1 Introduction

Installation

The Rhino to Air toolkit consists of a new Rib export plugin for Rhino 4 or Rhino 5, a set of toolbars, and this help file.

- Start Rhino 4 or 5
- Load the appropriate plugin. For Rhino 4 and Rhino 5 32-bit, load the RIB_Export.rhp plugin. For Rhino 5 64-bit, load RhinoAir5_x64.rhp.
- Load the included toolbar set AirTools.tb

You must also have a copy of Air installed in addition to the RhinoAir plugin. A free demo version of Air can be downloaded from the SiTex Graphics web site:

```
http://www.sitexgraphics.com/html/download.html
```

Once Air is installed, you are ready to render with Air from Rhino.

Quick Links

FAQ - Frequently Asked Questions

Rendering
Materials
Lighting

Global Illumination
Illustration
Animation

IPR - Interactive Preview Rendering

Baking Textures with BakeAir
Baking Meshes with BakeAir

Geometric Primitives

2 What's New

RhinoAir 6.2:

- New outline properties for max edge length, merging similar edges, and selecting a stroke shader in the Outline dialog and AirOutline command.
- New AirStroke command for specifying a custom stroke shader for vector-based outline drawing.
- New Watercolor option in the AirOption command to add a rough watercolor paper look to the final image. Useful for producing a watercolor appearance when combined with the WatercolorEdge stroke shader for outlines and the VWatercolor surface shader.

RhinoAir 6.1:

- Support for integer and boolean parameter types in compiled shaders and Air material files.
- New Area light quality control in the Indirect section of the Air GI page. This knob determines how area lights are sampled during indirect lighting.
- Modifications to material file loading and saving for compatibility with the new standalone Air material editor.

RhinoAir 6:

- New light controls to clamp the max emitted intensity to a reasonable value for lights that use large intensities with a distance-based falloff.
- Converted all gamma controls to simple option to use sRGB gamma correction (equivalent to approximately gamma 2.2). This affects the conversion of Rhino colors for rib export, texture map conversion, and final image conversion for display.
- When texture conversion is disabled and the texture color space is set to sRGB, RhinoAir now enables automatic raw texture color space conversion from sRGB (requires Air 13 to work).
- New Color section in the documentation describing how RhinoAir handles color input and output.
- New RhinoAir menu provides shortcuts to common commands and dialogs
- Spotlights and distant lights can now be used to project a texture like a slide projector.
- On the Air Display page the Ambient channel has been replaced by a Background channel which stores the background contribution to the final image (based on the Background setting on the Air Main page)
- The Shadow output channel on the Air Display page now saves the new subtractive shadow value computed by the latest Air shaders for better compositing.
- Check to make sure object names are printable (any control characters are converted to underscores).
- Support for the new interactive Retexture tool included with Air 12.11 and later
- New check box on the Air Main page to enable the new trace hider in Air 12, which uses ray tracing to compute the camera view.
- New control on the Air Plug-in page to enable rendering with the new 64-bit build of Air available in Air 12.
- The new environment cache for global illumination in Air 12 is now automatically turned on in the rib file, for much faster and smoother rendering of global illumination with environment shaders.
- The GI page has controls for the new radiosity cache for indirect lighting introduced in Air 12.01.
- Changes made on the Air Environment page are now updated in the IPR view (except changing the environment mode).
- The 'Use Rhino mesh' check box on the Air Main page has been replaced with a new drop-down that clearly indicates the 3 possible options. The default export mode for NURB surfaces now uses the Rhino render mesh.

- New control for GI intensity in occlusion mode on the Air GI page.
- The width for a linear light can be set on the Air Light page, and linear lights can be made visible to the camera and in reflections if desired.
- Expanded valid range for flatness tolerance
- DOF focus length can now be less than 1.
- Fixed object properties export so any ReadArchive appears at the end, so any attributes can apply to a referenced archive

3 Rendering

Basic Rendering

Once the plugin and toolbars are installed, you may easily render your scene with Air using the buttons on the Air Render toolbar:

Left-click the left-most render button  to render your scene with the default Air render settings. Right click the same button to render with higher quality.

When the render button is clicked, the plugin will export the scene to a RIB file and start Air as a separate process. The rendered image should appear in the standalone Air Show framebuffer. If Air Show fails to appear, make sure your system settings allow Rhino to start an external application. If Air Show opens but an image fails to appear, make sure any network security software allows Air to communicate with Air Show using port 47349.

The Air Show window can be kept in front of the Rhino window by enabling the Always on Top option in the Air Show Options menu.

To stop a rendering in progress, click the stop button in the Air Show toolbar (not the close button for the Air Show window).

One-click Rendering

Other buttons on the render toolbar provide common rendering options:

 Render only selected objects.

 Render with ambient occlusion

 Render with outlines enabled.

To render with higher image quality settings, right click a button.

Rendering a Region

The render region button  can be used to restrict rendering to a sub-rectangle of a viewport, which can be useful for test renders. After left clicking the render region button, select a rectangle in a viewport by picking two opposite corners. Any subsequent renders will use the selected render region. To disable the render region, right click the render region button.

The sub-toolbar attached to the render region button contains another button  that allows a region to be enlarged or "blown up" to occupy the entire output image area.

Instead of launching the renderer immediately, it is also possible to export a RIB file for later rendering using the AirExport command.

Interactive Preview Rendering

With RhinoAir you can see effects of shading and lighting changes without having to continually render test images by using the advanced Interactive Preview Rendering provided by TweakAir.

Use the IPR button 

to start interactive rendering, then watch as your shading and lighting changes update in the Air Show window.

Air Render Settings

The RhinoAir plugin adds several pages to the Rhino document properties dialog for controlling global options when rendering with Air:

Air Main page	Controls for image quality and output specification
Air Display page	Settings for specifying output images
Air Trace page	Settings for ray-traced shadows and reflections
Air GI page	Controls for global illumination modes
Air Environment page	Settings for the environment surrounding a model
Air Outline page	Settings for drawing outlines for illustration
Air Animation page	Controls to enable and configure animation
Air Advanced Lighting page	Controls for spectral prefiltering and chromatic adaptation
Air Interactive page	Settings for Interactive Preview Rendering with TweakAir
Air Bake page	Settings for Baking Textures with BakeAir
Air Plugin page	Global settings for scene conversion and the rendering process

Access the main Air options page using the render options button  .

Image Size

By default the output image size will match that of the viewport chosen for rendering. You can specify a different resolution using the Image Size control on the Air Main page. Either select from the list of pre-defined sizes or type in your own width and height values.

3.1 Render Management

Using Air Control to Manage Rendering

By default the RhinoAir rendering commands start a standalone Air process to render each scene after it is exported. In some cases you may wish to export a series of scenes to be rendered in order rather than having each scene start rendering immediately. The Air Control tool included with Air can be used to queue and monitor a sequence of renderings. Check **Submit jobs to Air Control** on the Air Plugin page to have RhinoAir submit rendering jobs to Air Control instead of starting rendering processes immediately.

Version Control

It is important not to overwite an exported scene file until it has completed rendering. As an aid to managing multiple renders, the RhinoAir plugin will give each exported scene file a unique version number if the **Append version** option is enabled on the Air Plugin page.

3.2 Network Rendering

Note: Network rendering is disabled in the Air demo.

Multiple machines on a network can be used to render a single image via the Vortex and Voluntair tool included with Air.

Requirements for Client Machines on the Network

- Each machine must have Air installed and have access to an Air license. The Air floating license manager can be used to share licenses over a network. Each active Air rendering process on a remote machine requires its own license.

- Each client must have access to all files needed to render the scene, including the RIB files exported by RhinoAir and any texture maps. The scene export RIB file specified on the Air Main page should be on a shared network drive. Any pre-converted texture maps or environment maps should also be on a shared drive.

- Each machine must have the voluntair render client running. This includes the local/host machine if that is to be used for rendering. Voluntair can be started from a command shell by typing

  ```
  voluntair -threads ncpu
  ```

  where *ncpu* is the number of processing cores to use for rendering on that machine.

Rendering over a Network

To enable network rendering, check Distributed rendering with Vortex on the Air Plugin page. Subsequent calls to the AirRender command will use Vortex to distribute rendering over all available network clients.

3.3 Large Images

The following tips may improve performance when rendering large images for printing or other purposes:

1. Increase the tile size on the Air Plugin page to 64 or 128 pixels.

2. If global illumination is used with one of the cache modes (Indirect + Cache or Occlusion + Cache), increase the max pixel distance based on the size of the rendered image. For example, if your test image is 500x500 and the final image is 3000x3000, increase the max pixel distance by a factor of 6 or so for final rendering.

3. Check the **Use Rhino mesh** control on the Air Main page to use the Rhino render mesh for rendering. AIR's default handling of NURB surfaces tessellates each NURB to sub-pixel accuracy, which is probably overkill for a printed image. Using the Rhino render mesh can reduce memory use and render time.

4. On the Air Main page, try setting the number of shading samples to 1 and the number of Pixel Samples to 4 or less. Small aliasing artifacts may not be noticable when an image is printed at high density.

5. If system memory is limited, an image can be rendered directly to a file instead of to a window by unchecking the Render to Air Show control on the Air Display page. Instead check the Render to file control and provide a valid file name and extension for the rendered image. Also be sure the Tile order is set to Rows on the Air Plugin page.

3.4 Optimizing Complex Objects with RIB Archives

Complex objects can sometimes noticably slow down rendering due simply to the amount of time it takes to export the geometric information to a file. The rendering of complex objects can be accelerated by writing the geometry to a separate RIB archive file that is then referenced for subsequent rendering.

To create a RIB archive for one or more objects:

- Select the desired object or objects.
- Start the AirWriteArchive command
- Use the **Archive** option to specify a file name for the RIB archive.
- Set the **Materials** flag to Yes or No depending on whether you wish material information included in the RIB archive. If material information is omitted, you will be able to change the material assigned to the object without re-exporting the archive.
- Press Enter to export the geometry (and material information if desired) to the specified archive file.

To use a previously exported archive to render an object:

- Select the object(s) of interest and display the Air Object page.
- In the ***Advanced*** section set the archive mode to Substitute archive.
- Use the dialog button next to the archive control to select the relevant RIB archive file.

3.5 Quick and Easy Outdoor Rendering

An easy way to quickly render an outdoor scene is to use the Sky environment shader with optional sun:

- Open the Rhino Document Properties dialog and select the Air Environment page.
- Set the Environment mode to Sky. Make sure the Use Sun check box is enabled.
- Select the Air GI page. Set the Global Illumination mode to Occlusion + cache or Indirect + cache.
- Close the dialog and render.

4 Color

Obtaining correct results from any renderer depends on the proper handling of color input and output values. This section describes how to properly convert colors when rendering with RhinoAir.

Linear and sRGB Color Spaces

The computations performed by Air assume that color values are linear, so that say doubling the output color for a pixel doubles the intensity value. However, most monitors and printers display images in a non-linear color space that better matches the response characteristics of the human visual system. Obtaining linear color values for use with Air will typically require some conversion on the input and the output sides.

The non-linear aspect of the display color space is often represented as a mathematical function with a single parameter called gamma. Typical gamma values can range from 1.8 to 2.4 or more. In recent years most manufacturers of devices that display or capture images have adopted the sRGB color space as a standard for digital images. The sRGB color space is approximately equivalent to a gamma value of 2.2 - though that approximation is not very close at the low end of the intensity range.

Input Color Conversion

Colors

By default RhinoAir assumes that color values in Rhino have been chosen based on their appearance on an sRGB monitor, and all color values are converted from sRGB color space to a linear color space for rendering with Air. This preserves the appearance of colors when viewed in a final image with sRGB color correction.

If you have instead configured your monitor to apply hardware gamma correction and want the Rhino colors to be used without conversion, you can disable the color conversion on the Air Plugin page by setting the **Monitor color space** to `linear RGB`.

Texture maps

RhinoAir assumes that texture images have been created in sRGB color space so they appear "correct" when viewed as-is on a standard monitor. RhinoAir makes sure that the source texture data is converted to linear RGB space for rendering with Air - either during the creation of Air texture files (when automatic texture conversion is enabled on the Air Plugin page) or by telling Air to apply the appropriate conversion at render time. Note that both these capabilities require Air 13.

If your texture maps are already in linear RGB color space, you should disable color space conversion for textures on the Air Plugin page by setting the **Texture color space** to `linear RGB`.

Output Color Conversion

The output colors computed by Air are in a linear color space, and they will need to be converted to

the display color space at some point in your pipeline. When that conversion takes place depends on the target device and purpose:

Rendering to Air Show

If you are rendering to Air Show for previewing or final rendering, you can use the sRGB display button in the Air Show toolbar to view a linear image in sRGB color space. If possible, select an option to render 16-bit or floating-point data to avoid banding artifacts that can appear when sRGB conversion is applied to an 8-bit image. This may be the only display correction you'll need. If you wish to save the image as it is displayed in sRGB space, use the Save as Displayed item in the File menu. To save the raw linear image, use the normal Save command.

Rendering to a file for later processing

When rendering to a file for later processing in an image editor or compositor, render linear images at 16-bit or float precision and apply sRGB conversion after any post-processing. This case includes rendering of extra output channels for later compositing.

Rendering a final image

A rendered image that is to be viewed or printed directly should have appropriate display conversion applied by Air. You can enable conversion of the standard RGB output values to sRGB color space by checking **to sRGB** on the Air Display page.

See Also:

Air User Manual: Color

5 Image Quality

High quality images require the elimination of aliasing - artifacts in an image due to undersampling some aspect of the scene. Air provides extensive support for fine-tuning the sampling in a scene.

Use the Air Main page in the document properties dialog to set global parameters for image quality.

The **Pixel samples** setting determines how often the scene's geometry is sampled.

The **Shading samples** value determines how often an object's shading is evaluated.

Air provides independent control over the sampling of geometry and shading. This is an important capability: for many scenes rendering time is dominated by shading calculations. With Air you can increase the sampling of a scene's geometry to smooth rough edges without increasing the number of shading calculations that are performed.

The following sections describe how to eliminate common sources of aliasing in rendered images.

Jagged Edges

Increase the number of pixel samples.

Shading Aliasing

Shading can introduce aliasing from a pattern, reflections, specular highlights, small bumps, shadow edges, and other sources. The simplest way to improve shading quality is to increase the number of shading samples.

Increasing the number of shading samples globally can significantly slow down rendering: rendering time is often directly proportional to the number of shading samples, so doubling the number of shading samples can also double rendering time. Instead, it is more efficient to increase the number of shading samples only for those materials that require more detail (using the *Shading samples* control on the Air Material page).

Shadows

Ray traced shadows can exhibit shading artifacts in the form of jagged edges or, for blurry shadows, excessive noise. In both cases increasing the number of shadow rays will improve shadow quality. The number of shadow rays can be set on the Air Light page in the Properties dialog for a selected light source.

Reflections

Ray-traced reflections may exhibit artifacts in the form of jagged edges or excessive noise. As with shadows, increasing the number of rays will improve image quality. The number of reflection rays can be set on the Air Material page in the Properties dialog for a selected object.

Summary

- A reasonable goal is to be able to render a final quality image with 1-4 shading samples per pixel. The "high quality" preset on the Air Main page and the high quality render buttons use 4 shading samples.
- To smooth noisy shadows for a light, increase the number of shadow rays cast by the light.
- To smooth reflections increase the number of reflection rays for the reflective material.
- For an individual material that exhibits artifacts, increase the number of shading samples only for that material on the Air Material page.

See Also:
Air User Manual: Image Quality

6 Lighting

Standard Lights

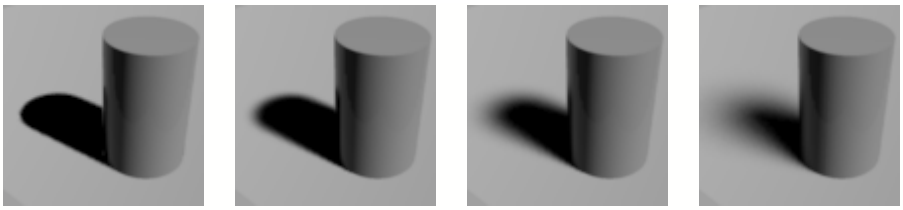
The RhinoAir export plugin converts most properties for the standard Rhino lights to the equivalent Air shaders and parameters. Point lights, directional lights, spotlights, linear lights, and rectangular area lights are all supported.

Use the Air Light page (in the object properties dialog for a selected light) to customize a light for rendering with Air.

Shadows

If the Shadow Intensity parameter for a Rhino light is greater than 0, Air will compute shadows for the light using ray tracing. Ray-tracing shadows increases rendering time. Save rendering time by limiting the number of lights that cast shadows, setting the shadow intensity to 0 for lights that do not need to cast shadows.

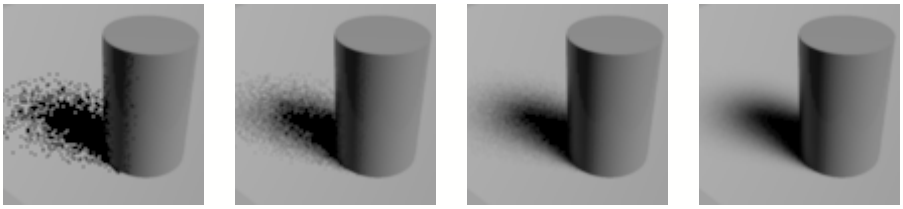
Soft shadows can be achieved for regular point lights, directional lights, and spotlights by providing a positive Shadow Blur value. Typical values are in the range 0 to 0.2.



blur 0.0 blur 0.04 blur 0.1 blur 0.2

Technically, shadow blur is an angle in radians that defines a cone of directions over which to send shadow rays, measured from the point being shaded.

Larger blur values can produce noisy shadows. To reduce the noise, increase the number of shadow rays that are cast to estimate the shadow value. It normally makes sense to increase or decrease the number of shadow rays by a factor of 2 or 4:



1 ray 4 rays 16 rays 64 rays

Soft shadows can also be achieved by using a linear light or a rectangular light, in which case the blurriness of the shadows depends on the size of the linear or rectangular light. The shadow blur value has no effect for these lights. Rectangular and linear lights usually take longer to render than regular lights.

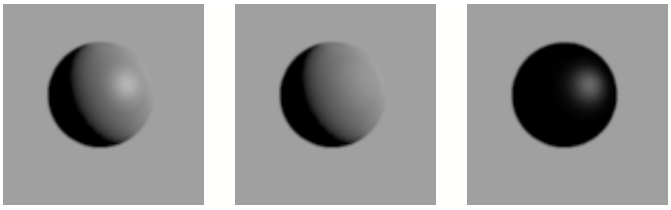
Light Intensity Falloff

Use the Falloff parameter on the Air Light page to select how light intensity varies with distance from the light: no decrease, linear decrease with distance, or decrease with distance squared. By default illumination received from a Rhino light does not decrease with distance from the light. For real lights the amount of illumination received decreases with the square of the distance from the light. The intermediate linear falloff may be easier to control. For linear and square-law falloff, the light intensity may need to be quite large to contribute significant illumination to the scene.

Directional lights do not use the falloff parameter.

Diffuse Only and Specular Only Lights

Sometimes it is useful to restrict a light to emitting only diffuse or only specular light. The Emit diffuse and Emit specular controls on the Air Light page can be used to choose whether a light contributes diffuse light, specular light, or both (which is the default).



diffuse & specular diffuse only specular only

Complex Shadows

By default AIR assumes that a shadow-casting object attenuates light based on its transparency attribute. This assumption saves rendering time because the object's surface shader does not have to be executed when an object is hit by a shadow ray.

Some surface shaders compute a complicated transparency pattern. Such shaders must be evaluated for shadow rays in order to cast appropriate shadows. Enable the **Surface modifies transparency** control on the Air Material page to force a surface shader to be evaluated for shadow rays.

See Also:

Air Light page
IES Lights
Caustics
Custom Area Light Shapes
Light Linking and Local Lights
Spectral Rendering
Global Illumination

6.1 IES Lights

AIR 9.18 and later can utilize IES light profiles to more accurately simulate illumination from specific lighting fixtures. IES files for lighting fixtures are typically available from the manufacturer.

To use an IES light profile:

- Create a rectangular area light in Rhino.
- Select the area light and display the Air Light properties page.
- In the Rectangle light section, click on the button next to the *Texture or IES file* control. Use the file chooser dialog to select an IES file.
- Make sure the box next to *Texture or IES file* is checked.

When an IES profile is used, RhinoAir will model the light as a point light source. No area light geometry will be created.

The light intensity distribution will be taken from the IES profile file. The position and orientation of the profile can be manipulated using the rectangle light object in Rhino.

In IES mode, the light's falloff parameter value will have no effect. The light intensity setting can be used to tweak the overall brightness of the illumination, and the color parameter can be used to tint the light. Shadow controls continue to work as with other lights.

