maps of both material models.

*1<sup>st</sup> Ambient Light* - Proportion of ambient light reflected off objects' surfaces.

*1<sup>st</sup> Diffuse Light* - Proportion of diffuse light reflected off objects' surfaces.

*1<sup>st</sup> Specular Light* - Proportion of specular light reflected off objects' surfaces.

*1<sup>st</sup> Opacity* - Amount of opacity that each object has, specified as a percent. A surface with 25% opacity is 75% transparent.

*Reflection Map* - Layer that will be reflected off all objects using the first material model.

*Reflectivity* - Proportion of the reflection map layer that is reflected off objects' surfaces.

*Bump Map* - Layer that will add roughness to the surface.

*2<sup>nd</sup> Ambient Light* - Ambient light of the second material.

*2<sup>nd</sup> Diffuse Light* - Diffuse light of the second material.

*2<sup>nd</sup> Specular Light* - Specular light of the second material.

*2<sup>nd</sup> Opacity* – Opacity of the second material.

*2<sup>nd</sup> Reflection Map* - Layer that will be reflected off all objects using the second material model.

*2<sup>nd</sup> Reflectivity* - Proportion of the reflection map layer that is reflected off objects' surfaces.

*2<sup>nd</sup> Bump Map* - Layer that will add roughness to the surface.

*Anti-aliasing quality* - The level of anti-aliasing performed by the plug-in. The choices are: *Coarse*, *Medium*, *Fine* and *Super Fine*. The default choice is *Medium*.

*Compositing* - Determines whether the Conoa 3D will be composited onto the layer to which it is applied. The default choice is *Off*, so Conoa 3D replaces the layer to which it is applied.

*Render Mode* - Sets the style with which Conoa 3D will render the image. The choices are: *Wireframe*, *Ambient*, *Diffuse* and *Full*. When *Wireframe* is chosen, Conoa 3D will

render the geometry with a “stick” representation, allowing for interactive placement of the objects. With *Ambient*, Conoa 3D renders the objects with all material properties set to full ambient light and all other material properties turned off. With *Diffuse*, Conoa 3D will render only ambient and diffuse light, allowing for quicker placement of lights. *Full* will render all material properties, including reflection and refraction. The default choice is *Full*.

## Known Issues

- When switching from draft to high quality, materials with partial opacity can show a change in brightness.