Converting IES Light Values for Rendering

In order to incorporate the measured data from IES files into a scene for rendering, Air needs to know how the IES values match up with the (unitless) illumination values generated by non-IES lights. The *Illuminance unity* control on the Air Plugin page allows you to define the illuminance value (in lux) that corresponds to an emitted intensity value of 1 from a non-IES light. This value is roughly the maximum illuminance value that can be represented in the image without clipping or clamping of the brightness values.

When rendering with IES lights, you may wish to save images at floating-point precision in a high dynamic range image format (such as HDR, EXR, or TIFF) and adjust the final brightness and exposure levels in an image processing program as a post-process.

6.2 Caustics

Air can render caustics - illumination effects due to light that has been reflected or refracted in a focused manner.

Rendering caustics requires the following steps:

1. Enable caustics on the Air Advanced Lighting page.

2. Select at least one light to emit photons. Check the light's `Emit photons` property and select the number of photons to shoot. Note that the value is in millions of photons (e.g., a value of 0.1 will shoot 100,000 photons). The light's Falloff parameter should be set to Square. Directional lights will not emit photons.

For best results, use a spotlight with a narrow a cone to emit photons only in the region where caustics could be generated by shiny objects.

3. The scene must include objects that reflect or refract light. Surface shaders for shiny objects include: ceramic, plastic, metal, and glass.

4. Caustics appear as part of the diffuse lighting component. The scene must have at least some objects that are not completely reflective or refractive in order for caustics to be visible.

When your render a scene with caustics, Air will execute a prepass in which it traces the photons emitted by all lights, tracking them through reflections and refractions, and storing those that hit diffuse surfaces. This preprocess may take a while depending on the number of photons and the complexity of the scene. When the normal rendering process starts, Air uses the stored photons to generate caustics.

The set of photons stored for caustics may be saved to a file and re-used for subsequent renderings. When a caustic cache file is used, the photon-shooting preprocess is skipped.

See Also

Air Advanced Lighting page
Air Light page

6.3 Custom Area Light Shapes

Any shape created in Rhino can be used an as area light.

To use a custom shape for an area light instead of the default rectangle shape:

1. Select the shapes for that will be used for the area light.

2. Use the AirWriteArchive command to save the shapes to an archive file.

3. Display the Air Object page and uncheck **Reflected** and **Cast shadow**.

4. Select the rectangle light that is to use the custom shape (or create a new rectangle area light).

5. On the Air Light page. click the file chooser button next to the **Use Archive** check box.

6. Select the archive file created above with the saved shape geometry.

7. Make sure **Use Archive** is checked.

8. Render.

Notes:

- A rectangle light with a custom shape always uses the normal area light mode.
- NURB geometry should be saved with the Use Rhino Mesh attribute enabled.
- No transformation is applied to the custom light shape. The position and orientation of the rectangle light does not affect the location of the custom light shape.

6.4 Light Linking and Local Lights

With RhinoAir illumination can be fine tuned on a per-object basis in two ways:

- Normal lights, which illuminate all objects in the scene by default, can be excluded from illuminating a subset of objects.
- A light can be made into a "local" light, illuminating no objects by default, and turned on for a subset of objects.

The following two sections describe both methods of fine-tuning illumination for individual objects.

Excluding Objects from Normal Lights

To exclude a set of objects from the illumination cast by a light:

- Select the light to be excluded, and display the Air Light properties page.
- Set the **Channel** value to an unused channel number.
- Select the desired objects.
- Start the AirIllum command.
- Click **ExcludeLights**.
- Type the channel number selected above and press Enter twice.

The objects will not receive illumination from the excluded light source (or any other light sources with the same channel number).

Creating Local Lights for Selected Objects

To create a light that only illuminates a select group of objects:

- Create a new light as usual, or select a pre-existing light if desired.
- Display the Air Light properties page.
- Uncheck **Illuminate all objects**
- Set the **Channel** value to an unused number.
- Select the set of objects to be illuminated.
- Start the AirIllum command.
- Click **IncludeLights**
- Type the channel number selected above and press Enter twice.

The local light should now illuminate only the selected group of objects.

See Also:

AirIllum command

6.5 Spectral Rendering

Air supports rendering with spectral data in the following ways:

1. Colors for materials and lights can be defined using spectral data.

2. A spectral pre-filtering option produces accurate results from spectral data while preserving the efficiency of normal RGB rendering.

Spectral Colors

Air allows a color to be specified as spectral curve defined in a spectral profile file. The Air distribution includes a small collection of SPF files in the `spectra` directory of the Air installation.

The spectral color for a material can be defined using the AirMaterial command.

For a light source, a spectral profile can be selected on the Air Light page.

Spectral Prefiltering

Air provides a spectral prefiltering option based on a couple simple observations:

1. The direct lighting component of the final image is the most important for overall image accuracy.

2. Most scenes have a single dominant illuminant. There may be many light sources, but most tend to share the same spectral profile.

These observations suggest the following prefiltering method:

1. Compute the reflected color for each surface under the dominant illuminant (basically the product of the color spectrum and the dominant spectrum).

2. Modify the spectrum for each light so that lights with the same spectrum as the dominant illuminant emit white light.

By construction, this produces the exact result for the direct lighting component, and a reasonably close approximation for other components. This method also works well for spectral data with sharp spikes, such as the spectra for some fluorescent lights.

To enable spectral prefiltering in RhinoAir:

- Open the Rhino options dialog and look for the Air Main page under Document Properties.
- Select the Air Advanced Lighting page under the Air Main page.
- Check **Enable Spectral Prefiltering**.
- Select a spectral profile for the dominant illuminant.

NB: For lights share the same spectral profile, you do not need to modify the light properties at all to achieve the effects of spectral prefiltering. If a light has a different spectrum, select a profile for it on the Air Light page.

Chromatic Adaptation

When computing colors using spectral data, it is also important to take account of how the human visual system processes visible colors. In particular, there is a strong tendency for viewers to discount

the illuminant in their observations. E.g., the computed color for a white patch viewed under a tungsten lamp might be yellow-orange, but an observer would still call it white. To compensate for this chromatic adaptation, Air can transform the prefiltered color from the color space of the dominant illuminant to a color space corresponding to the display viewing conditions.

This option can be enabled or disabled on the Air Advanced Lighting page. In most cases you will want to leave it enabled.

See Also

Air Advanced Lighting page
Air User Manual: Lighting -> Spectral Prefiltering and Chromatic Adaptation

6.6 Illuminating with Textures

A spotlight or distant light source can be used to project a texture to cast light like a slide projector. To add a texture to a light source:

- Select a spotlight or distant light.
- Display the Air Light properties page for the light.
- Click the button next to the Texture or IES file label. Use the file dialog that appears to select a texture map.

7 Global Illumination

In addition to simulating direct illumination from lights placed in the scene, Air can simulate illumination from other sources, such as the environment surrounding the scene or light that has been reflected from a surface. The RhinoAir plugin groups the controls for these additional lighting effects under the general heading of global illumination or GI.

All GI modes contribute only diffuse illumination to the scene. Surfaces such as glass and metal with little or no diffuse component will not receive additional light from global illumination.

Global Illumination Modes

The Air GI page contains controls for global illumination. The top control determines how global illumination effects are simulated:

Off

No additional illumination is added to the scene.

Ambient

A constant amount of light is added to the scene based on the intensity and color values in the Global Illumination Environment section. The addition of a constant amount of illumination that is independent of surface position and orientation tends to flatten the appearance of objects.

Indirect

In this mode Air computes indirect diffuse illumination - light that has been reflected from at least one surface instead of coming directly from a light source. The illumination computed with this method includes color bleeding effects.

Air simulates indirect illumination by casting a number of rays from the current shading location and accumulating the colors of the surfaces hit by those rays. For rays that miss all objects, the indirect contribution is based on the Global Illumination Environment settings.

The quality of indirect illumination results depends on the number of rays cast. More rays produce smoother results. Using too few rays can produce a grainy appearance.

Indirect computations can be accelerated in several ways:

- The maximum trace distance gives the maximum distance Air will trace a ray looking for intersecting objects. Using a lower distance will reduce rendering time.
- When adaptive sampling is enabled, Air casts fewer rays initially (nrays/4) and additional rays only where there are significant differences in the results of the first set of rays.
- Air can optionally re-use the shading samples computed when a polygon is hit by an indirect ray. The minimum detail setting gives the maximum size of any one shading sample; polygons larger than the specified size will store multiple shading samples.

Indirect Cache

To accelerate indirect illumination computations, Air supports irradiance caching - a technique in which GI estimates are stored and re-used at nearby shading locations.

When rendering GI with a cache, Air first attempts to estimate GI by re-using values already in the cache. Whether a given cache value can be re-used is determined by the max error setting. A higher maximum error allows cached values to be re-used more often. If Air cannot find enough usable values in the cache, it will generate a new GI estimate by casting rays and store the new result in the cache for possible re-use.

To ensure that all areas of the image receive some GI samples, the max pixel distance setting gives the maximum distance in pixels within which Air will look for usable GI samples in the cache.

When an irradiance cache is used, the rendering process takes place in two passes. In the initial prepass only the indirect illumination is computed, generating the irradiance cache. In the second rendering pass, the cache values are used to produce smooth GI results for the final image.

Occlusion

Ambient occlusion is a faster alternative to indirect diffuse illumination. Ambient occlusion captures the effect of local shadowing without color bleeding. Ambient occlusion is computed by casting shadow rays from the current shading location to estimate the extent to which the region being shaded is blocked or occluded by nearby objects. The occlusion value is then used as a shadow value for light coming from outside the scene as determined by the Global Illumination Environment. Computing occlusion is faster than computing indirect illumination because a ray cast for occlusion only has to determine the extent to which it is blocked by an object, whereas a ray cast for indirect illumination also has to compute the illumination at an intersection point.

The quality of the occlusion estimate depends on the number of rays cast. More rays produce smoother results. Using too few rays can produce a grainy appearance.

Occlusion computations can be accelerated by setting a maximum trace distance or enabling adaptive sampling. The maximum trace distance gives the maximum distance Air will trace a ray looking for occluding objects. Using a lower distance will reduce rendering time. When adaptive sampling is enabled, Air casts fewer rays initially (nrays/4) and additional rays only where there are significant differences in the results of the first set of rays.

Occlusion Cache

Air can accelerate occlusion estimation using an occlusion cache in a manner similar to the way indirect illumination can be accelerated with an irradiance cache.

With this GI mode occlusion samples are stored in a cache, and at each shading location Air attempts to compute a new estimate using samples in the cache. A new raw occlusion sample is generated only if an acceptable estimate cannot be made from pre-existing samples. The max error setting gives a threshold for re-using an occlusion estimate. A higher max error value allows a sample to be re-used more often. The max pixel distance is the maximum distance in pixels (measured from the current shading location) within which Air will search for samples within the cache. This value ensures that all areas of the image receive some raw occlusion estimates.

When using an occlusion cache, the rendering process has two passes. On the first pass, occlusion values are generated and stored in the cache. On the second pass, the final image is computed using the cached occlusion samples to compute smooth occlusion values.

Global Illumination Environment

The settings in this section of the Air GI page control the illumination coming into the scene from the surrounding environment.

By default the background illumination is simply the product of the color and intensity provided. If an environment map is provided, that is used to compute incoming illumination from a particular direction, scaled by the intensity value.

The specified environment map is used as-is; no texture conversion is performed. For best results it is recommended that the environment map be generated using the Air texture conversion tool - mktexui. The texture conversion tool can be easily accessed from the Air Show tools menu.

HDR Environment Maps

The environment map may be a high-dynamic range image. To obtain good results from an HDR image, some care must be taken in its preparation. Specifically:

- A small image is usually sufficient. E.g., 256x128 pixels should be plenty of resolution.
- Apply some blur to the image prior to or during conversion to an Air texture file.
- Clamp the maximum intensity value to something reasonable. Some HDR images have very large intensity values (1000+) that may make it difficult to obtain a clean rendering.
- Use some blur in the Global Illumination Environment settings.

An image processing program that works with HDR images such as HDRShop may be useful for the above pre-processing.

8 Geometric Primitives

Air renders a wide variety of geometric primitives:

NURB Surfaces

Air can render NURB surfaces directly, without requiring Rhino to generate a render mesh. By default the RhinoAir plugin passes the mathematical description of each NURB surface to Air. During rendering Air converts each NURB to an appropriate polygonal representation based on its size in the final image. The tessellation quality is based on the Tolerance setting on the Air Main page (which can also be overridden for a particular object on the Air Object page). Higher tolerance values will produce a coarser tessellation, using less memory and rendering faster.

In some cases you may obtain better or faster rendering by using the Rhino render mesh instead. Check the Use Rhino mesh control on the Air Main page to render using the Rhino render mesh for each NURB surface.

Polygon Meshes

Air can render Rhino's polygon mesh primitives.

Subdivision Surfaces

Air will render a polygon mesh as a Catmull-Clark subdivision surface (SDS) if the **Subdivision mesh** control on the Air Object page is checked. For best results it is important that the exported mesh not have any coincident duplicate vertices. If you suspect that a mesh has duplicate vertices, enable the **Weld polygon vertices** option on the Air Object page to have RhinoAir weld the vertices prior to export. The RhinoAir weld option does not affect the polygon mesh representation within Rhino.

Curves

Air will render Rhino curves as true 3D primitives if the **Curves and points** option is checked on the Air Main page. The default width for curves is given by the **Curve width** setting on the Air Main page, and the default color assignment is determined by the **Curve color** setting on the same page. The width of an individual curve object can be adjusted on the Air Object properties page, which also allows the object color to be overridden.

Air can render a line pattern assigned to a curve. The line pattern length is computed by first converting the line segment lengths given in the line pattern definition from millimeters to the units selected for the current scene. The lengths are then multiplied by the display Scale factor defined on the Linetypes page of the Rhino Document Properties dialog. That Scale factor can thus be used to globally stretch or shrink the length of all line patterns. The line width is determined by the Curve width parameter described above (just as for curves without a pattern).

By default curves are rendered as annotation entites, and they do not use materials. To apply a material to a curve, enable the **Shade curves and points** control on the Air Object properties page.

Points

Air will render points and point clouds as 3D entities if the **Curves and points** option is checked on the Air Main page. The default width for points is given by the **Curve width** setting on the Air Main page, and the default color assignment is determined by the **Curve color** setting on the same page. The width of an individual curve or point object can be adjusted on the Air Object properties page, which also allows the object color to be overridden.

By default points and point clouds are rendered as annotation entites, and they do not use materials. To apply a material to a point or point cloud, enable the **Shade curves and points** control on the Air Object properties page.

By default points are rendered as spheres. The **Point type** control on the Air Object page allows 4 other types of point representation: sprites, disks, blobby, and volume primitive.

Sprites

To render a point or point cloud object as sprites, enable Curves and points on the Air Main page and set the Point type to Sprite on the Air Object page. Points rendered as sprites appear as square polygons oriented to face the camera.

Blobbies

Air will render a point cloud as a blobby implicit surface or metaball when the point type is set to Blobby on the Air Object page (and curve and point rendering is enabled on the Air Main page). Note that blobby rendering only works for a point cloud primitive, not a collection of individual points. You may need to use the Rhino PointCloud command to convert a set of points to a point cloud primitive.

Blobbies are always shaded using the assigned material. For faster rendering with lower memory use, increase the **Tolerance** setting on the Air Object page above the default value of 0.5.

Volume primitives

Air will render a point cloud as a volume primitive when the point type is set to Volume on the Air Object page (and curve and point rendering is enabled on the Air Main page). Note that volume rendering only works for a point cloud primitive, not a collection of individual points. You may need to use the Rhino PointCloud command to convert a set of points to a point cloud primitive.

For appropriate shading, try using one of the following surface shaders included with Air: particle, VSmokeSurface, VCumulusCloud. In most cases the **Surface modifies transparency** control on the Air Material page should also be checked.

9 Materials

Air uses the native Rhino material settings as the basis for the appearance of an object when rendered with Air. By default the plugin translates Rhino material properties including color, texture maps, gloss settings, and transparency to the equivalent Air shaders and attributes for rendering. You can continue to use regular Rhino materials when rendering with Air.

The RhinoAir plugin allows the basic Rhino material properties to be augmented by Air-specific properties. The Air material properties are attached to the Rhino material regardless of how the material is assigned to an object - whether by layer, by parent, or by object. To change the method of material assignment, go to the Rhino Material page for the object and select the desired method in the Assign by section.

Air material properties can be edited on the Air Material page, available in the Rhino Properties dialog for a selected object.

Shaders

Air uses small programs called shaders to perform all shading computations. Each material uses a surface shader to compute the output color for an object at a particular location. A material may also have a displacement shader, which adds small topographical features such as bumps, grooves, or dents.

Air comes with more than 50 pre-written surface shaders that you can use for your materials. You do not need to write a shader to use Air or the Rhino-to-Air plugin. If you would like to write a custom shader, Air includes an easy to use shader-building tool, Vshade. See the separate Vshade documentation for more information on building custom shaders.

Surface Shaders

The Air Material page in the Rhino Properties dialog has controls for selecting a surface shader. The dropdown list contains many commonly used shaders. Additional shaders can be loaded from the `shaders` directory of your Air installation. The compiled shader files for any custom shaders should be placed in the `usershaders` directory of your Air installation.

If the surface shader is set to the special value Rhino, the plugin will use the Rhino material properties - color, maps, and gloss settings - for the appearance of the material.

Most surface shaders have a list of parameters for modifying the effect of the shader, such as adding texture maps, adjusting lighting levels, etc. The parameter list will appear below the shader controls in the Air Material page. The Shader Guide section of the Air User Manual has additional information about each surface shader and its parameters.

Displacement Shaders

Use a displacement shader to add topographical details such as dents or embossing to a surface using the Displacement controls on the Air Material page. The dropdown list contains many commonly used displacement shaders. Additional displacement shaders can be loaded from the shaders directory of your Air installation.

When the Displacement shader is set to Rhino, the plugin translates the Rhino bump map settings to an Air displacement shader.

Displacement mode

The displacement mode determines how a displacement shader is applied:

Off	The displacement shader is not used.
Bump only	The displacement is applied as a bump effect, modifying the shading normal but not moving the surface.
Regular displacement	The displacement shader moves the surface. The shader is evaluated by carving a surface into pieces and displacing each piece separately.
Mesh displacement	The displacement shader moves the surface. An entire object is tessellated and displaced at once.

Both regular and mesh displacement perform true "sub-pixel" or "micropolygon" displacement. The quality of the displaced mesh depends on the surface tolerance property, which can be set globally on the Air Main page or for an individual object on the Air Object page. A higher tolerance setting will produce a coarser displacement, which will use less memory and render more quickly.

Mesh displacement is generally slower than regular displacement. Mesh displacement is less likely to exhibit cracks, and it produces smaller final meshes. Using the Rhino render mesh for NURB surfaces may also improve displacement results.

Instancer Shaders (new in Air 8)

An instancer shader can be used to create new objects at render time based on properties of a "base" object in Rhino. Instancer shaders are useful for allowing models to be represented by simple entities (such as points) in Rhino with more complex representations created at render time.

See Also:

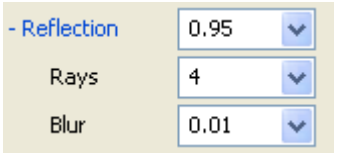
Air Material page
AirMaterial command

Air User Manual: Shader Guide
Air User Manual: Texture Mapping

9.1 Reflections

Reflections are a common feature of many shiny real world surfaces. As with other surface characteristics, in Air the appearance of reflections is controlled through the surface shader assigned to an object.

Many surface shaders provide an option for reflections, including the Plastic, Metal, and Ceramic shaders available in the Surface control dropdown list on the Air Material page. The following reflection controls are typically provided:



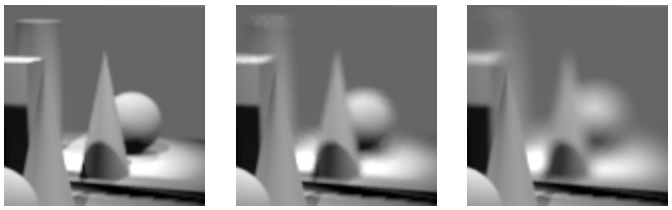
Reflection Intensity

The `Reflection` parameter serves as a multiplier for the overall reflection intensity. A `Reflection` value of 0 disables reflections for a surface, which saves render time by not casting reflection rays.

Reflection intensity is also affected by the type of reflective material. Metals typically have fairly uniform reflection intensity. For plastics and other composite materials, the intensity varies with viewing angle: reflections viewed face-on are dimmer than those viewed at a glancing angle. Air surface shaders that simulate composite materials such as plastic and ceramic incorporate a physically-based variation in reflection intensity with viewing angle.

Reflection Blur

The `Reflection Blur` parameter controls the softness or blurriness of reflections.

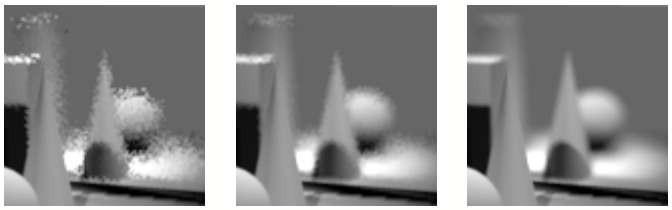


blur 0.01 blur 0.05 blur 0.1

Technically, the blur value is the half angle in radians of a cone of directions within which reflection rays are traced.

Reflection Rays

The quality of ray-traced reflections depends on the number of rays that are cast. More rays produce smoother results but take longer to render. For blurry reflections you may need to increase the number of rays significantly.



1 ray 4 rays 16 rays

Global Reflection Properties

The Air Trace page holds controls for several reflection properties that apply to the scene as a whole.

Max Bounces

The max bounces setting limits the number of "bounces" through which Air will follow a reflected or refracted ray. Lower values will reduce rendering time, but too low a value can leave some shiny materials without reflective or refractive effects.

Reflected Environment

The look of highly reflective materials such as polished metal or glass depends heavily on having something interesting to reflect. That includes not only other objects modeled in the scene but also the surrounding "world" outside the model.

The reflected environment settings determine what color is returned by reflection rays that "leave" the scene after failing to intersect any objects. The default setting simply returns a constant color. More interesting and realistic results can be achieved by using an environment map that represents an appropriate surrounding for the model.

Reflection Maps

AIR allows reflections to be generated using an environment map instead of ray tracing. Reflections from an environment map can be faster and smoother than traced reflections, particularly for very blurry reflections. Blurry reflections also help to hide any inaccuracies in the environment map used for reflections.

You can specify an environment map in the Map name parameter of a shader. When using an environment map, the Space parameter under Reflection should also be set to "world".

The RhinoAir plugin includes a AirRenderCubeMap command for rendering a cube-faced environment map from a user-specified "eye" point in the current scene. To generate a map for a particular object:

1. Go to the Air Main page in the Rhino document properties dialog and select the desired image width and height. The width should be exactly twice the height, and the height should be a power of 2.
2. Go to the Air Display page and enter a name for environment map image
3. Close the dialog
4. Note the approximate center of the object that will use the environment map
5. Hide the object temporarily
6. Invoke the AirRenderCubeMap command.
7. Specify the eye point for the cube map as the object center noted in step 4.

When the cube map has finished rendering:

8. Show the hidden object and select it.
9. Display the Air Material dialog
10. Choose a shader with reflections such as the Metal shader

11. Expand the `Reflection` section
12. Click the button next to the `Map name` parameter and use the file chooser dialog to select the rendered cube map
13. Set the `Space` parameter to "world".

For a scene with many objects that are small on-screen or have very blurry reflections, you may be able to use a single environment map for all objects.

See Also:
Air Trace page
AirRenderCubeMap command

9.2 Texture Maps

With Air texture maps can be used to control almost any aspect of a rendering depending on the surface and displacement shaders that are used.

When the surface shader for an Air material is set to Rhino, Air will use a Rhino texture or transparency map assigned in Rhino during rendering. When the displacement shader is set to Rhino, RhinoAir uses a Rhino bump map if present as a displacement map.

Most of the surface shaders included with Air provide parameters for specifying texture maps that control color, opacity (the inverse of transparency), specularity or shininess, and bump effects. The special Decal 2D and Decal 3D shaders can be used to apply texture maps as decals.

Texture Conversion

For efficient rendering, texture maps are automatically converted to Air texture maps prior to rendering if the Convert Textures option is enabled on the Air Plugin page. These special texture maps allow Air to load only those parts of the map that are needed during rendering, and to load each texture section at a resolution that is appropriate to the size of the texture in the rendered image.

The Air Plugin page allows a texture cache directory to be specified to hold all converted textures. If no cache directory is provided, the converted texture map will reside in the same directory as the source texture image.

Texture conversion can include gamma correction based on the gamma value specified on the Air Plugin page. Many commercially available textures have had gamma correction applied so that they appear "nice" when viewed on a standard computer monitor. If such textures are used as-is in a rendering that has gamma correction applied to the final image (as specified on the Air Display page), the textures will effectively have gamma correction applied twice, and they will appear faded and incorrect. The texture gamma value specified on the Air Plugin page is that assumed gamma for the texture maps. RhinoAir will use the inverse of that value to convert the texture map back into a linear color space for rendering. If you view a converted texture map in Air Show, the converted map will appear darker than the original texture.

Texture Wrapping

By default texture maps for a Rhino material will repeat in both directions, as will color, specular, opacity, and bump maps provided to an Air surface shader. Decal maps are converted so that they do not repeat.

For greater control over the texture conversion process, use the Air texture conversion tool (available from the Tools menu of Air Show) to convert a source map to an Air texture file, and provide the name of the converted Air texture as the desired shader parameter value.

Air can read image files in TIFF, PNG, HDR, PSD, and JPEG formats. Textures in other formats (such as BMP) will need to be converted to one of the preceding formats when rendering with Air.

See Also:

Ptex: Per-Face Texture Mapping

9.3 Placing Decals and 2D Patterns

Decals are small non-repeating textures used to add a label or other detail to a model.

Air provides 2 surface shaders for rendering a surface with decals. The Decal 2D shader positions decals using the standard texture coordinates assigned to an object. The Decal 3D shader (documented elsewhere) positions decals using projective mappings that are independent of the assigned texture coordinates.

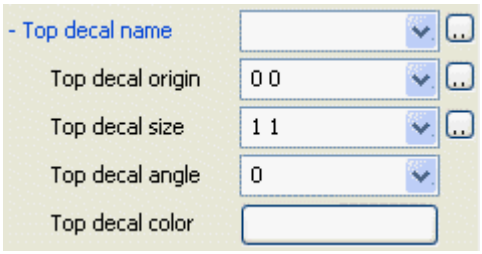
Decal 2D - Decals Positioned with Texture Coordinates

Use the Decal 2D surface shader to create a surface with decals as follows:

- Select the object to receive decals.
- Display the Air Material page in the Rhino object properties dialog.
- Click the New button to create a new basic material for the object.
- Select the Decal 2D shader from the Surface dropdown list.

The Decal 2D shader allows up to 3 decals to be applied.

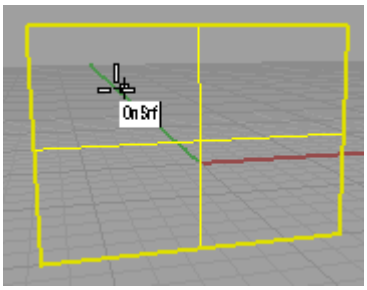
- Click the dialog button next to the `Top decal name` parameter and use the file selection dialog to pick the image for the decal.
- Click on the Top decal name parameter to reveal the associated parameters used to position the decal:



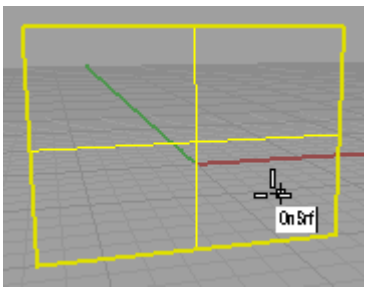
Initially the decal will cover the entire texture range on the surface:

For NURB surfaces and polygon meshes, the decal origin and size can be set by selecting points on the surface in a Rhino viewport. Only one object should be selected at a time when placing decals.

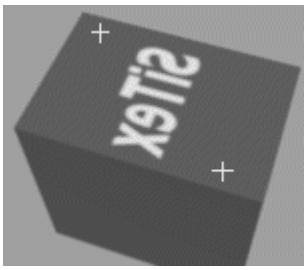
- Click the edit button next to the `Top decal origin` parameter.
- Pick a point on the surface in a Rhino viewport where you would like the top, left corner of the decal to be positioned.



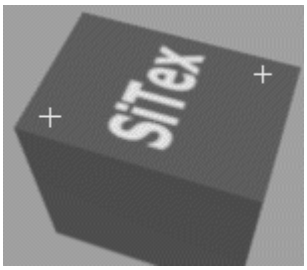
- Now click the edit button next to the `Top decal size` parameter.
- Pick the position on the surface for the bottom, right corner of the decal:



In some cases (particularly on polysurfaces with packed texture coordinates) the decal may appear twisted or flipped about its diagonal:



To untwist the decal, re-pick the origin and far corner points starting with one of the corners that was not chosen before:



Then set the `Top decal angle` parameter to 90 or 270 degrees to rotate the decal to the desired orientation:

Tip: Interactive Preview Rendering can quickly show the location of a decal and aid in fine-tuning decal placement.

Placing 2D Patterns

This same technique can be used to place any texture or 2D pattern that uses similar positioning parameters: a 2D origin, a 2D size, and a rotation. One copy of the pattern will exactly cover the region defined by the origin and size parameters.

See Also:
Projected Decals and Planar Mapping

9.4 Projected Decals and Planar Mapping

Decal 3D - Decals Positioned with Projective Mapping

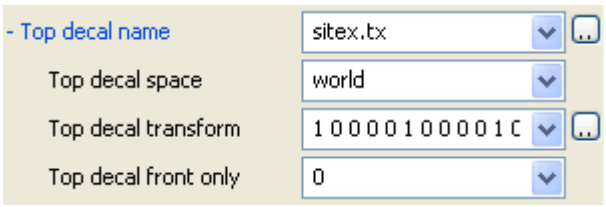
Decals are small non-repeating textures used to add a label or other detail to a model.

The Decal 3D surface shader applies decals by projecting the images onto a surface in a manner similar to the way in which a slide or film is projected onto a flat surface for display.

- Select the object to receive decals.
- Display the Air Material page in the Rhino object properties dialog.
- Click the New button to create a new basic material for the object.
- Select the Decal 3D shader from the Surface dropdown list.

The Decal 3D shader allows up to 3 decals to be applied.

- Click the dialog button next to the `Top decal name` parameter and use the file selection dialog to pick the image to apply as a decal.
- Click on the `Top decal name` parameter to reveal the associated parameters used to position the decal:

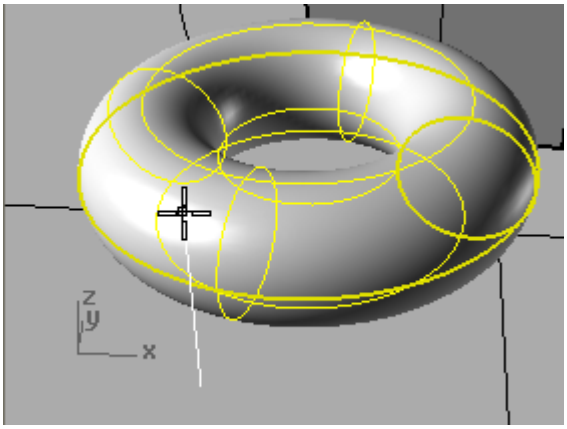


The `Top decal transform` parameter contains the transformation matrix used for the projection.

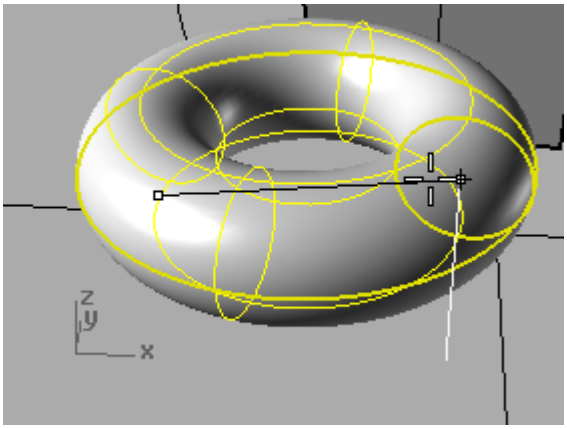
- Click the edit button next to the Top decal transform parameter to begin selecting a rectangle in 3D space that will define a projection. This process is very similar to Rhino's ApplyPlanarMapping

command.

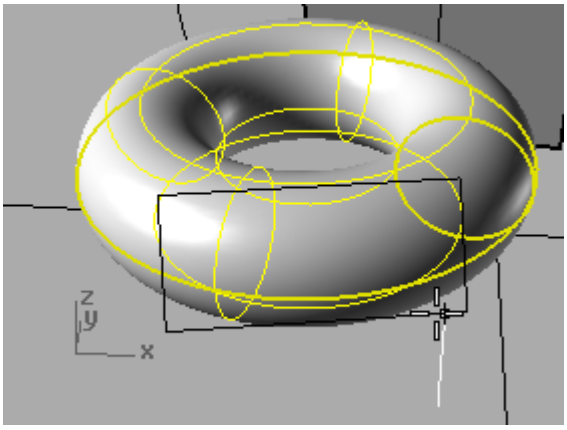
- Select a 3D point to use to project the top, left corner of the decal.



- Pick a second point to correspond to the top, right corner of the decal.



- Select a third point to finish defining the projection rectangle.



- Render a test image to see the decal in position.

Tip: Interactive Preview Rendering can quickly show the location of a decal and aid in fine-tuning decal placement.

Positioning 2D Patterns with Projection

This same method of defining a projection can be used to position any 2D pattern that provides parameters for `Projection` type and `ProjectionTransform`: Set the `Projection` type to "planar", and set the `ProjectionTransform` parameter using the associated edit button. The projection rectangle will define the region covered by a single copy of the 2D pattern.

Moving Objects with Projected Textures

The 3D-to-2D transformation used to position a projected decal or patterns is defined relative to a coordinate system. By default this coordinate system is the common "world" space shared by all objects in Rhino. If the textured object is translated, rotated or otherwise transformed, the projection will no longer match up.

If you need to move an object after applying a projected texture, you can use Rhino's block feature as a workaround. Standard Rhino objects do not keep track of a local coordinate system; blocks, however, do have a local coordinate system. We can use that to lock the projected texture to the object within a block:

- Select the textured object and display the Air Material page.
- Find the `decal space` or `Projection space` parameter and change the value from `world` to `object`.
- With the object selected, go to the Rhino Edit menu, and choose Blocks -> Create Block Definition.
- When prompted for the base position for the block, choose the world space origin (0,0,0). This step is very important! By choosing the origin as the base point, we make the position of the object within the block match the object position used when setting up the projected texture.
- Create one or more instances of the block, translating and rotating as desired.

See Also:
Placing Decals and 2D Patterns

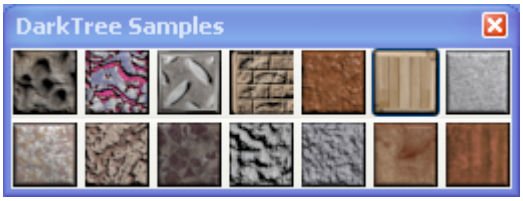
9.5 DarkTree Shaders

Air and the RhinoAir plugin allow you to use DarkTree shaders as materials as well as Air's native RenderMan shaders.

The Air distribution includes several sample DarkTree shaders in the subdirectory:

```
viztools\darktree
```

The sample DarkTree shaders can be applied to an object using the DarkTree Samples toolbar included with RhinoAir:



More than 300 additional DarkTrees are available for download from the Darkling Simulations web site:

```
www.darksim.com
```

Using DarkTree Shaders

The DarkTreeSurface shader allows any DarkTree shader to be used as a surface shader for Air. To use this shader, select it from the dropdown list as the Surface shader for a material. Use the dialog button next to the DarkTreeShader parameter to load a DarkTree shader.

Most DarkTree shaders include parameters for controlling the appearance of the shader. RhinoAir will automatically load those parameters and display them at the bottom of the parameter list for the DarkTree surface shader.

The DarkTreeDisplacement shader allows any DarkTree shader with bump features to be used as a displacement shader for Air.

About DarkTree

DarkTree is a visual shader creation tool from Darkling Simulations:

> "DarkTree 2.0 is an advanced procedural shader authoring tool. Its visual flow-based editor lets you interactively create photo-realistic procedural materials, surface shaders, and animated effects. DarkTree 2.0 includes 100 procedural components that can be combined to generate almost any texture or surface effect you need."

An evaluation version of DarkTree is available from the Darkling Simulations website
www.darksim.com

9.6 Trees

Air 8 introduces new instancer and procedure shader types that make it feasible to add trees to Rhino scenes. The workflow uses a set of points or a point cloud to represent the positions of the trees which are created at render time.

Step-by-step instructions:

- Create a separate layer to hold the points that will represent the trees. Then create a set of points or a point cloud with the desired position of each tree.
- Select the points or point cloud.
- Display the Air Object properties dialog and check **Shade curves, points**.
- Display the Air Material dialog.
- Select the Instancer radio button and choose `Instance tree` from the drop down list of shaders.

This shader will create the trees.

The `Tree archive` parameter holds the name of a rib file with a tree definition (in the form of a call to the VTree procedure shader). The Air distribution includes a few sample trees in the archives subdirectory of the Air installation.

- Click the edit button next to the `Tree archive` parameter to display a file chooser dialog. Navigate to the `archives` directory of your Air installation and choose one of the sample trees.

- Expand the list of parameters under `Tree archive` by clicking on the parameter name. By default the trees are created with the Y axis as the up direction. Set the `Tree rotate x` parameter to 90 to rotate the trees so that Z is the up direction.

Each tree is a random variation of a parameterized tree model. By changing the `Tree seed` parameter you can create a different random tree. For a point cloud each point will receive a different random seed.

The tree dimensions are defined in meters. If the units in your scene are different, use the `Tree scale` parameter to scale the trees appropriately. The tree height parameter can be used to set a specific tree height (in meters). Note that the tree height affects many other aspects of the tree including the number branches created.

We don't want the points themselves to be visible in the final rendering.

- Check **Hide base** in the Air Material dialog to hide the points at render time.

The renderer needs to know approximately how large the trees will be so it can expand the bounding box around the points accordingly.

- Set the **Extent** value to the maximum height of the selected tree - try 10 to start.

- Display the Air Main dialog page in the Rhino Document Properties dialog.
- In the Geometry section check **Curves and points** to enable export of the point geometry.
- Click OK to close the Air Main dialog.

Render the scene to see the trees.

You can create your own tree models using the VTree procedure shader included with Air. The Air User Manual has a detailed description of the tree shader and a tree-creation workflow under:

Shader Guide -> Procedures -> VTree

See Also

Materials

9.7 Crowds

Massive (www.massivesoftware.com)

Massive is the premier 3D animation system for generating crowd-related visual effects for film and television. Using Massive, an animator designs characters with a set of reactions to what is going on around them.

The reactions of the characters determine what they do and how they do it. Their reactions can even simulate emotive qualities such as bravery, weariness, or joy. The agent reactions can control key-

framed or motion captured animation clips called actions.

Characters that perform on their own in this way are referred to as agents. Massive is a system for designing and running such agents. When scaled up into the hundreds - or hundreds of thousands - the interaction within the crowd that emerges from these individuals is highly realistic.

Rendering Massive Crowds

RhinoAir provides an easy way to add Massive crowds to a rendering of your scene using the MassiveAgents instancer shader. This page describes in detail how to render a crowd simulated in Massive.

Preliminary: Massive uses a small program called `runprogram.exe` to create agents at render-time. Air must be able to find the `runprogram.exe` file at render-time. The easiest way to ensure that is to copy the `runprogram.exe` file from your Massive installation to the `procedurals` directory of your Air installation.

1. Select the terrain object in the scene (or another large object if there is no terrain). Display the Air Material page for the object. Assign the MassiveAgents shader as the instancer shader.

2. Set the instancer `Extent` to a value such that the terrain object bounding box incremented by the Extent would encompass all the Massive agents in the scene.

3. Set the `Agent archive prefix` parameter to the file name of the agent archives exported from Massive minus the frame number and `.rib` extension.

4. Copy the Massive options string from one of the scene rib files exported by Massive (the options should be the same for every frame). Look in the scene rib for a line that looks like:

```
Procedural "RunProgram" ["run_program.exe" "options motion_blur on render_pass
renderpass_Air air "][-2250.06 2249.94 -262.813 302.097 -2250.36 2249.64]
```

The string after "runprogram.exe" is the options string. Copy all characters between the quotes and paste them as the value for the `Massive options` parameter in the Air Material dialog.

5. Set the `Rotate x` value to 90 to compensate for the different up directions in Rhino and Massive (the Y axis is up in Massive; the Z axis is up in Rhino).

6. Use the `Frame offset` value to pick the Massive agent frame that should correspond to the first Rhino frame in an animation.

7. Use the `Bound` parameter to define a bounding box that encompasses all the agents in the scene. This bound is used in the Procedural call to set the Massive runprogram options. In many cases you may be able to use the bounding values in the Procedural call in the main scene rib described above. The bounding box is defined with six values: *minx maxx miny maxz minz maxz*.

8. To render an animated sequence, you must enable one of the animation modes in RhinoAir on the Air Animation page of the Rhino options dialog. If your scene does not employ any other animation, set the Animation mode to Turntable with a Max angle of 0.

9. Render to see your Rhino model with Massive agents generated at render-time.

9.8 Ptex: Per-Face Texture Mapping

Air 11 and later support per-face texture mapping using the open-source Ptex library. (www.ptex.us)

Overview

The Ptex library was developed to address several common problems with traditional 2D texture mapping:

- Assigning "good" texture coordinates to complex models can be difficult and tedious
- Texture seams can be visible along discontinuities in the texture map
- Large numbers of texture files can create a significant IO bottleneck

The Ptex system addresses these concerns by eliminating UV assignment, providing seamless filtering, and allowing an arbitrary number of textures in a single file. A Ptex file stores a separate texture map for each face in a mesh, with adjacency information to allow proper filtering across face boundaries. The Ptex library provides a texture cache for managing large numbers of textures efficiently.

Ptexfiles can store 8-bit, 16-bit, float, and half precision data with an arbitrary number of channels.

Creating Ptex Textures

Ptex textures can be created using a 3D paint program such as 3DCoat (www.3d-coat.com).

Using Ptex Textures

Ptex textures can be used for color, specular, or displacement maps just like any other texture file. To render Ptex textures, you must enable one additional property for the material assigned to an object. With the object selected, start the AirMaterial command, and click on **UsePtex** to enable the creation of special texture coordinats and face ids for the textured object. Note that you cannot combine regular textures and Ptex textures on a single object.

Using 3DCoat Textures

The PTEX files exported by the 3DCoat paint program appear to have the texture coordinates swapped. You can compensate for that in most Air surface shaders by setting the `TextureSizeXY` parameter to 1 -1 and the `TextureAngle` to 90.

10 Environment Shaders

An environment shader is used to shade a traced ray that misses all objects in a scene.

You can set the global environment shader on the Air Environment page or using the AirEnvironment command. The RhinoAir interface provides the following environment modes:

Off
: No environment shader is defined for the scene, and ray queries always return black.

Color
: A single constant color is returned for all ray queries.

Map
: An environment map is sampled for each ray query.

Sky
: A physical sky model is computed based on location, date, and time. An optional directional light can be automatically included for the sun.

For each ray type, you can select whether to use the common environment shader or to use a custom environment for that ray type:

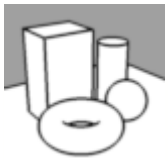
- For camera rays, select the Image Background mode on the Air Main page. By default the common environment shader is NOT used for camera rays.
- For reflection and refraction rays, select the Reflection Environment mode on the Air Trace page. By default reflected and refracted rays use the common environment shader.
- For indirect rays, set the Global Illumination Environment on the Air GI page. By default indirect rays use the common environment shader.

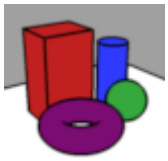
11 Illustration

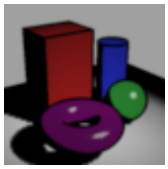
Air can draw outlines in a scene, which can be combined with different surface finishes to produce illustrations.

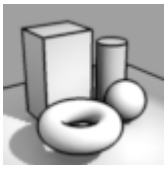
The illustration toolbar has buttons for rendering a few preselected illustration types with a single click:

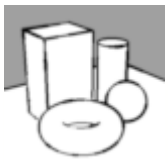
The following images show a simple scene rendered with some of the illustration buttons:

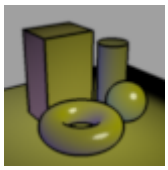

all white
no shading

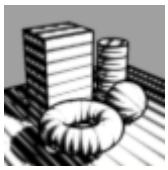

color
no shading

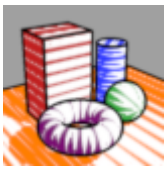

cartoon
shader


white matte
occlusion


sketch
outline shader


tone
shader


black lines
on white


color
lines

Outlines

Controls for outline rendering can be found on the Air Outline page in the Rhino document properties dialog.

You may obtain cleaner outline rendering by enabling the "Use render mesh" option on the Air Main page.

12 Animation

Air can be used to render animated sequences as well as still images.

The RhinoAir plugin comes with several builtin animation options which can be configured on the Air Animation page. The View Animation section contains information about animating a camera move or producing a simple turntable animation. The Object Animation section describes now to animate individual objects. These animation methods are efficient to export because the main scene data needs to be exported only once for all frames.

Air can also be used to render animations created with the Bongo companion to Rhino.

See Also:
View Animation
Bongo Animation

Air Animation page

12.1 View Animation

The Rhino Air plugin includes builtin options for creating several basic types of view animation. The Air Animation page in the Rhino document properties dialog holds controls to enable and configure the builtin animation modes.

Animation Export

Just as when rendering a single frame, rendering multiple frames consists of 2 steps:

1. Exporting a scene file for each frame to be rendered.

2. Starting Air as an external process to render the frames.

The AirRender command performs both steps. The AirExport command only creates the scene files. Once the scene files have been created, they can be rendered with Air outside of Rhino at any time.

When exporting an animated scene, the RhinoAir plugin creates several RIB files. The file names are derived from the base RIB file name given on the Air Main page. To minimize disk space and export time, all objects and most scene properties are exported once to a single (potentially large) file that is referenced by every frame. For each frame a smaller RIB file is created with frame-specific information, such as the current camera position in a fly-through animation. Finally, RhinoAir creates a master RIB file that can be used to render all the exported frames.

For example, assuming the base RIB file name is `RhinoAir`, exporting a 4 frame animation would create the following files:

`RhinoAir_world.rib`	scene elements common to all frames
`RhinoAir_0000.rib`	first frame
`RhinoAir_0001.rib`	second frame
`RhinoAir_0002.rib`	third frame
`RhinoAir_0003.rib`	fourth frame
`RhinoAir_all.rib`	file that reads every frame file in order

Version Control

It is important not to overwite any of the exported frame files until the animation has completed

rendering. As an aid to managing multiple renders, the RhinoAir plugin can give each exported sequence a unique version number if the **Append version** option is enabled on the Air Plugin page.

Animation Output

For an animation that requires a non-trivial amount of time to render, it is highly recommended that you output images to a file and not to the Air Show framebuffer so that in case of a system failure, any complete frames will be saved. To render to an image file instead of Air Show, uncheck **Render to Air Show** on the Air Display page.

For animation the rendered image file will have the frame number appended to the base image name given on the Air Display page. E.g., if the base name is `air.tif`, the rendered frames will be

```
air_0000.tif
air_0001.tif
air_0002.tif
air_0003.tif
...
```

Once all frames have been rendered, they can be converted into an AVI file using Air Show. Air Show can load a numbered sequence of files (select the first file in the open dialog; Air Show will then ask if you wish to load all files in the sequence). Note that many AVI compression codecs do not support the full color images generated by Air.

The inexpensive Pro version of Apple's QuickTime player can create a Quicktime movie from an image sequence.

Rendering with Air Control

The separate Air Control render management program included with Air can be used to render a previously exported animation sequence. Air Control can be started from the Windows Start menu or from the Tools menu of Air Show.

To render a number frame sequence with Air Control, select the first frame as the scene file. Check the Frame range option. By default Air Control will render all frames beginning with frame 0. You can specify a subrange of frames using the From and To parameters.

Command Line Rendering

An exported scene file can be rendered by starting Air from an MS-DOS prompt (command shell). For example, assume that the above scene files have been exported to the directory C:\Temp. From an MS-DOS prompt, all frames could be rendered with:

```
cd C:\temp
air RhinoAir_all.rib
```

Note that the number of processors and processor priority set on the Air Plugin page are not included in the RIB files. To set the number of processors, use the -p command line option. For example, to render with 4 processors:

```
air -p 4 RhinoAir_all.rib
```

To render in the background with a lower priority process, use

```
air -pri -1 -p 4 RhinoAir_all.rib
```

To render a single frame, render the rib file for that frame:

```
air RhinoAir_0002.rib
```

Air has a couple special command line switches for selecting subsets of an animated sequence. Use the -frames switch to specify a range of frames. For example, to render the 2nd and 3rd frames (frames 1 and 2), use

```
air -frames 1 2 RhinoAir_all.rib
```

Keep in mind that the first frame is frame number 0.

Use the -step option to specify an increment in a frame range. For example, to render only even frame numbers in a 4 frame animation, use

```
air -frames 0 3 -step 2 RhinoAir_all.rib
```

For odd frames:

```
air -frames 1 3 -step 2 RhinoAir_all.rib
```

See Also:

Air Animation page

12.2 Object Animation

RhinoAir provides a simple mechanism for animating objects in a scene.

To animate an object, use the AirMotion command to assign one or more actions. Actions are stored as a list on the object, and are applied in order.

Every action has a start and end time. The time values are relative to a scene duration set on the Air Animation page. The scene duration can be any value and in any units that make sense for your animation. E.g., for a 30 second animation, you might wish to set the duration to 30, and then all time values would be in seconds.

Animating

To start animating:

- Select one or more objects.
- Type AirMotion and press Enter.
- Click on Append to add a new action.

The following action types are currently supported:

Translate - translate an object in X, Y, or Z
Rotate - rotate the object an angle in degrees about an arbitrary axis
Scale - scale an object in X, Y, or Z

By default the new action added with Append will be a Translate action. Click on the Action item to change the action type.

Set the Start and End times to the desired values. Each action type has additional parameters controlling the animation. Change those to the desired values for your animation.

When you are through editing the new action, press Enter to return to the main AirMotion command list. From there you may view the new action with the List command. Use the Edit command if you need to edit the action parameter values. The Delete option can be used to remove an action. With

more than one action, an Order option will appear, allowing you to re-order the actions.

Rendering

To render an animated sequence with object motion:

- Open the Rhino options dialog and select the Air Animation page under the Air Main page.
- Check Animate objects.
- Render.

See the View Animation page for details on how animation data is exported and rendered.

See Also:

View Animation
AirMotion command

12.3 Bongo Animation

Air can be used to render animations created with the Bongo companion animation tool for Rhino. (*Bongo 1 users please see the note at the end of this page.*)

Use the Bongo-to-Air toolbar button 

to export a Bongo animation and render it with Air.

Bongo to Air <Render> (FirstTick_17 LastTick_25 Render Quit):

The Bongo-to-Air render and export scripts have two important parameters. Set the FirstTick parameter to the tick or frame at which to start the animated sequence. Set the LastTick parameter to the last tick or frame in the sequence. The script will export one frame for each tick.

Press Enter or click the Render parameter to start the export and render process. The script will create a separate scene file for each frame in the animation. The name for each file is created from the RIB file name specified on the Air Main page by appending the frame number.

After all frames have been exported, the script will start an external process to render the frames. You can continue to work in Rhino as the frames are rendered in the background.

Version Control

It is important not to overwite any of the exported frame files until the animation has completed rendering. As an aid to managing multiple renders, the RhinoAir plugin can give each exported sequence a unique version number if the **Append version** option is enabled on the Air Plugin page.

Animation Output

For an animation that requires a non-trivial amount of time to render, it is highly recommended that images be rendered to a file and not to the Air Show framebuffer so that in case of a system failure, any complete frames will be saved. To render to an image file instead of Air Show, uncheck **Render to Air Show** on the Air Display page.

Each frame in the sequence will have the frame number appended to the base image name given on the Air Display page. E.g., if the base name is `air.tif`, the rendered frames will be

```
air_0000.tif
```

```
air_0001.tif
air_0002.tif
air_0003.tif
...
```

Once all frames have been rendered, they can be converted into an AVI file using Air Show. Air Show can load a numbered sequence of files (select the first file in the open dialog; Air Show will then ask if you wish to load all files in the sequence). Note that many AVI compression codecs do not support the full color images generated by Air.

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```
cd C:\temp
air RhinoAir_all.rib
```

Note that the number of processors and processor priority set on the Air Plugin page are not included in the RIB files. To set the number of processors, use the -p command line option. For example, to render with 4 processors:

```
air -p 4 RhinoAir_all.rib
```

To render in the background with a lower priority process, use

```
air -pri -1 -p 4 RhinoAir_all.rib
```

To render a single frame, render the rib file for that frame:

```
air RhinoAir_0002.rib
```

Air has a couple special command line switches for selecting subsets of an animated sequence. Use the -frames switch to specify a range of frames. For example, to render the 2nd and 3rd frames (frames 1 and 2), use

```
air -frames 1 2 RhinoAir_all.rib
```

Keep in mind that the first frame is frame number 0.

Use the -step option to specify an increment in a frame range. For example, to render only even frame numbers in a 4 frame animation, use

```
air -frames 0 3 -step 2 RhinoAir_all.rib
```

For odd frames:

```
air -frames 1 3 -step 2 RhinoAir_all.rib
```

Bongo 1 Compatibility

Bongo 1 users will need to edit the scripts attached to the Bongo button in order for them to work with Bongo 1.

The Bongo 2 developers changed the name of one crucial Bongo command in Bongo 2. You will need to change new BongoSetSliderPosition command back to the old BongoSetCurrentTick:

- Move the mouse over the Bongo-to-Air button. Hold down the SHIFT key and right click to bring up the edit dialog.
- Make this change to both scripts. Look for the line that says:

  ```
  Rhino.Command "-_BongoSetSliderPosition " & Frame, vbFalse
  ```

  and change it to

  ```
  Rhino.Command "-_BongoSetCurrentTick " & Frame, vbFalse
  ```

- Click OK when you're done.

You should then be able to render the animation with Air using the Bongo-to-Air button.

13 IPR - Interactive Preview Rendering

With RhinoAir you can interactively adjust shading and lighting in a scene while viewing the results in a high-quality preview rendering managed by TweakAir. TweakAir is a special version of the Air renderer optimized for interactive shading and lighting.

If you do not have an Air license, TweakAir will run in demo mode, which limits the image resolution to 400x300.

Starting an Interactive Rendering Session

Use the AirIprStart command or the IPR toolbar button 

(on the main Air toolbar) to begin an IPR session. To start an IPR session, RhinoAir first exports the scene as with a normal rendering and then starts TweakAir as a separate process to manage the interactive render view. The rendered view will appear as a frame in the separate Air Show framebuffer.

Tip: You can keep the Air Show window in front of the Rhino window by enabling the **Always on top** option in the Air Show Options menu.

Interactive Preview Rendering

Once an IPR session is started, RhinoAir sends shading and lighting changes to the active TweakAir process as you make them.

Materials can be edited using any available method - the Rhino Material page, the Air Material page or

the AirMaterial command. During IPR the material preview on the Air Material page is disabled to make more processing power available for interactive updates.

In some cases you may notice a delay in the update of the Rhino user interface when selecting new texture maps. This delay occurs when RhinoAir converts a raw image file to an Air texture map prior to sending the updated material information to TweakAir. Texture conversion should only occur the first time a map is used; subsequent references to the same source image will use the existing converted texture.

Lighting changes can be made in any manner supported by Rhino. Lights can be added, removed, moved and edited on the Air Light page or the Rhino Light page.

View Changes

Beginning with TweakAIR 8.05, the camera position and field of view in the IPR window can be updated without restarting the IPR session. Check the **Automatically update view** option on the AIR Interactive page to enable automatic IPR view updates.

Environment Updates

Changes made to the reflected environment on the Air Trace page or using the Air Trace command will update in the IPR view if the Auto-updated reflections option is checked on the Air Interactive page.

Changes to the Global Illumination environment will update when the GI mode is set to Ambient or one of the Occlusion modes. Note that the GI mode must be set prior to starting the IPR session.

Changes to the image background made on the Air Main page are reflected in the IPR view.

Ending an Interactive Rendering Session

Use the AirIprEnd command or right click the Air IPR button 

to end an IPR session, terminating the background TweakAir process.

IPR Options

The Air Interactive page in the Rhino document properties dialog has controls for configuring the behavior and performance of interactive preview rendering.

See Also:
Air Interactive page

AirIprStart command
AirIprEnd command

14 Baking Textures with BakeAir

Demo restrictions: The BakeAir demo limits baked map size to 256 pixels in width and height, and baked maps are watermarked.

RhinoAir provides an interface for rendering or baking shading and lighting to texture maps with SiTex Graphics BakeAir dedicated texture renderer. The Air Bake toolbar has convenient buttons for baking textures.

Baking or Rendering Textures

The baking process consists of the following steps:

- Set properties for the baked texture maps on the Air Bake page or using the AirBake command.
- Use the AirBake command to export a rib file and start BakeAir as a separate process to render the texture maps.
- Wait for the BakeAir process to complete.

That completes the baking process.

Viewing Baked Textures in Rhino

The baked maps can be viewed in Rhino using a special baked display mode. The RhinoAir distribution includes a BakedAir.ini file that defines this special display mode. To load the baked display mode:

- Display the Rhino Document Properties dialog.
- In the Appearance section of RhinoOptions, select Advanced Settings.
- Click the Import button.
- Navigate to the directory with the RhinoAir distribution. For Rhino 4, load BakedAir.ini. For Rhino 5, load BakedAir5.ini.

To view baked texture maps in Rhino:

- Use the AirLoadBakedMaps command to load the texture maps into Rhino.
- Set the display mode for the viewport to BakedAir.

Note that Rhino's display mechanism does not have an exact method for applying textures that already contain lighing information. The BakedAir mode is the best approximation currently possible with Rhino's standard display options.

When texture maps are re-rendered, you may need to execute the RefreshAllTextures command to reload the textures into Rhino.

Exporting a Model with Baked Textures

The RhinoAir plugin includes a special AirExportVrml command for exporting a model with baked textures to a VRML file. Unlike Rhino's VRML exporter, this special command knows how to properly define shading in the VRML file for use with baked textures.

The exported VRML file should be located in the same directory as the baked textures (since texture references in the VRML file will not have full paths).

If the current Rhino view is a perspective view, that view will be used as the default view in the VRML file. Due to limitations in the way a viewpoint is defined in a VRML file, the view in the VRML file will generally not exactly match the Rhino viewport.

The background color in the exported VRML file will be taken from the RhinoAir image background color.

Limitations

- Only shading on one side of a surface is baked. If a baked texture appears black, try using the Rhino Dir command to reverse the orientation of the surface.
- Only NURB surfaces and polygon meshes with well-defined texture coordinates in the unit square

can be baked.
- Each object generates its own baked texture map.

See Also:
Air Bake page
AirBake command
Baking Meshes with BakeAir

15 Baking Meshes with BakeAir

Note: Baking meshes requires BakeAir 11 or later. Mesh baking is disabled in the Air demo version.

The latest version of BakeAir introduces a new mesh baking mode, in which selected shader output values can be computed and saved as vertex data in an exported render mesh.

RhinoAir provides several pre-defined mesh baking modes, described on the following pages:

Baked Meshes for Realtime Viewing
Baked Meshes for Faster Occlusion
Baked Meshes for Faster Indirect Illumination
Baked Meshes for Subsurface Scattering
Baked Meshes for Procedural Patterns

For your first experiments with mesh baking, you may wish to work with a very simple model to keep bake times low.

Baked Mesh Quality and Mesh Density

Quality of the results when rendering with baked meshes depends strongly on the density of the underlying mesh. For shading values that vary smoothly across a surface - such as occlusion and indirect illumination - you may be able to bake a relatively coarse mesh. A finer mesh may be required to capture the fine details of a procedural color pattern or sharp shadow boundary.

The **EdgeLength** parameter of the AirBake command provides a simple, direct way of increasing the density of a polygon mesh. When the edge length value is greater than 0, it specifies the maximum length of any polygon edge in the mesh. When Air detects a polygon that is too large, it will automatically subdivide it until the edge length criterion is met. When EdgeLength is set to 0, finer tessellation of polygon meshes is disabled.

See Also:

AirBake command
Baking Textures with BakeAir

15.1 Baked Meshes for Realtime Viewing

A mesh with baked colors can be exported to a PLY file, then imported into another instance of Rhino for high-quality realtime viewing. Here's how:

Baking

- First, on the Air Main options page, make sure **Use Rhino Mesh** is checked.
- Select all objects you wish to export, and display the Air Object properties page.

- In the Advanced section, set the mesh mode to **Bake mesh**.
- Click the adjacent file dialog button, and provide an export file name ending in PLY Polygon format.
- Type the AirBake command and click on the **BakeMesh** option, or right-click the 'Bake mesh' button in the AirBake toolbar.
- Click on the **EdgeLength** argument, and type in the maximum edge length for polygons in the baked mesh. Smaller values will produce a denser mesh with more polygons, giving greater detail but also using more memory. Press Enter.
- Press Enter to start baking. BakeAir will produce a single (potentially very large) PLY file.

Viewing

- Once the baking process has finished, start a new instance of Rhino.
- Choose Import from the File menu, and import the PLY file created above.
- Load the BakedAir display mode if you have not already done so. (Navigate to the Advanced Settings page under Appearance in the Rhino Options dialog. Click import and navigate to the RhinoAir location. For Rhino 4, load BakedAir.ini. For Rhino 5, load BakedAirV5.ini)
- Set the viewport display mode to BakedAir.

See Also:
AirBake command

15.2 Baked Meshes for Faster Occlusion

Rendering with the global illumination Occlusion mode can be accelerated by baking an occlusion value to vertices.

Baking

- First, on the Air Main options page, make sure **Use Rhino Mesh** is checked.
- Select all objects you wish to export, and display the Air Object properties page.
- In the Advanced section, set the mesh mode to **Bake and use**.
- Click the adjacent file dialog button, and provide an export file name ending in RIB (to save in RenderMan RIB format). In the **Bake and use** mode, RhinoAir assigns a unique export file name to each object based on the file name you provide.
- On the Air GI page, set the GI mode to **Occlusion**. Adjust the quality and background options as desired.
- Type the AirBake command and click on the **BakeMesh** option, or right-click the 'Bake mesh' button in the AirBake toolbar.
- Click the **MeshMode** option and select **Occlusion**.
- Click on the **EdgeLength** argument, and type in the maximum edge length for polygons in the baked mesh. Smaller values will produce a denser mesh with more polygons, giving greater detail but also using more memory. Press enter.
- Press enter to start baking. BakeAir will generate a separate mesh file for each object. The mesh data will have an extra single float value per vertex holding the occlusion value.

Rendering

- When you render the scene with Air, each object with a baked mesh is rendered using the exported mesh. The occlusion values are automatically detected by the light shader used for occlusion rendering, allowing Air to avoid re-computing occlusion for those objects.

Updating

If you make changes to some objects in the scene, you can re-bake only those objects by selecting

them and enabling the **Sel** option in the AirBake command.

See Also:
Global illumination
AirBake command

15.3 Baked Meshes for Faster Indirect Illumination

Rendering with the global illumination Indirect mode can be accelerated by baking the indirect light color at each vertex.

Baking

- First, on the Air Main options page, make sure **Use Rhino Mesh** is checked.
- Select all objects you wish to export, and display the Air Object properties page.
- In the Advanced section, set the mesh mode to **Bake and use**.
- Click the adjacent file dialog button, and provide an export file name ending in RIB (to save in RenderMan RIB format). In the **Bake and use** mode, RhinoAir assigns a unique export file name to each object based on the file name you provide.
- On the Air GI page, set the GI mode to **Indirect**. Adjust the quality and background options as desired.
- Type the AirBake command and click on the **BakeMesh** option, or right-click the 'Bake mesh' button in the AirBake toolbar.
- Click the **MeshMode** option and select **Indirect**.
- Click on the **EdgeLength** argument, and type in the maximum edge length for polygons in the baked mesh. Smaller values will produce a denser mesh with more polygons, giving greater detail but also using more memory. Press enter.
- Press enter to start baking. BakeAir will generate a separate mesh file for each object. The mesh data will have an extra color value per vertex holding the incoming indirect illumination at that vertex.

Rendering

- When you next render the scene with Air, each object with a baked mesh is rendered using the exported mesh. The indirect light values attached to a mesh are automatically passed to the indirect light shader, allowing Air to avoid re-computing indirect illumination for that surface.

Updating

If you make changes to some objects in the scene, you can re-bake only those objects by selecting them and enabling the **Sel** option in the AirBake command.

See Also:
Global illumination
AirBake command

15.4 Baked Meshes for Faster Subsurface Scattering

Baking the diffuse shading component can be used to accelerate the rendering of subsurface scattering.

For this test, create a simple object and assign the Translucent surface shader. Add a light or two. Adjust the Scatter distance scale parameter of the Translucent surface shader until a preview render produces a pleasing effect. You may wish to use a color texture map to help visualize the scattering effect and compare the representation in the baked mesh.

Baking

- First, on the Air Main options page, make sure **Use Rhino Mesh** is checked.
- Select the test object, and display the Air Object properties page.
- In the Advanced section, set the mesh mode to **Bake and use**.
- Click the adjacent file dialog button, and provide an export file name ending in RIB (to save in RenderMan RIB format). In the Bake and use mode, RhinoAir assigns a unique export file name to each object based on the file name you provide.
- Type the AirBake command and click on the **BakeMesh** option, or right-click the 'Bake mesh' button in the AirBake toolbar.
- Click the **MeshMode** option and select **Diffuse**.
- Click on the **EdgeLength** argument, and type in the maximum edge length for polygons in the baked mesh. Smaller values will produce a denser mesh with more polygons, giving greater detail but also using more memory. Press enter.
- Press enter to start baking.

Rendering

When you next render the scene with Air, the test object is rendered using the exported mesh. The Translucent surface shader will detect the baked diffuse values attached to the mesh, and use those instead of re-computing subsurface scattering for the object.

See Also:
AirBake command

15.5 Baked Meshes for Procedural Patterns

By baking the unlit surface color from shaders assigned to an object, the color pattern from a procedural primitive can be stored for re-use in Air or another renderer, such as Rhino's realtime viewport display.

For this test, be sure to use shaders that generate a color pattern on the test objects.

Baking

- First, on the Air Main options page, make sure **Use Rhino Mesh** is checked.
- Select all objects you wish to export, and display the Air Object properties page.
- In the Advanced section, set the mesh mode to **Bake mesh**.
- Click the adjacent file dialog button, and provide an export file name ending in PLY.
- Type the AirBake command and click on the **BakeMesh** option, or right-click the 'Bake mesh' button in the AirBake toolbar.
- Click the **MeshMode** option and select **UnlitColor**.
- Click on the **EdgeLength** argument, and type in the maximum edge length for polygons in the baked mesh. Smaller values will produce a denser mesh with more polygons, giving greater detail but also using more memory. Press Enter.
- Press Enter to start baking. BakeAir will produce a single (potentially very large) PLY file.

Viewing

- Once the baking process has finished, start a new instance of Rhino.
- Choose Import from the File menu, and import the PLY file created above.
- Set the viewport display mode to Rendered.
- You can add highlights and other shading features to the object using Rhino's native material

properties.

See Also:
AirBake command

16 Rapid Prototyping

Note: Mesh export is disabled in the Air demo.

Air's displacement feature can be used to apply topographical patterns to a surface, which can be exported as a mesh for later 3D printing or manufacturing.

Basic Instructions

Any displacement shader can be used to generate the displaced mesh. The instructions below describe how to use a texture map to displace a surface and export the displaced mesh from a rendering.

1. Select the object to be displaced.

2. Display the Air Material page in the Rhino Properties dialog.

3. Select Bump map from the dropdown list for the Displacement control.

4. Set the Texture name parameter to the name of the texture map to be used for displacement.

5. The Bump max parameter sets the maximum distance the surface will be moved by the displacement. Use a negative value to displace the surface inward instead of outward.

6. Set the Displacement Mode to Mesh displacement.

7. Display the Air Object page for the selected object in the Rhino Properties dialog.

8. In the Advanced section check Export mesh and use the dialog button to specify a file name for the exported mesh. Use a file name extension of .OBJ to specify a Wavefront OBJ file, STL for an STL file, or PLY for a Polygon file. Rhino can usually load PLY files much faster than OBJ files.

That concludes the basic setup for mesh export. Click the render or render selected button in the Air render toolbar to start a rendering which will render the displaced object and export the displaced mesh.

The OBJ file created by Air can be loaded into Rhino or another application for further manipulation.

Additional Tips

Air displaces a surface by dividing it into a fine mesh of polygons whose vertices are then moved based on the displacement shader.

The density of the displacement mesh is based on the current rendered view of the object and the Tolerance setting on the Air Object page. The tolerance setting gives the maximum size of the small polygons in the mesh in pixels. A smaller tolerance setting will result in a finer mesh, which will produce a larger file and take longer to render.

In some cases enabling the Use render mesh control on the Air Object page may improve the quality of the displaced mesh.

17 Retexture

What is Retexture?

Retexture is a new interactive tool for rapidly changing the textures and shading of images created from a 3D scene. Retexture works with "deep" images rendered by Air that include extra channels to the standard RGB color and alpha channels. Retexture uses the deep image data to provide real-time updates of a scene as changes are made to any materials.

With Retexture you can:

- Explore shading and texture variations with high quality lighting in real time.
- Quickly produce many variations of the same scene with different textures/colors.
- Provide interactive client review, and allow your customers to experiment with shading options.

Retexture is included in AIR 12.11 and later.

Preparing a Scene for Retexture

To prepare a scene for use with Retexture:

- Decide which materials you want to be able to interactively change in Retexture.
- For each of those materials:
- Assign the special Retexture surface shader (available in the dropdown list of surface shaders).
- With the Retexture shader selected, assign a unique Material Id value for each material (the value should not be zero).

Any material that you don't want to change in Retexture can retain its current shader assignment. It will be visible in the image used by Retexture but it cannot be changed in Retexture.

Rendering for Retexture

- Make sure the desired output resolution and view are specified on the Air Main dialog page.
- On the Rhino command line, enter the Air Render command:

```
airrender
```

- In the list of render options, click on `Retexture` to enable output for the Retexture application.
- In the list of render options, click on `RetexName`. Use the file dialog to specify a file name for the `.retex` file that will be created by the export process.
- Press Enter to start the rendering process.

Once the image has finished rendering, you are ready to start working in Retexture:

- If Air Show is open, choose Retexture from the Tools menu to start Retexture. You can also start Retexture by typing `retexture` from a command shell.
- Click the Open button in the Retexture toolbar, and select the `.retex` file specified above.

See the Retexture user manual for additional information on using Retexture.

18 Dialog Pages

Document Properties
- Air Main
- Air Display
- Air Trace
- Air GI

- Air Environment
- Air Outline
- Air Animation
- Air Advanced Lighting

- Air Interactive
- Air Bake
- Air Plugin

Object Properties
- Air Light
- Air Material
- Air Object

18.1 Air Main page

Location: DocumentProperties AirMain

The Air Main page sets basic parameters for the rendered image.

Image size (*width x height* or Viewport)

Gives the image size as a width and height in pixels. Select from the drop down list, or type a width and height into the text box.

If the text box is set to Viewport the image size will be taken from the size of the view used for rendering.

View (*viewport name* or Current)

The name of the Rhino viewport to use for the rendering camera. If the view name is Current, the current (active) viewport will be used.

Image Quality

Parameters in this section control overall image appearance and quality

Presets

This control provides several pre-selected combinations of pixel and shading samples:

Quality Level	Pixel Samples	Shading Samples
Normal	4	1
Smoother edges	8	1
Finer shading	4	4
High quality	8	4
Higher quality	12	8
Extreme quality	16	16

Pixel samples (integer between 1 and 32, default 4)

The number of times the scene geometry is sampled at each pixel, defined as an N x N grid. For example, a pixel samples value of 4 would result in 4x4=16 samples per pixel.

Increase the number of pixel samples to smooth geometric edges.

Shading samples (integer between 1 and 32, default 1)

The number of times an object is shaded per pixel. Use more shading samples for smoother shading. Increasing the number of shading samples typically increases rendering time proportionally.

Clamp to alpha (default on)

When checked shading results for each pixel sample are clamped to be no greater than the alpha/transparency value (and no greater than 1 in any case). This option can help to smooth shading in images using HDR (high-dynamic range) textures or environment maps which may result in shading values that are much greater than 1. Note that when this option is enabled, the resulting output values for every pixel will be less than or equal to 1.

Sharp filter (default off)

When checked the rendered image will be filtered using a Mitchell filter which produces a sharper image than the default gaussian filter.

Trace camera (default off)

When checked Air uses ray tracing to compute the visible surfaces from the camera. In this mode the shading samples control is disabled because each ray is shaded separately, with the number of rays determined by the Pixel Samples grid setting. This mode will generally be slower than Air's default scanline rendering method, but it may produce better images especially when rendering motion blur or depth of field effects. Requires Air 12 or later.

Geometry

NURB Rendering ('Use Rhino render mesh' 'Use NURB surfaces' 'Hybrid mode')

Air is able to render NURB surfaces without relying on Rhino's render meshes. This control determines how NURB surfaces are exported for rendering:

Use Rhino render mesh: Each NURB surface is exported using its Rhino render mesh.

Use NURB surfaces: NURB surfaces are always exported as NURB primitives.

Hybrid mode: NURB surfaces are exported as NURBs unless the render mesh is necessary to accurately reproduce some Rhino shading feature. The most common case where a render mesh is required is a polysurface with packed texture coordinates.

Tolerance (number greater than 0, default 0.5)

The tolerance setting controls the accuracy of the polygon mesh used by Air to render to a NURB surface (when the Rhino render mesh is not used). The tolerance is given as the maximum allowed difference in pixels between the mesh representation and the NURB surface.

By default the allowable distance is given in pixels, and the density of the polygon mesh generated by Air varies depending on how large the NURB surface appears on screen: a surface that is small will use fewer polygons than one that appears large in an image. The default tolerance is 0.5. Larger values will produce coarser meshes, which will use less memory and render faster. When rendering large images for printing, you may be able to use larger tolerance values with no visible difference.

When the tolerance measure control is set to 'units' instead of 'pixels', the tolerance distance is measured in the common coordinate system of all Rhino objects. This setting results in a view-independent tessellation and mesh. A view-independent tessellation may be helpful when exporting a mesh for manufacturing or for use with another application.

Curves and points (default off)

When checked, Air will render Rhino curves as Air curve primitives and Rhino points and points clouds as Air point primitives. These are true 3D primitives with a defined size in world space. The default width for curves and points is given by the **Curve width** value. The default color assignment is determined by the Curve color setting (described below).

Air can render a line pattern assigned to a curve. The line pattern length is computed by first converting the line segment lengths given in the line pattern definition from millimeters to the units selected for the current scene. The lengths are then multiplied by the display Scale factor defined on the Linetypes of the Rhino Document Properties dialog. That Scale factor can thus be used to globally stretch or shrink the length of all line patterns. The line width is determined by the Curve width parameter described above (just as for curves without a pattern).

The width of an individual curve or point object can be adjusted on the Air Object properties page, which also allows the object color to be overridden.

By default curves and points are rendered as annotation entites, and they do not use materials. To apply a material to a curve or point object, enable the **Shade curves and points** control on the Air Object properties page.

Dimensions and text (default off)

When checked, Air will render Rhino dimension and text entities. The color used for dimensions and text is determined by the Curve color setting (see below).

Curve color (Black Display Print)

This selection determines how RhinoAir assigns a color to an individual curve. By default all curves are assigned a black color. Display mode uses the Rhino display color for the curve object. Print mode uses the print color assigned to a curve in the curve's object properties.

Image Background

The settings in this section determine what appears in areas of the image that are not covered by any objects.

Mode (Transparent Color Gradient Wallpaper Environment)

Transparent: Empty pixels are transparent (black with alpha=0), allowing the image to be composited over another in post-processing.

Color: Unrendered pixels are filled with a constant color given by the color button.

Gradient: The background is filled with a smooth gradient from top color button to the bottom color button.

Wallpaper: The background is exactly covered by the provided background image.

Environment: The scene environment shader is queried for uncovered pixels.

Scene Output

RIB file name

The name of the scene file produced by the AirRender or AirExport commands.

Read options file

Use this set of controls to specify an external text file of RIB commands to be included in the options section of the exported RIB file.

See Also:
Image Quality

18.2 Air Display page

Location: DocumentProperties AirDisplay

Image file name

Name for the rendered image. When rendering to a file, this is the file that will be generated by the renderer. The image file format is determined by the file name extension:

Image Format	Extension	Precision
Windows Bitmap	`.bmp`	8-bit
OpenEXR	`.exr`	float
Radiance	`.hdr`	float
JPEG	`.jpg`	8-bit
Portable Network Graphics	`.png`	8-bit,16-bit
SGI Image Format	`.sgi`	8-bit,16-bit
Targa	`.tga`	8-bit
TIFF	`.tif`	8-bit,16-bit,float
Photoshop File Format	`.psd`	8-bit,16-bit

Render to Air Show window

When checked the rendered image(s) are displayed in the standalone Air Show framebuffer.

Render to File

When checked the rendered image(s) are written to one or more files. The file type is determined by the extension of the image file name.

Channels

Specifies the information that is saved in the rendered image. The standard choices are

`r` - red channel only (produces a grey scale image)
`rgb` - color with no coverage information
`rgba` - color with coverage

Precision

Precision determines the numeric accuracy and format of the image data:

8-bit: Output values are scaled and converted to integers between 0 and 255. Each channel value is stored as a single byte.

16-bit: Output values are scaled and converted to integers between 0 and 65535. Each channel value is stored as 2 bytes.

float: Output values are saved as single-precision floating-point numbers. Each channel value requires 4 bytes of storage.

Not all image formats support all precision types. TIFF files support all precision types. PNG and PSD files support 8-bit and 16-bit images. OpenEXR and HDR images require float precision. Most other formats expect 8-bit data.

to sRGB (default off)

When enabled, Air converts the rendered RGB values to sRGB color space prior to sending them to the output file or device. See the Color section for more information about color spaces.

Stereo

When checked, Air generates two images for every frame representing the left and right view points in a stereo pair. The **interocular distance** value gives the separation between the two view points.

Extra Channels

During a single rendering Air can generate extra images containing arbitrary output values computed by a shader. This section provides options for most of the extra output channels provided by Air's shaders.

Check the **Save extra channels** box to enable export of additional channels. If the **in single file** box is checked, the extra channels are added to the main image file instead of being saved as separate images. Only the TIFF, OpenEXR, and PSD formats allow multiple images in a single file.

Extra output images have the same precision, gamma correction, and image format as the main image. In most cases extra channels should be saved as linear images without gamma correction

(set Gamma to 1). For maximum flexibility in post-processing the channels, they should also normally be saved at 16-bit or float precision.

Light Channels

When this option is checked, a separate image is created for each light channel (set on the Air Light page for a light) showing the scene as illuminated by only those lights in the selected channel. By giving each light a different channel, a scene can be re-lit in a compositing or paint program as a post-process.

Illumination from the occlusion and occlusion cache GI modes is saved in channel 0. The indirect GI modes write to the separate Indirect output channel. The ambient GI mode writes to the separate Ambient channel.

By default light channels do not included reflected light or the effects of bounced light. Check the **+ reflections** option to include reflected light in each channel's output. Check the **+ GI** option to include the effects of bounced light from the Indirect global illumination (GI) modes.

See Also:

Air User Manual: Output

18.3 Air GI page

Location: DocumentProperties AirGI

Global illumination mode (Off Ambient Indirect IndirectCache Occlusion OcclusionCache)

Selects among the following ways of simulating global illumination effects:

Off
No GI effects. The RhinoRender ambient light settings are translated to a simple AIR ambient light source that contributes a fixed amount of diffuse illumination to each surface.

Ambient
A constant amount of ambient light is added to the scene based on the Rhino renderer's ambient light color.

Indirect
Compute indirect diffuse illumination which includes color bleeding effects without caching.

Indirect Cache
Compute indirect diffuse illumination using an irradiance cache to accelerate rendering.

Occlusion
Simulate environment lighting using ambient occlusion to compute shadows.

Occlusion Cache
Simulate environment lighting with ambient occlusion using an occlusion cache to accelerate rendering.

Sample Quality

Rays per sample (integer between 1 and 1024, default 256)

Number of rays to trace for each GI sample. More rays produce more accurate and smoother GI results but take longer to render. A useful guideline when making adjustments is to increase or decrease the number of rays by a factor of 2.

Max trace distance (number greater than 0, default 100000)

Maximum distance to trace each ray for possible intersection with nearby surfaces. Lower distances will reduce rendering time. A low trace distance can allow occlusion to be used even for interior scenes.

Adaptive ray casting (default off)

When enabled Air casts fewer rays initially, then additional rays only in regions where the initial ray casts indicate high variation.

Cache Properties

To accelerate GI rendering, Air allows GI samples to be stored and reused. These parameters control how often samples are generated and when they are re-used.

Maximum error allowed (number between 0 and 1, default 0.2)

Sets a maximum error threshold when re-using samples in the cache. If a result cannot be obtained from cached values within the given threshold, a new sample will be generated.

Max pixel distance (number greater than 0, default 20)

Gives a maximum distance in pixels between samples in the cache. This parameter ensures that even flat sections in an image receive some GI samples. This setting should be increased for larger image sizes.

Cache file

Air allows the contents of the GI cache to be saved to a file and re-used to accelerate future renderings. The cache file name is relative to the directory containing the main rib file. Check the Read or Write boxes to, respectively, read from or write to the cache file.

Indirect and occlusion GI modes use different cache formats.

Indirect Only

This section has controls that affect only the indirect and indirect cache GI modes.

Max bounces (integer between 1 and 5, default 1)

Gives the maximum number of "bounces" to follow indirect light rays. More bounces take longer to render. When using indirect lighting without a cache, rendering with more than 1 bounce may take a long time.

Shading mode (Constant Diffuse Shader)

The indirect shading mode determines how the indirect illumination contribution from a surface is computed:

Constant

Reflected light from a surface is approximated using the object's standard color property. This is the fastest shading mode since the renderer does not need to perform any shading or lighting computations.

Diffuse
Air approximates bounce light from an object by computing the incoming diffuse illumination multiplied by the object color. This is slower than constant shading but much faster than the shader mode since Air does not need to execute the object's surface shader.

Shader
Indirect light from an object is computed by evaluating its surface shader. This is the slowest and most accurate mode.

Intensity (number greater than 0, default 1.0)

Multiplier for the indirect light contribution of each object. This is a simple global control to increase or decrease the amount of indirect (or bounce) light from objects.

Re-use shading samples (Off On)

Turns on Air's radiosity cache (requires Air 12.01 or later). When enabled, Air stores the shading results for polygons hit by indirect rays. If the same polygon is hit again, the shading result is re-used for faster rendering. For large polygons, more than one sample can be stored by specifying a minimum detail greater than 0, giving the maximum size of any one shading sample. Lower detail values produce more detailed results at the cost of longer render time and greated memory use.

Area light quality (number between 0 and 1, default 0.1)

A multiplier applied to the number of area light samples when computing indirect illumination. Larger values cause more samples to be used for higher quality results at the cost of longer render time.

Occlusion Only

The controls in this section only affect the occlusion GI modes.

Shadow color (black)

Sets the color for shadowed or occluded areas.

Intensity (default 1)

Overall result multiplier for global illumination contribution in occlusion mode.

Global Illumination Environment

This section specifies the illumination that comes into the scene from the surrounding environment. There are 3 modes:

Color
Incoming light color is given by the specified color scaled by the **Intensity** value.

Map
Background illumination comes from the provided environment map scaled by the **Intensity**.

The **Rotate** controls gives the rotation in degrees of the map about the Z axis.

Environment
Use the environment shader selected on the Air Environment page.

See Also:
Global Illumination
AirGI command

Air User Manual: Lighting -> Indirect Diffuse Light
Air User Manual: Lighting -> Ambient Occlusion

18.4 Air Environment page

Location: DocumentProperties AirEnvironment

Use the Air Environment page to select an environment shader for the scene. The environment shader is evaluated for rays that miss all objects for a scene. You can select whether to query the environment shader for each ray type:

- For camera rays, set the Image Background mode to Environment on the Air Main page.
- For reflection and refraction rays, set the Reflected Environment mode to Environment on the Air Trace page.
- For indirect rays, set the Global Illumination mode to Environment on the Air GI page.

Environment (Off Color Map Sky)

Selects one of the following environment shaders:

Off
No environment shader is included in the scene.

Color
The environment is shaded with a single constant color.

Map
Use an environment texture map for environment queries.

Sky
Use a physical sky model for the environment, including an optional directional light for the sun.

Color Environment

Color (default white)

The color to return for all environment queries.

Map Environment

Map

File name of the environment map to query. For best results, the environment map image should be converted to an Air environment map using the Air texture conversion tool. (For quick access

to the tool, choose Convert Textures from the Tools menu in Air Show.)

Map Intensity (default 1)

Scalar multiplier for the environment map value.

Map Blur (default 0.01)

Blur value for environment map query in radians.

Rotate (default 0)

Rotation angle about the vertical axis in degrees.

Sky Environment

The sky environment computes a sky color based on the specified location, date, and time. The default location values are for Seattle, Washington, USA.

Turbidity (5)

Atmospheric turbidity as an integer between 2 and 9.

Month (4)

Month of the year (1-12).

Day (15)

Day of the month.

Hour (12)

Hour of the day (0-24).

Time Zone (-8)

Difference between local time and GMT in hours.

Latitude (47.45)

Latitude for the location of the model.

Longitude (-122.3)

Longitude for the location of the model.

North (0)

North direction as an angle in degrees relative to the X axis.

Sky Intensity (0.5)

Intensity multiplier for the sky light.

Sun (No Yes)

Whether to include a directional light for the sun in the scene.

Sun Intensity (0.8)

Intensity multiplier for the sunlight.

18.5 Air Outline page

Location: DocumentProperties AirOutline

Use the Air Outline page to control how Air generates outlines for illustration.

Outline quality is determined by the pixel samples setting on the Air Main page. More pixel samples will produce smoother outlines.

Line Properties

Line width (number greater than 0, default 1)

Sets the width of the outlines in pixels. Fractional widths are allowed.

Line color (default black)

Default color for outlines. Outline color can be overridden on a per-object basis on the Air Object properties page.

Image-Based Edge Detection

Air supports several independent methods of detecting edges which can be grouped into two broad categories: image-based and geometry-based. Image-based methods are based on analyzing values in the high-resulotion image buffer (at sub-pixel resolution) used for rendering. Air will draw a line at a location if any method indicates an edge is nearby. Each method can be independently enabled or disabled.

Regions (None PerScene PerObject PerSurface PerPolygon)

One method of edge detection is based on defining regions of interest in the image, and drawing edges along boundaries between those regions. Use this control to select how regions are defined:

None: No edges are generated based on regions.

Per Scene: All objects are assigned to the same region; the scene as a whole is outlined but individual objects are not.

Per Object: Each object is treated as a distinct region. A single polysurf is treated as one region.

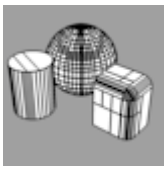
Per Surface: Each NURB surface or mesh is defined as a region. Each surface in a polysurf is a separate region.

Per Polygon: Each polygon in a mesh or the render mesh for a NURB surface is treated as a distinct region.


per Scene


per Object


per Surface


per Polygon

Silhouette threshold (number between 0 and 1, default 0.5)

The silhouette threshold controls edge detection based on differences in the surface normal. The higher the threshold, the fewer edges will be detected. Set the threshold to 0 or 1 to disable this method of edge detection.

Geometry-Based Edge Detection

Geometry-based methods of edge detection look at the geometric properties of an object to determine where to draw edges.

Minimum angle for edge (default off)

Enable this control to draw lines along edges that separate faces whose normals differ by more than the specified minimum angle (in degrees).

Merge similar edges (default off)

When enabled, edges whose end points are near will be merged. Depending on the min angle and silhouette settings, the resulting single edge may either be kept or discarded.

Silhouette edge detection (default off)

This control enables edge detection by identifying those edges in the render mesh that lie between a front-facing and a back-facing polygon.

Include single edges (default off)

Draw lines along edges only belonging to a single polygon.

Max edge length (pixels) (default off)

When enabled, vector-based outlines will be limited to the specified maximum length in pixels. Longer vectors will be split to meet the criterion. This setting is most useful when rendering with some of the stroke shaders.

Export vectors (default off)

Enable this option to export outlines as vectors to a file in SVG format. The exported file will only contain lines generated by the geometry-based edge detection methods.

Stroke Mode (Off Custom PencilRough PencilSmooth WatercolorEdge)

Use this option to specify a stroke shader to use when drawing vector-based outlines:

Off: No stroke shader is used. Lines are drawn in the standard manner.

Custom: The custom stroke shader and setting specified using the AirStroke command are used

for rendering.

PencilRough: The strokePencil stroke shader is used with default parameter values.

PencilSmooth: The strokePencil stroke shader is used with Wobble=0 and ScaleWidth=0.125.

WatercolorEdge: The strokeWatercolorEdge stroke shader is used with default parameter values.

Fade with Distance

Air can optionally make lines thinner as they become farther from the camera. Enable line width attenuation with distance by setting the fade start distance to a positive number.

Start distance (default 0)

Distance at which to begin reducing line width based on distance to the camera

Min line width (default 0)

Minimum line width in pixels for lines reduced by distance.

See Also:
Illustration
AirOutline command

Air User Manual: Toon Rendering and Illustration
Air User Manual: Shader Guide -> Stroke Shaders

18.6 Air Trace page

Location: DocumentProperties AirTrace

The properties in the top portion of this page control aspects of ray tracing for shadows and reflections. The bottom section holds controls for depth of field (which does not require ray tracing).

Trace offset (number greater than 0, default 0.01)

The trace offset is a small distance used to shift the starting location when rays are traced for reflections or shadows. Use this setting to prevent rendering artifacts due to incorrect self-intersection of a ray with the surface from which it is cast.

Max bounces (integer between 0 and 20, default 6)

Gives the maximum number of bounces through which to trace reflection rays. Set max bounces to 0 to globally disable ray traced reflections.

Reflected Environment

This section determines the color returned by reflection rays that miss all objects in the scene. There are 3 basic modes:

None

Reflection rays that miss all objects simply return a black color.

Color
Reflection rays that fail to intersect an object return the specified color scaled by the **Intensity** value.

Map
The provided environment map is used to select a color for reflection rays based on the ray direction. The **Intensity** value gives a multiplier for the environment map result. The **Blur** parameter can be used to add blurriness to the result to soften the look or smooth the appearance of a low-resolution map. The **Rotate** value gives an angle in degrees to rotate the map about the Z (up) axis.

Depth of Field

Use the controls in this section to enable and configure simulating the limited focal range of a physical camera.

Enable (default off)

Check to enable depth of field effects.

Camera lens (lens length in mm)

Camera lens focal length in mm for DOF computation. Longer lenses have a shallower depth of field, producing more blur.

f-Stop (number greater than 0, default 8)

The simulated f-Stop value for the camera. Lower numbers produce more blur.

Focus distance

Distance at which objects are most in focus. If **Camera target** is checked, the distance from the camera location to the camera target is used as the focus distance.

Samples (integer greater than 0, default 64)

Sets the number of samples to use when simulating depth of field. More samples produce smoother results but take longer to render.

See Also:
AirTrace command

Air User Manual: Reflections

18.7 Air Animation page

Location: DocumentProperties AirAnimation

Frames (30)

Number of frames of animation to render.

Motion blur (0%)

When greater than 0, Air will render moving objects with motion blur. The motion blur value is a percentage of the time between frames that the camera shutter should remain open. A value of 100% means the camera shutter is open continuously between frames. To simulate the behavior of a real camera, a value of 50% is appropriate.

The smoothness of the rendered motion blur can be improved by increasing the number of pixel samples on the Air Main page.

View Animation

Use the controls in this section to perform simple camera or view-based animation.

Mode (Off Turntable Fly-through Paths)

Off:
No view animation.

Turntable:
Rotates the scene around the camera target point. The **Max angle** parameter gives the final rotation angle in degrees.

Fly-through:
Moves the camera through the scene along a curve path. Any Rhino curve can be used for the camera path by assigning a name to the curve (on Rhino's Object property page in the Properties dialog), and selecting the curve name from the drop-down list for the **Camera path** control. Define the field of view for the animated camera with the **Camera lens** setting.

Paths:
Moves the camera location and target location along separate paths through the scene. To be used as a path, a curve primitive must be assigned a name. The **Camera path** and **Target path** controls specify the names of the curves to be used for the camera and target paths, respectively. The **Camera lens** setting determines the field of view for the animated camera.

Object Animation

Animate objects (default off)

When enabled, RhinoAir animates objects that have been assigned motion with the AirMotion command.

Scene duration (100)

Nominal time value for the length of the animated scene. The start and end time values set for object motion are relative to the scene duration.

See Also:

View Animation
Object Animation
AirMotion command

18.8 Air Advanced Lighting page

Location: DocumentProperties AirAdvancedLighting

Caustics

Enable (default off)

Check to enable rendering of caustic effects.

Min photons per sample (default 75)

Minimum number of photons that must be found within the search radius for caustics to be visible at the current shading location. Smaller numbers produce broader, softer caustics. High numbers produce sharper caustics but also require higher numbers of photons to be emitted in order to obtain smooth results.

Search radius in pixels (default 10)

Defines a region around the current shading location to search for photons. Smaller values render faster but may miss some relevant photons.

Cache file (Off Read Write)

The point set generated from shooting photons can be saved to a file and re-used to accelerate subsequent rendering. When a cache file is used for caustics (mode=Read), Air does not need to shoot photons to generate caustics.

Spectral Prefiltering and Chromatic Adaptation

Enable Spectral Prefiltering (default off)

Whether to perform spectral prefiltering for spectral data.

Dominant Illuminant

The spectral profile to use for the dominant illuminant in the scene. The Air distribution includes a set of light source profiles in `$AIRHOME/spectra/lights`.

Enable Chromatic Adaptation (default on)

Whether to apply chromatic adaptation during spectral prefiltering.

Apply to RGB colors (default on)

Whether to apply spectral prefiltering to normal RGB colors and textures.

See Also

Caustics
Spectral Rendering

18.9 Air Interactive page

Location: DocumentProperties AirInteractive

Interactive Rendering with TweakAir

Use the controls on this page to configure interactive preview rendering (IPR) for shading and lighting with TweakAir.

To start a TweakAir session, use the AirIprStart command or the IPR toolbar button.

Image size (*width x height* or Viewport)

Gives the IPR image size as a width and height in pixels. Select from the drop down list, or type a width and height into the text box.

If the text box is set to Viewport, the image size will be taken from the size of the view used for rendering.

Demo limitation: The TweakAir demo limits the IPR image size to a maximum resolution of 400 x 300.

View (*viewport name* or Current)

The name of the Rhino viewport to use for the IPR camera. If the view name is Current, the current (active) viewport will be used.

Automatically update view

When this option is enabled, RhinoAIR sends camera changes made in the IPR viewport to the active TweakAir session, allowing the view to be adjusted without re-starting TweakAir.

Quality and Optimization

Shading (Matte Fast relighting Full shading)

The shading mode can be used to optimize shading during interactive preview rendering without affecting shading in a final rendered image.

Matte: Surfaces are shaded using a fast, simple matte or diffuse surface shader instead of the assigned surface shader. This mode may be useful when adjusting lighting in scenes with complex surface shaders.

Fast relighting: In this mode TweakAir optimizes re-rendering after lighting changes by recomputing the surface color without executing the assigned surface shader. In many cases this produces the same result as the full shading mode described below in a fraction of the time. Surface shaders that use non-standard illumination models may be incorrectly shaded in this mode.

Full shading: TweakAir re-evaluates the assigned surface shader whenever a change is made that affects the surface.

Smooth edges (default off)

When this option is enabled TweakAir antialiases geometric edges by computing coverage information for the primitive(s) covering each pixel. This results in more memory use and slower

refresh rates but produces a higher-quality image.

Always use Rhino mesh (default on)

When checked, the Rhino render mesh is used by default for objects in an interactive rendering, regardless of the Use Rhino mesh setting on the Air Main page. Using the Rhino mesh can often improve interactive performance.

Auto-update reflections (default on)

Use this option to automatically refresh reflections whenever a reflected object changes. This option is helpful for improving the preview accuracy of scenes with many highly reflective objects.

Max shadow rays (default 1)

Sets a limit on the number of shadow rays cast for each light. The actual number of rays cast for a light is the lesser of this number and the number of shadow rays specified on the Air Light page.

Max reflection rays (default 1)

Gives a limit on the number of rays to trace for reflection or refraction. The actual number of rays cast is the lesser of this limit and the number of reflection or refraction rays specified in the assigned surface shader.

Interactive Rendering Process

Rendering threads (default 1)

Number of separate threads of execution to use for interactive rendering.

Run at low priority (default off)

When enabled the interactive rendering process executes at a lower than normal priority enabling foreground applications like Rhino to run without being slowed down by the IPR process.

See Also:
IPR - Interactive Preview Rendering

AirIprStart command
AirIprEnd command

18.10 Air Bake page

Location: DocumentProperties AirBake

Baked Map Properties

Map base name (*imagename*)

The base name for all baked texture maps. The name for each map is derived from the base name by appending an object's unique identifier.

The image file format is determined by the file name extension. Maps that are to be used with Rhino's graphics display or other realtime engines should be rendered to as PNG or JPEG files.

Max map size (*width* x *height*)

The maximum size of each texture map. The width and height should be a power of 2 (e.g., 128, 256, 512, 1024, or 2048). The actual size of each map may be less depending on the texel size parameter describe below.

Precision

Precision determines the numeric accuracy and format of the image data:

8-bit: Output values are scaled and converted to integers between 0 and 255. Each channel value is stored as a single byte.

16-bit: Output values are scaled and converted to integers between 0 and 65535. Each channel value is stored as 2 bytes.

float: Output values are saved as single-precision floating-point numbers. Each channel value requires 4 bytes of storage.

Not all image formats support all precision types. TIFF files support all precision types. PNG and PSD files support 8-bit and 16-bit images. OpenEXR and HDR images require float precision. Most other formats expect 8-bit data.

to sRGB color space (default on)

When enabled, baked color values are converted to sRGB color space prior to being written. Requires BakeAir 13.03 or later. See the Color section for more information on color spaces.

Texel size (0.1)

Desired width of each texel (or pixel) in the texture map in world coordinates. Smaller values produce maps that are larger and have more detail, subject to the maximum map size specified above.

Border padding (1)

Gives a border region in pixels to fill in around baked regions in a texture map. A border can help prevent artifacts visible discontinuities along boundaries between texture regions when a baked map is applied to an object.

Wrap (yes)

Allows border region filling to "wrap" around in texture space. This option produces maps that display better with Rhino's default texture wrapping behavior. Requires BakeAIR 8.15 or later.

Maps

Use the controls in this section to select one or maps for baking. The channel setting specifies the information that is rendered or baked to the the map. The standard channel choices are

`rgb` - color with no coverage information
`rgba` - color with coverage
`__diffuse` - surface as though lit by only diffuse light, without specular highlights or reflections
`__constant` - shader color pattern with no lighting information
`__bump` - scalar bump amount from a displacement shader

Any output variable from a surface or displacement shader can be baked. Custom output variables should be entered with a full inline type declaration. For example:

```
varying color __occlusion
```

BakeAir 9.18 and later can also bake multiple channels to a single map by specifying a comma-separated list of output variables.

The name of each baked map is derived from the base map name (specified above) by appending the optional suffix and then the Rhino unique identifier for each object. Note that only the first baked map can be loaded and viewed in Rhino using the AirLoadBakedMaps command and baked map view mode.

Map Quality

Pixel Samples (4)

Defines a grid of samples used to create each pixel or texel in a baked map. Normally the default value of 4 is more than adequate.

Shading Samples (1)

Number of shading samples to take per pixel in the baked map. More samples take longer to render but produce smoother shading.

Sharp Filter (off)

When checked the baked map will be filtered using a Mitchell filter which produces a sharper image than the default gaussian filter.

See Also:
Baking Textures with BakeAir
Color

18.11 Air Plugin page

Location: DocumentProperties AirPlugin

Rendering Process

Rendering threads (integer between 1 and 32, default 1)

Number of separate threads of execution to use for rendering; normally 1 thread should be used for each processing core available.

Use 64-bit (default off)

When enabled, the 64-bit version of Air is used for rendering. Not available in the Air demo.

Run at low priority (default on)

When enabled the rendering process executes at a lower than normal priority enabling foreground applications like Rhino to run without being slowed down by the rendering process.

Distributed rendering with Vortex (default off)

Check this option to use Vortex to distribute rendering of a single image over multiple computers. For additional information on Vortex see "Vortex" in the Tools section of the Air User Manual. Vortex does not work with the demo version of Air.

Tile size (integer between 8 and 256)

Air renders an image in small tiles, and this property sets the width and height of each tile. Larger tile sizes usually render more quickly but also use more memory.

Tile order (Columns Rows Spiral)

Sets the order in which the image is rendered.

Render Management

Submit rendering jobs to Air Control (default off)

When checked the RhinoAir plugin will submit rendering tasks to Air Control, a separate program for starting and managing multiple renders. Rendering tasks sent to Air Control are placed in a queue or list, and each task is rendered in order. By using Air Control you can define several potentially time-consuming jobs to be rendered in sequence without having to start each one manually as the previous task finishes.

When using the Air Control render queue, it is important not to overwrite the exported scene file for a job before the job has finished rendering. To make this easier, it is recommended that you also enable the following option when submitting jobs to Air Control:

Append scene and image names with version (default off)

When checked the supplied version number is appended to the file names for scene export and rendered images. After a rendering task is started, the version number is automatically incremented. Use this option to automatically generate unique scene and image names for every rendering.

To keep your storage device from becoming cluttered with many old version files, you may wish to use Air Control to manage rendering tasks and enable the Air Control option to delete scene files after a job has finished.

Color conversion

Monitor color space ('linear RGB' sRGB)

Color space used to interpret colors chosen in Rhino. See the Color section for more information on color spaces.

Texture conversion

Automatically convert textures

When enabled, RhinoAir automatically converts source texture images to Air texture files for more efficient rendering.

Texture color space ('linear RGB' sRGB)

Color space of source texture maps. If the color space is not linear, texture values will be converted to linear for rendering with Air. See the Color section for more information about color spaces.

Cache directory

Directory to use for Air texture files created when automatic texture conversion is enabled. If a directory is not specified, a texture directory is created in the system TEMP directory.

Light conversion

Illuminance unity (default 500)

This conversion factor for rendering IES lights gives the illuminance value in lux corresponding to an emitted intensity value of 1 from a regular (non-IES) light. This will be the maximum illuminance that can be represented in a low-dynamic range image (8-bit or 16-bit data).

See Also:

Color
IES Lights

18.12 Air Light page

Location: PropertyPages AirLight

Use the Air Light page to customize the behavior of Rhino lights when rendered with Air.

Channel (1)

Set the light output channel for per-light output images (available as an option on the Air Display page). Multiple lights may share the same channel.

Illumination

Color

Sets the Rhino light color.

Intensity (number greater than 0)

Gives the strength or brightness of the emitted light. The intensity value can be greater than 1. For lights whose brightness varies with distance from the source (see falloff below), the intensity value may need to be very large.

Falloff (None Linear Square)

Determines how the light's intensity varies with distance from the light:

None: Intensity does not vary with distance.

Linear: Intensity decreases linearly with distance from the light.

Square: Intensity decreases as the square of the distance from the light source. This setting is appropriate for physically accurate lights.

Clamp to (default enabled, 1)

When enabled, the emitted intensity from the light is clamped to the specified maximum value. This option can be used to limit the emitted intensity for light sources whose intensity varies with distance from the light.

Emit diffuse light (default on)

When checked the light contributes diffuse illumination to the scene. A light that does not contribute diffuse light may not need to cast shadows either.

Emit specular light (default on)

When checked the light produces specular highlights on shiny surfaces.

Emit photons (default off)

If checked, the light emits photons to generate caustics when caustics are enabled on the Air Advanced Lighting page. When emitting photons, the light's Falloff parameter should be set to Square. Directional lights do not emit photons.

Use spectrum (default off)

When checked and a spectral profile file has been chosen, the light's color is defined by the spectral profile curve. Click the adjacent button to display a file dialog for choosing a spectrum for the light. The Air distribution includes a selection of light profile in $AIRHOME/spectra/lights.

Shadow

Color

Color to use for areas that are in shadow.

Intensity (number between 0 and 1)

Gives the fraction of the emitted light obscured in shadowed areas (the same as the Rhino shadow intensity control). A shadow intensity value of 0 disables shadow-casting for the light.

Rays (integer between 0 and 256)

Sets the number of rays to trace for shadows for the selected light. Linear lights and rectangular area lights, as well as lights with a large shadow blur may require more rays. It usually makes sense to increase and decrease the number of rays by a factor of 2.

It is usually much more efficient to increase the number of shadow rays for smoother shadows than to increase the number of Shading Samples.

Set the number of rays to 0 to disable shadow casting for the light.

Blur (angle in radians)

An angle used to blur the shadows for a light. Technically, it's the half-angle of a cone measured from the point being shaded within which rays are cast toward the light. Typically values are in the

range 0.01 to 0.1.

Reducing the amount of blur below 0.005 increases the chance that self-shadowing artifacts may appear.

Rectangle light

Properties affecting only rectangle area lights.

Mode (Normal Fast Portal)

Normal: The area light is approximated by evaluating the light at multiple points across the surface. Slower but more accurate than fast mode.

Fast: The area light is evaluated once with shadows approximated using Air's fast areashadow function. Faster but less accurate than normal mode. Fast mode cannot be used with a texture map.

Portal: The area light represents a window or door opening admitting light from an external environment. A suitable environment should be provided as the texture map value (see below). The orientation of the environment map is the same as the background map for traced reflections, set on the Air Trace page.

Visible to camera (default off)

When checked a rectangle light will be visible to the camera. The light is given the illumination color and a constant surface shader.

Visible in reflections (default off)

When checked a rectangle light will be visible in reflections. You may wish to uncheck the Emit specular setting for a rectangle light visible in reflections to prevent the light from contributing twice to shiny surfaces.

Texture or IES file (default off)

When checked the specified texture map modulates the illumination emitted by the area light. This option automatically disables the fast approximation optimization.

When the texture map is an IES light profile file, the light is modeled as a point light with the corresponding IES profile, and no area light will be visible.

See Also:
Lighting
IES Lights

18.13 Air Material page

Location: PropertyPages AirMaterial

Use the Air Material page to customize the appearance of a Rhino material for Air.

Material Assignment

This page displays the current material for an object regardless of how the material is assigned. A label at the top of the page indicates the kind of material currently assigned to the selected object - a basic material, the layer material, or the parent material.

The New button on the Air Material page can be used to create a new basic material for each selected object. To select a different method of material assignment, go to the Rhino Material page for the object and select the desired method in the Assign by section.

Material Name

The material name (if any) will be displayed next to the method of material assignment. You can type a new material name into the text box.

Select Matching

Use this button to select all objects in the scene with the same material properties as the currently selected object. The material settings for only the first currently selected object are used for comparison. Materials are tested for equality by comparing name, color, transparency, surface shader, displacement shader, and displacement mode.

Force basic material (default on)

When checked, a new basic material is automatically created for an object that has its material assigned by layer the first time an Air-specific property is assigned to the material. If you are accustomed to organizing materials by layer, uncheck this option.

Attributes

Color

Sets the Rhino material color, also used as the color attribute for Air.

Transparency (number between 0 and 1)

Sets the Rhino material transparency.

Shading samples (integer between 1 and 32, default 1)

This control allows the number of shading samples to be increased for an individual material to improve the detail and smoothness of a material. Air will use the maximum of the local samples value and the global shading samples value. Rendering time can be reduced by using additional shading samples only for those materials that require more detail rather than increasing the number of shading samples globally for all materials.

To smooth reflections it is more efficient to increase the number of reflection rays than to increase the number of shading samples.

To smooth noisy shadows it is more efficient to increase the number of shadow rays for the shadow-casting light than to increase the number of shading samples.

Preview

When preview is enabled, the plugin automatically generates and updates an small preview image for the material. For some materials updating the preview image after every change may noticably slow down the operation of the plugin. In this case you may wish to disable the preview option while modifying the material, periodically enabling the preview temporarily to check the appearance of the material.

The material preview is disabled when an Interactive Preview Rendering session is active to leave more processing power available to update the IPR view.

Shaders

Air uses small programs called shaders to compute the appearance of a material. Use the controls in this section to select the surface and displacement shader for the material.

Surface

Gives the surface shader used to compute the output color for the material. The dropdown list contains some of the surface shaders included with Air. A custom shader can chosen by clicking the dialog button.

Most shaders have several parameters to adjust features such as intensity and size of highlights, position and type of texturing, etc. The Air Material page shows the parameters for the currently selected shader in the lower section of the dialog.

If the surface shader is set to Rhino, the plugin will translate the Rhino material properties (set on the Rhino Material page) as the surface shader. The Rhino surface shader has no parameters.

Surface modifies transparency

Check this option if the surface shader computes a complex transparency pattern. By default Air assumes all shadow-casting objects are fully opaque and does not evaluate an object's surface shader when it is intersected by a shadow ray. When a surface shader alters the transparency of a surface, Air must execute the surface shader for shadow rays to produce accurate shadows. This additional processing slows down rendering.

Displacement

A displacement shader is used to add topographical details like bumps, grooves, and ripples to a surface. The dropdown list contains some of the displacement shaders included with Air. Use the dialog button to choose a custom displacement shader.

If the displacement shader is set to Rhino, the RhinoAir plugin will translate the Rhino material bump map to a displacement shader. The Rhino displacement shader has no parameters.

Displacement mode

The displacement mode determines how the displacement shader is applied:

Off	The displacement shader is not used.
Bump only	The displacement is applied as a bump effect, modifying the shading normal but not moving the surface.
Regular displacement	The displacement shader moves the surface. The shader is evaluated by carving a surface into pieces and displacing each piece separately.
Mesh displacement	The displacement shader moves the surface. An entire object is tessellated and displaced at once.

Both regular and mesh displacement perform true "sub-pixel" or "micropolygon" displacement. The quality of the displaced mesh depends on the surface tolerance property, which can be set globally

on the Air Main page or for an individual object on the Air Object page. A higher tolerance setting will produce a coarser displacement, which will use less memory and render more quickly.

Mesh displacement is generally slower than regular displacement, but mesh displacement is less likely to exhibit cracks and produces smaller final meshes. Using the Rhino render mesh for NURB surfaces may also improve displacement results.

Instancer

An instancer shader can be used to create new objects at render time based on properites of the current object.

Extent

Gives the maximum distance from the parent primitive that new objects will be created. Using too small a value can cause created objects to appear "clipped" in a rendering.

Hide base (default off)

If checked, the base/parent primitive will be hidden in the final rendering.

See Also:
Materials
AirMaterial command

18.14 Air Object page

Location: PropertyPages AirObject

Use this page to modify Air-related properties for selected objects.

Visibility

Camera (default on)

If unchecked, an object will be not be directly visible in the rendered image (though it may cast shadows or appear in reflections).

Reflected (default on)

If not checked, an object will not be visible in reflections.

Cast shadow (default on)

If not checked, an object will not cast shadows.

Back faces (default on)

If not checked, back-facing surfaces are not visible.

Outlines, curves, points

The controls in this section can be used to customize outline, curve, and point properties on a per-object basis.

Scale width (number greater than 0)

When checked this setting gives a multipler for the global outline or curve width.

Set color (default off)

When checked, the color overrides the outline, curve, or point color for the selected objects.

Shade curves and points (default off)

When checked, curves and point objects use their assigned material for shading, instead of the default constant shading for annotation.

Point type (Sphere Sprite Blobby Volume Disk)

Sphere: points and point clouds are rendered as geometric spheres.

Sprite: points and point clouds are rendered as square polygons oriented to always face the camera.

Blobby: a point cloud is rendered as a metaball or blobby implicit surface. Blobbies are always shaded using the assigned material. For faster rendering with lower memory use, increase the **Tolerance** setting (described below) above the default value of 0.5.

Volume: a point cloud is rendered as a volume primitive. For appropriate shading, try using one of the following surface shaders included with Air: particle, VSmokeSurface, VCumulusCloud. In most cases the **Surface modifies transparency** control on the Air Material page should also be checked.

Disk: points are rendered as disks.

Curve type (Auto Polyline Ribbon Tube)

Auto: choose a curve type based on the curve geometry. Polylines are rendered using the polyline type. NURB curves are rendered as ribbons.

Polyline: render a curve as a sequence of straight line segments. This type renders fastest and uses the least memory. Wide curves may exhibit gaps between segments. If you are applying an instancer shader to the curve, this type should be selected.

Ribbon: renders a curve as a ribbon or quad-strip.

Tube: renders the curve as an open-ended tube.

Geometry

Use Rhino mesh

This control determines whether Air uses the Rhino render mesh when rendering a NURB surface or whether Air renders the NURB surface natively. Possible settings are:

Unchecked: do not use the Rhino render mesh.
Checked: always use the Rhino render mesh.
Neither checked nor unchecked: use the global render mesh setting on the Air Main page.

Tolerance (number greater than 0 in pixels)

When checked the tolerance value (in pixels) overrides the global tolerance setting (on the Air Main page) for the selected objects.

Subdivision mesh (default off)

When enabled, a polygon mesh primitive is exported as a Catmull-Clark subdivision surface. For meshes with duplicate vertices, enabling the following **Weld polygon vertices** option will improve the quality of the subdivision result.

Weld polygon vertices (default off)

When enabled, coincident polygon vertices are merged during rendering for export. Per-vertex normals and texture coordinates are preserved for every face (unlike Rhino's polygon weld function). This capability may be useful when exporting displaced meshes for rapid prototyping or rendering a mesh as a subdivision surface.

Advanced

Archive mode (Disable archive 'Insert archive' 'Substitute archive')

Use the dialog button to display a dialog for choosing an external file of rib commands.

When the archive mode is set to 'insert archive', the specified file will be referenced in the main rib file just prior to the definition of the selected objects.

When archive mode is set to 'substitute archive', a reference to the external file is included and the geometry for the selected objects is not exported. The substitute mode may be useful for rendering complex objects objects that have been previously saved using the AirWriteArchive command.

Export mesh (Disable mesh file 'Export mesh' 'Bake mesh' 'Bake and use')

Use this control to enable Air's mesh export capability in one of 3 modes:

Export mesh: the render mesh is always exported to the specified file
Bake mesh: the render mesh is only exported when baking meshes with BakeAir
Bake and use: the mesh is exported when rendering with BakeAir, and the exported mesh is used in place of the object when rendering with Air.

Use the dialog button to display a dialog for specifying the export file name.

See Also:
AirObject command

19 Commands

AirBake - bake texture maps with BakeAir
AirCopyRhinoMap - copy Rhino color map to Air surface shader parameters
AirEnvironment - edit environment settings
AirEnvironmentMap - specify an environment map for all backgrounds

AirExport - export RIB file
AirExportVrml - export model with baked textures to VRML file
AirIllum - change per-object illumination properties

AirIprEnd - stop interactive preview rendering (IPR)

AirIprStart - begin interactive preview rendering (IPR)
AirIprUpdateView - update camera position in IPR view
AirGi - change global illumination settings

AirLoadBakedMaps - load baked texture maps into Rhino
AirLoadSettings - load global settings
AirMaterial - change material settings
AirMotion - animate objects

AirObject - set per-object properties
AirOptions - set global rendering options
AirOutline - change outline settings
AirRender - export and render

AirRenderCubeMap - render a cube-faced environment map
AirResetSettings - reset global settings
AirSaveSettings - save global settings
AirStroke - set custom stroke shader for vector-based outline drawing

AirTrace - edit ray trace settings
AirVersionIncrement - increment version number
AirWriteArchive - write selected objects to RIB archive file

19.1 AirBake command

Use the AirBake command to bake or render shading and lighting information to texture maps with BakeAir.

BakeMesh (Yes No)

Whether to bake meshes or maps.

EdgeLength (0)

When baking meshes, specifies the maximum size of any polygon in a mesh. Only applied to mesh objects. Set to 0 to disable this mode of mesh refinement.

Gamma: (1.0)

Specify the gamma correction applied to baked map or baked mesh color values.

MeshMode (Color Occlusion Indirect)

Selects the value to store when baking meshes:

Color: the surface shader color output is stored.

Occlusion: an occlusion value is stored as a single float value per vertex, prim_occ, in an exported RIB file. A mesh with baked occlusion can be used to accelerate rendering with the occlusion GI mode.

Indirect: an indirect illumination value is stored as a color value per vertex, prim_indirect, in an exported RIB file. A mesh with stored indirect lighting information can be used to accelerate rendering with the indirect GI mode.

Diffuse: the diffuse component of the shader output (diffuse lighting modulated by diffuse surface

color) is stored as a color value per vertex, prim_diffuse. Baked diffuse can accelerate subsurface scattering with the Translucent surface shader.

DiffuseLight: the diffuse light illuminating a location, stored as a color per vertex, prim_diffuse_light.

UnlitColor: the base color pattern of a surface with no lighting information, stored as a color per vertex for RIB or PLY export. This option can be used to bake the color pattern from a procedural shader for realtime rendering.

MeshNormals (Yes No)

Whether to include vertex normals in a baked mesh file.

MeshTexCoords (Yes No)

Whether to include texture coordinates in a baked mesh file.

Sel (Yes No)

Whether to bake only selected objects or all objects.

TexelSize (0.1)

Size of each texel (or pixel) of the baked texture map. Smaller values produce larger and more detailed maps, subject to the maximum map size set on the Air Bake page.

See Also:
Baking Textures with BakeAir

Baking Meshes with BakeAir

Air Bake page

19.2 AirCopyRhinoMap

The AirCopyRhinoMap command copies the current Rhino texture (color) map and its position and size information to the corresponding parameters in a custom Air surface shader.

Specifically, the command copies the texture file name to a ColorMapName parameter if possible. The texture origin is copied to TextureOriginXY, and texture size is converted to corresponding values for TextureSizeXY.

19.3 AirEnvironment

Use the AirEnvironment command to set properties for the global environment shader.

Mode (Off Color Map Sky)

Select a shader to use for rays that miss all objects in a scene:

Off
No environment shader is used, and environment ray queries return black.

Color
Return a constant color for environment ray queries.

Map
Query the provided environment map. The map intensity, blur, and orientation can be set.

Sky
Use a physical sky shader for the environment.

In Color mode the following options are available:

Color (default white)

The color to return for environment queries.

In Map mode the following options are available:

MapIntensity (1.0)

Multiplier for the environment map color.

MapBlur (0.01)

Blur for the environment map query as an angle in radians.

MapRotateZ (0)

Rotation angle about the Z axis in degrees.

Map

File name for the environment map. For best results, the environment map image should be converted to an Air environment map using the Air texture conversion tool. (For quick access to the tool, choose Convert Textures from the Tools menu in Air Show.)

In Sky mode the following options are available:

Day (15)

Day of the month.

Hour (12)

Hour of the day (0-24).

Latitude (47.45)

Latitude for the location of the model.

Longitude (-122.3)

Longitude for the location of the model.

Month (4)

Month of the year (1-12).

North (0)

North direction as an angle in degrees relative to the X axis.

Sun (No Yes)

Whether to include a sun light in the scene.

SunIntensity (1)

Intensity multiplier for the sunlight.

SkyIntensity (0.5)

Intensity multiplier for the sky light.

TimeZone (-8)

Difference between local time and GMT in hours.

Turbidity (5)

Atmospheric turbidity as an integer between 2 and 9.

19.4 AirEnvironmentMap command

Sets the environment map for GI background, reflected background, and image background simultaneously.

Note that this command does not change the mode for any of the backgrounds.

19.5 AirExport command

Use the AirExport command to export the current scene to a RIB file.

The AirExport command accepts the same options as the AirOptions command. Changes to options affect only the current export.

19.6 AirExportVrml command

This command exports a model with baked textures to a VRML file. Unlike Rhino's VRML exporter, this special command knows how to properly define shading in the VRML file for use with baked textures.

The exported VRML file should be located in the same directory as the baked textures (since texture references in the VRML file will not have full paths).

If the current Rhino view is a perspective view, that view will be used as the default view in the VRML file. Due to limitations in the way a viewpoint is defined in a VRML file, the view in the VRML file will generally not exactly match the Rhino viewport.

The background color in the exported VRML file will be taken from the RhinoAir image background color.

See Also:
Baking Textures with BakeAir

19.7 AirGi command

Use AirGi to configure global parameters for the different global illumination modes. The current GI mode can be set with the GiMode option of the AirOptions command.

Adaptive (No Yes)

When this setting is enabled, Air will use adaptive sampling to estimate global illumination. With adaptive sampling Air casts fewer rays initially and additional rays only where needed.

MaxTraceDistance (default 100000)

Maximum distance to trace rays when searching for surrounding objects.

MaxError (default 0.2)

Maximum error allowed when re-using cached irradiance or occlusion estimates.

MaxPixelDistance (default 20)

Maximum distance in pixels between estimates in an irradiance or occlusion cache.

Rays (integer between 1 and 1024)

Number of rays to cast for each estimate of global illumination.

ReadCache (No Yes)

Whether to initialize the internal irradiance or occlusion cache from the cache file.

WriteCache (No Yes)

Whether to write cached occlusion or irradiance values to the cache file when rendering is complete.

CacheFile

File name for irradiance or occlusion cache file.

BgMode (Color Map Environment)

Sets the method of specifying illumination coming into the scene from the surrounding environment.

BgColor (default white)

Average color of the surrounding environment that contributes light to the scene.

BgColorIntensity (default 0.5)

Multiplier for the background color.

BgMapIntensity (default 0.5)

Multiplier for the illumination contribution from a background environment map.

BgMapBlur (default 0)

Blur angle in radians for query of the background environment map.

BgMapRotateZ (default 0)

Angle in degrees to rotate the background environment map around the Z axis.

BgMap

File name for a background environment map.

See Also:
Air GI page

Air User Manual: Lighting -> Indirect Diffuse Light
Air User Manual: Lighting -> Ambient Occlusion

19.8 AirIllum command

Use the AirIllum command to fine-tune illumination properties for individual objects.

UseAverageColor (No Yes)

Use the average color property set below when computing the object's indirect illumination contribution in Constant or Diffuse shading mode.

AverageColor (0.5 0.5 0.5)

Average object color used in the fast indirect shading modes Constant and Diffuse when the UseAverageColor property above is enabled.

ContributeIndirect (No Yes)

Whether the object contributes indirect illumination to the scene.

Exclude lights

A list of light channels (1 through 9). Lights with those channel numbers will not illuminate the selected objects.

Include lights

A list of light channels (1 through 9). Lights with the corresponding channel number are turned on for the selected objects.

IndirectShading (Auto Constant Diffuse Shader)

The indirect shading mode determines how the indirect illumination contribution from a surface is computed:

Auto
The indirect shading mode is taken from the global setting on the Air GI properties page.

Constant
Reflected light from a surface is approximated using the object's standard color property. This is the fastest shading mode since the renderer does not need to perform any shading or lighting computations.

Diffuse
Air approximates bounce light from an object by computing the incoming diffuse illumination multiplied by the object color. This is slower than constant shading but much faster than the shader mode since Air does not need to execute the object's surface shader.

Shader
Indirect light from an object is computed by evaluating its surface shader. This is the slowest and most accurate mode.

ReceiveGI (No Yes)

Whether the object receives global illumination.

See Also:
Global Illumination
Air GI page

Air User Manual: Lighting -> Indirect Diffuse Light

19.9 AirIprEnd command

Use the AirIprEnd command to terminate an interactive rendering session.

See Also:
IPR - Interactive Preview Rendering

AirIprStart command
Air Interactive page

19.10 AirIprStart command

Use the AirIprStart command to begin an interactive rendering session with TweakAir.

See Also:
IPR - Interactive Preview Rendering

AirIprEnd command
Air Interactive page

19.11 AirIprUpdateView

Use the AirIprUpdateView command to transmit the current camera position of the IPR viewport to an active IPR session.

See Also:
IPR - Interactive Preview Rendering

AirIprStart command
AirIprEnd command

Air Interactive page

19.12 AirLoadBakedMaps command

Loads baked texture maps into Rhino.

Note that the load process will create a unique material for each Rhino object if necessary, which may alter the current material settings if the scene contains materials assigned by layer.

See Also:
Baking Textures with BakeAir

19.13 AirLoadSettings command

This command loads AIR global settings from an Air Rhino Settings file (*.ars) previously saved with the AirSaveSettings command.

19.14 AirMaterial command

Use the AirMaterial command to change properties of the material assigned to an object.

Air material properties will be altered for whatever material is assigned to the object, regardless of how the material is assigned (e.g., by layer, by parent, etc.)

Name

Sets the Rhino material name.

Color

Sets the Rhino material color, also used as the color attribute for Air.

Surface (Rhino)

Sets the Air surface shader used to compute the materials output color. If the Surface shader is set to Rhino, the Rhino material properties will be used for the appearance of this material.

Displacement (Rhino)

Sets the Air displacement shader used to apply topographical effects to a surface. If the Displacement shader is set to Rhino, the Rhino material bump map properties will be used for displacement.

DisplacementMode

Determines how the displacement shader is applied to a surface:

Off	The displacement shader is not used.
Bump only	The displacement is applied as a bump effect, modifying the shading normal but not moving the surface.
Regular displacement	The displacement shader moves the surface. The shader is evaluated by carving a surface into pieces and displacing each piece separately.
Mesh displacement	The displacement shader moves the surface. An entire object is tessellated and displaced at once.

Transparency (number between 0 and 1)

Sets the Rhino material transparency.

UsePtex (No Yes)

Enable generation of per-face texture coordinates for PTEX texture maps.

UseSpectrum (No Yes)

Whether to use a spectral color profile (defined with the Spectrum property below).

Spectrum

File name of a spectal color profile.

See Also:
Materials
Air Material page

19.15 AirMotion command

Use the AirMotion command to animate objects.

Object animation is stored as a list of actions attached to an object. The actions are applied to the object in the order in which they are listed. Actions are referenced by ordinal position within the list; the first action is action 1.

Every action has a start and and end time. Time is relative to the scene duration set on the Air Animation page.

The AirMotion command provides the following options:

Append

Add a new action to the end of the action list for each object.

Edit

Edit an existing action. You will be prompted to enter the item number for the action to be edited.

Delete

Delete an action.

List

List actions assigned to the first selected object.

Order

Change the order of items in the list. You will be prompted for an item number and then a new position in the list for that item.

The following actions are currently supported:

Translate - translate an object in X, Y, or Z
Rotate - rotate the object an angle in degrees about an arbitrary axis
Scale - scale an object in X, Y, or Z

See Also:

Object Animation

19.16 AirObject command

The AirObject command provides scriptable access to the same object properties as the Air Object page.

InCamera (No Yes)

Object is visible to the camera.

Reflected (No Yes)

Object is visible in reflections.

CastShadow (No Yes)

Object casts shadows.

BackFaces (No Yes)

Backward-facing surfaces are visible.

ShadeCurves (No Yes)

Should curves and points be shaded using the assigned AIR material?

Subdivide (No Yes)

Export a polygon mesh as a Catmull-Clark subdivision surface.

Weld (No Yes)

Weld coincident polygon vertices

PointType (Sphere Sprite Blobby Volume Disk)

Sphere: points and point clouds are rendered as geometric spheres.

Sprite: points and point clouds are rendered as square polygons oriented to always face the camera.

Blobby: a point cloud is rendered as a metaball or blobby implicit surface. Blobbies are always shaded using the assigned material. For faster rendering with lower memory use, increase the **Tolerance** setting (described below) above the default value of 0.5.

Volume: a point cloud is rendered as a volume primitive. For appropriate shading, try using one of the following surface shaders included with Air: particle, VSmokeSurface, VCumulusCloud. In most cases the **Surface modifies transparency** control on the Air Material page should also be checked.

Disk: points are rendered as disks.

CurveType (Auto Polyline Ribbon Tube)

Auto: choose a curve type based on the curve geometry. Polylines are rendered using the polyline type. NURB curves are rendered as ribbons.

Polyline: render a curve as a sequence of straight line segments. This type renders fastest and uses the least memory. Wide curves may exhibit gaps between segments. If you are applying an instancer shader to the curve, this type should be selected.

Ribbon: renders a curve as a ribbon or quad-strip.

Tube: renders the curve as an open-ended tube.

UseLineColor (No Yes)

Use per-object line color defined below.

LineColor (black)

Optional per-object line color.

UseLineWidth (No Yes)

Apply per-object line width defined below.

LineWidth

Multiplier for the global outline or curve width.

UseTolerance (No Yes)

Use per-object tolerance value defined below.

Tolerance

Per object-override for global geometric tolerance setting.

19.17 AirOptions command

The AirOptions command sets parameters that are global to a particular scene or model.

Options:

AirShow (Yes No)

When Yes, the rendered image is sent to the standalone AIR Show framebuffer.

Animate (Off Turntable FlyThrough Paths)

The animation mode to use for rendering.

BgMode (Transparent Color Gradient Wallpaper Environment)

Determines how to treat pixels in the image that are not covered by any objects.

BgColor

Color to use for the image background when BgMode is set to Color.

Colors (Yes No)

Whether to export the color of each object.

ConvertTexture (Yes No)

If yes, images used as texture maps are converted to Air texture maps prior to rendering.

Crop (Yes No)

Whether to use the crop region for a rendering.

CropRegion (*left right top bottom*)

Specifies a sub-region of an image to which rendering is restricted. Each window coordinate lies between 0 and 1. When the AirOptions command is invoked in interactive mode, the CropRegion can be set by selecting a rectangle in a Rhino viewport.

Curves (Yes No)

Whether to render curve objects.

Dimensions (Yes No)

Whether to render dimension and text annotation objects.

Displacable (Yes No)

When set to No, disables true displacement for all objects.

Draft (Yes No)

When Draft is Yes, the number of shadow samples and reflection samples are restricted to 1 regardless of other settings.

Enlarge (Yes No)

When enabled the crop region is rendered at full image size instead of as a subrectangle of the defined image size. The Enlarge option only affects the renderer's behavior when the Crop option is enabled.

Frame (integer, default -1)

When greater than or equal to 0, the frame value gives the frame number to use for the exported file. The frame number is appended to the RIB file name and appended to the image file name. The RIB file will also include a `FrameBegin`/`FrameEnd` block with the specified frame number. As a side effect, when a valid frame number is specified, the RhinoAir version counter is not automatically incremented after export to facilitate exporting multiple animation frames with the same version number.

GiMode (Off Ambient Indirect IndirectCache Occlusion OcclusionCache)

GiMode selects among the following ways of simulating global illumination effects:

Off:
No GI effects. The RhinoRender ambient light settings are translated to a simple AIR ambient light source that contributes a fixed amount of diffuse illumination to each surface.

Ambient
A constant amount of ambient light is added to the scene.

Indirect:
Compute indirect diffuse illumination which includes color bleeding effects without caching.

IndirectCache
Compute indirect diffuse illumination using an irradiance cache to accelerate rendering.

Occlusion
Simulate environment lighting using ambient occlusion to compute shadows.

OcclusionCache
Simulate environment lighting with ambient occlusion using an occlusion cache to accelerate rendering.

ImageHeight (integer greater than or equal to 0)

Sets the height of the rendered image in pixels. A value of 0 will cause the image dimensions to be taken from the viewport used for rendering.

ImageWidth (integer greater than or equal to 0)

Sets the width of the rendered image in pixels. A value of 0 will cause the image dimensions to be taken from the viewport used for rendering.

Lights (Yes No)

When set to No, no standard lights are included in the scene.

LowPriority (Yes No)

When Yes a render process started with AirRender runs at lower than normal priority so that the performance of foreground applications such as Rhino is not degraded by the rendering process. This setting does not affect or appear in the exported rib file.

PixelSamples (integer between 1 and 32)

Gives the number times the scene geometry is sampled per pixel as a grid of N by N samples. For example, a PixelSamples value of 4 will result in a sample grid of 4 x 4 = 16 samples per pixel.

ShadingSamples (integer between 1 and 64)

Number of shading samples to compute per pixel. In the rib file this setting appears as a ShadingRate call, which is the inverse of the number of shading samples:

ShadingRate = 1 / ShadingSamples

SharpFilter (Yes No)

When SharpFilter is Yes, the image pixel samples will be combined using a Mitchell pixel filter, which produces a sharper image than the default gaussian filter used if SharpFilter is No.

Sel (Yes No)

When Sel is Yes, only selected objects are rendered. All lights are exported independent of this setting.

Stroke (empty)

Specify a custom stroke shader to use when drawing vector-based outlines.

StrokeMode (Off)

Set the stroke drawing mode for vector-based outlines.

Surface (empty)

Specify a surface shader to use for all objects, overriding the per-object material settings.

Threads (integer between 1 and 24)

Number of processing cores to use for a rendering process started with the AirRender command. This setting does not appear in the exported rib file.

TraceDepth (default = 4)

Maximum number of "bounces" to trace reflected rays. A trace depth of 0 disables ray-traced reflections.

WriteImage (Yes No)

When set to Yes, the rendered image is written to a file. The image file format is derived from the file name extension.

RibName

Use this option to enter a file name for the exported rib file. The default file name is RhinoAir.rib located in the directory pointed to by the TEMP environment variable.

ImageName

Use the ImageName option to specify the file name for a rendered image. The default image name is air.tif.

Watercolor (Yes No)

When enabled, the WatercolorPaper imager shader is applied to the final rendering, adding a rough

paper look the image.

19.18 AirOutline command

Use the AirOutline command to set parameters for rendering outlines.

FrontBack (No Yes)

When set to Yes this parameter enables an object-based edge detection method that identifies edges that separate front-facing and back-facing polygons.

InkColor

Color for outlines.

InkWidth

Sets the width of outlines in pixels.

MaxEdgeLength (default 20)

Maximum edge length in pixels for vector-based edges. Only used if the UseMaxEdgeLength parameter is enabled.

UseMaxEdgeLength (No Yes)

When enabled, vector-based edges are limited to the specified maximum edge length in pixels; longer edges are subdivided to meet the criterion.

MergeEdges (No Yes)

When enabled, vector edges with end points that are close will be merged to a single edge, which is then tested for retention based on the other vector-based edge detection methods that are enabled.

MinEdgeAngle (30)

Minimum angle for vector-based edge detection based on the angle between adjacent faces. Only used if the following UseMinEdgeAngle parameter is enabled.

UseMinEdgeAngle (No Yes)

When enabled, Air will retain an edge joining two faces for outlines if the angle between the faces is greater than the minimum edge angle setting.

Silhouette (float value between 0 and 1)

Sets the threshold for edge-detection based on surface normal differences. Use a value of 0 or 1 to disable silhouette edge detection.

SingleEdges (No Yes)

When enabled, single (unshared) edges are added the list of edge-based outline vectors.

FadeDepth

When set to a positive value, this option gives the distance at which to begin reducing outline width based on distance from the camera.

MinInkWidth

When fade with distance is enabled, this parameter gives the minimum outline width.

See Also:
Air Outline page

Air User Manual: Toon Rendering and Illustration

19.19 AirRender command

The AirRender command can be used to export a scene and start a rendering process.

The AirRender command accepts the same options as the AirOptions command. Any options that are changed affect only this invocation of the command; the global state of each option is not affected.

The rendering process will use the number rendering threads set with the Threads option. The process will execute at low priority if the LowPriority option is set to Yes, allowing other processes to execute without being slowed down by the rendering.

19.20 AirRenderCubeMap command

The AirRenderCubeMap command produces a cube-face environment map for the current scene from a user-specified "eye" point.

The final image size is based on the current image height, rounded up to an even power of 2. The cube-faced environment map is generated by rendering 6 smaller images of the scene, one along each direction of each major axis. The six individual maps are then combined into a single environment map with the MakeCubeFaceEnvironment RIB command.

19.21 AirResetSettings command

Use this command to reset all global Air settings to their default values.

19.22 AirSaveSettings command

This command requests a file name and then saves all global RhinoAir settings to an Air Rhino Settings file.

19.23 AirStroke command

Use the AirStroke command to select a custom stroke shader for use when drawing vector-based outlines.

In order for the stroke shader to be used in rendering, the following options must also be set in the Air Outline dialog (or using the equivalent commands):

- Outline drawing must be enabled.
- The Stroke Mode must be set to Custom.
- One or more of the object-based edge detection methods must be enabled.

See Also:
Air Outline page

Air User Manual: Shader Guide -> Stroke Shaders

19.24 AirTrace command

Use the AirTrace command to set global parameters for ray-traced reflections.

TraceBias (default 0.01)

Small distance used to prevent incorrect self-intersection during ray-tracing. The bias setting affects ray-traced shadows and reflections.

TraceDepth (default = 4)

Maximum number of "bounces" to trace reflected rays. A trace depth of 0 will disable ray-traced reflections.

BgMode (Transparent Color Map Environment)

This section determines the color returned by reflection rays that miss all objects in the scene. There are 3 basic modes:

Transparent
Reflection rays that miss all objects simply return a black color.

Color
Reflection rays that fail to intersect an object return the specified color scaled by the **Intensity** value.

Map
The provided environment map is used to select a color for reflection rays based on the ray direction. The **Intensity** value gives a multiplier for the environment map result. The **Blur** parameter can be used to add blurriness to the result to soften the look or smooth the appearance of a low-resolution map. The **Rotate** value gives an angle in degrees to rotate the map about the Z (up) axis.

Environment
Query the global environment shader.

BgColor (default white)

Background color returned by rays that miss all objects in the scene.

BgColorIntensity (default = 0.2)

Multiplier for the reflected background color.

BgMapIntensity (default 1.0)

Multiplier for the reflected color in Environment background mode.

BgMapBlur (default 0.0)

Blur angle in radians for environment map query in Environment background mode.

BgMapRotateZ (default 0.0)

Rotation angle in degrees about the Z axis for orientation of the background environment map.

BgMap

File name of the environment map to use in background mode Environment.

See Also:
Air Trace page

19.25 AirVersionIncrement command

This command simply increments the RhinoAir internal version counter used when the **Append version** option on the Air Plugin page is enabled.

This command is primarily useful for scripting. It is used by the RhinoAir scripts for exporting and rendering Bongo animation.

19.26 AirWriteArchive command

This command writes selected objects to a RIB archive file.

Archive

Name of the file to which the objects are written.

Materials (Yes No)

Whether material information is included in the archive file.

See Also:

Optimizing Complex Objects with RIB Archives

20 Material, Object, and Light Properties

The RhinoAir plugin stores Air-specific properties using Rhino user text attributes. You can use the standard Rhino commands for viewing and potentially changing the RhinoAir attributes for materials, lights, or objects.

20.1 Light Properties

Light color and shadow intensity are taken from the corresponding Rhino light properties.

AirAreaLightType (normal fast portal)

Method of simulating a rectangle area light.

AirLightArchive (empty string)

Name of RIB archive for custom area light geometry.

AirLightChannel (1)

Channel index for per-light output channels/images (1 through 9).

AirLightEmitDiffuse (yes no)

Does the light contribute diffuse illumination?

AirLightEmitSpecular (yes no)

Does the light produce specular highlights?

AirLightFalloff (0)

Exponent for decay in light intensity with distance.

AirLightIntensity (1)

Scalar light intensity value.

AirLightTexture (empty string)

Texture map for use with rectangle area light.

AirLightUseArchive (yes no)

Whether to use the light's archive for custom area light geometry.

AirLightUseTexture (yes no)

Whether to use the light's texture map.

AirRectangleLightInCamera (yes no)

Is a rectangle area light visible from the camera?

AirRectangleLightReflected (yes no)

Is a rectangle area light visible in reflections?

AirShadowBlur (0.01)

Shadow blur value as an angle in radians measured from the current shading location.

AirShadowColor (0.0 0.0 0.0)

Shadow color as 3 floats in the range 0 to 1.

AirShadowSamples (8)

Number of rays to cast for each shadow evaluation.

20.2 Material Properties

Material color and transparency values are taken from the corresponding Rhino material properties.

AirComplexShadow (yes no)

Whether the surface shader computes a complex opacity/transparency (and hence must be evaluated by shadow rays).

AirDisplacement (Rhino)

Displacement shader declaration including full inline type declarations for every parameter. If the shader is set to Rhino, RhinoAir translates the standard Rhino bump map parameters to an equivalent Air displacement shader.

AirDisplacementLayout

Used to track display properties of the parameter list.

AirDisplacementMode (off bump regular mesh)

How to apply the displacement shader.

AirHideInstancerBase (yes no)

Hide base object for instancer shader?

AirInstancer

Instancer shader declaration including inline type declarations for all parameters.

AirInstancerBound (1.0)

Distance from the base object defining the region within which the instancer will create new objects.

AirInstancerLayout

Used internally to track display of shader parameters.

AirShadingSamples (1)

Number of shading samples per pixel.

AirSurface (Rhino)

Surface shader declaration including inline type declarations for all parameters. When the shader value is 'Rhino', RhinoAir translates the standard Rhino material properties to an equivalent Air surface shader.

AirSurfaceLayout

Used internally to manage the display of shader parameters.

AirUsePtex (yes no)

Whether to generate texture coordinates and face ids for Ptex texture files.

20.3 Object Properties

AirArchive (empty string)

Name of a RIB archive file.

AirArchiveMode (off insert replace)

Whether and how to incorporate the RIB archive stored in AirArchive.

AirBackFace (yes no)

Is the back side of the object visible?

AirCastShadow (yes no)

Does the object casts shadows?

AirCurveType (auto polyline ribbon tube)

Geometric representation of curve objects.

AirUseFlatness (yes no)

Use object's flatness override value?

AirFlatness (0.5)

Per-object surface tolerance override value (in pixels).

AirUseLineColor (yes no)

Use object's line color setting?

AirLineColor (black)

Line color used when AirUseLineColor is yes.

AirUseLineWidth (yes no)

Apply the per-object line width multiplier?

AirLineWidth (1)

Line width multiplier when rendering curves and outlines. Only applied if AirUseLineWidth is yes.

AirUseMeshFile (yes no)

Export object to the file specifed in AirMeshFile?

AirMeshFile (empty)

Name of file for geometry export.

AirPointType (blobby disk patch sphere volume)

Geometric representation for point objects.

AirReflected (yes no)

Does the object appear in reflections?

AirRenderMesh (undefined yes no)

Whether to use the Rhino render mesh. When undefined, the default global mesh preference is used.

AirShadeCurves (yes no)

Apply normal material shading to curve primitives?

AirSubdivisionMesh (yes no)

Render polygon mesh as a Catmull-clark subdivision mesh?

AirVisibleToCamera (yes no)

Is the object is visible to the camera (and hence in the main image output)?

AirWeldPolyVerts (yes no)

Weld polygon vertices (combining coincident points that may have differing texture coordinates or normals)?

21 FAQ - Frequently Asked Questions

1. How do I specify a custom image size or resolution?

On the Air Main page, you can type a custom width and height into the Image Size text box. For example, typing

```
1000 750
```

would specify an image 1000 pixels wide and 750 pixels high.

2. How can I keep the Air Show window in front of the Rhino window?

Enable the Always on Top option in the Air Show Options menu.

3. How can I stop a rendering in progress?

If you are rendering to the Air Show display program, click on the close button in the Air Show

toolbar (not the close button for the window) to the close the image being rendered and stop the rendering process. Newer versions of Air Show also have a stop button for halting a rendering without closing the partially rendered image.

If you are rendering to an image file, closing the console window will stop the rendering process.

4. I've increased the number of shading samples, but some blurry reflections or shadows are still too "noisy". How can I produce smoother reflections or shadows?

The best way to smooth noisy reflections is to increase the number of reflection rays in the surface shader on the Air Material page. Look for the Rays parameter under Reflection.

To smooth noisy shadows, increase the number of shadow rays for the light on the Air Light page.

Increasing the number of reflection or shadow rays will render in less time and produce better results than increasing the number of shading samples. See the Image Quality section for additional advice on efficiently producing high-quality images.

5. When I choose a new surface shader for a material, the new surface applies to all objects on the layer of the selected object, not just the selected object. How can I change the material for just the selected object?

Air material properties are attached to the Rhino material assigned to an object. By default new objects in Rhino have a material assigned by layer. To change the method of material assignment, go to the Rhino Material page for the object and select the desired method in the *Assign by* section. Choose *Assign by Basic* to create a unique material for an object.

The New button on the Air Material page will create a new basic material for each selected object.

The buttons in the Air Material toolbar also create a new material for selected objects.

6. How do I add ambient light to a scene?

One of the global illumination options on the Air Gi page is a simple ambient light.