7

Lighting

LIGHTING IS WHERE the magic happens. Although an excellent model, clever rigging, strong character animation, and fine textures can make a project impressive, it's the lighting that makes the viewer believe that the 3D might actually be *real*. When surveying the wealth of literature on the subject of lighting, 3-point lighting is encountered repeatedly. Despite this, 1-point, 2-point, and naturalistic lighting remain equally valid. Although a good portion of lighting technique deals with aesthetic issues of light placement, color, and intensity, many technical issues are present, such as, for example, the creation of high-quality shadows and the control of light decay.

This chapter's topics are organized into the following techniques:

- Mastering 1-, 2-, and 3-Point Lighting
- Mastering Naturalistic Lighting
- Setting the Mood with Light Color and Position
- Setting Up Believable Lamp Light
- Forcing Decay on Directional and Ambient Lights
- Industry Tip: Unusual Lighting Techniques
- Producing Quality Depth Map Shadows

Mastering 1-, 2-, and 3-point Lighting

Generally, when books cover 3D lighting, they begin with the 3-point technique. Although 3-point lighting is appropriate for many scenarios, there are an equal number of scenarios where it falls short. Naturalistic, 1-point, and 2-point lighting are therefore equally valid approaches. Whereas 1- and 2-point lighting are related, naturalistic lighting is in its own category. Hence, this section starts with 1-point lighting, while naturalistic lighting is reserved for the next section.

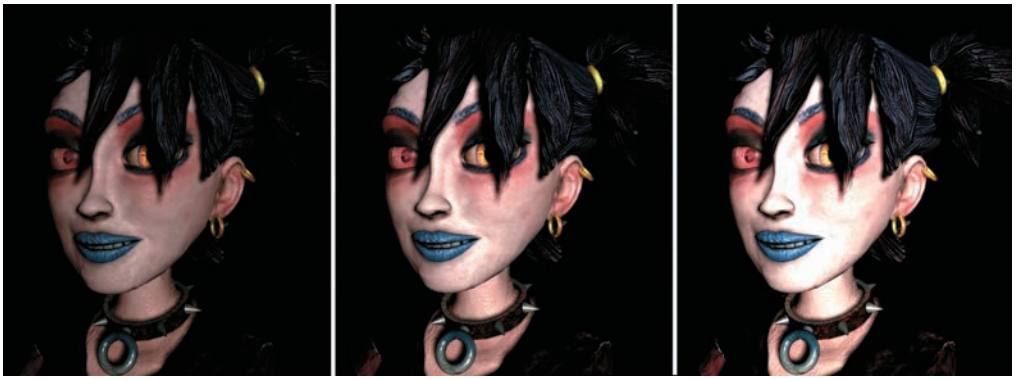
A single key light is used for 1-point lighting. In this situation, no appreciable fill exists. The style is appropriate for dark, moody pieces. In the world of art, examples of 1-point lighting include the paintings of Rembrandt (1606–1669) and Caravaggio (1573–1610). In the world of motion pictures, film noir and similarly stark styles typify 1-point lighting.

(Left) Rembrandt. *The Syndics of the Clothmakers' Guild*. 1662. Oil on canvas. Rijksmuseum, Amsterdam. (Right) Still from the 1950 motion picture *The Miniver Story*. Arrows indicate key direction. *Photos © 2007 Jupiterimages Corporation.*

Spot lights and directional lights generally make the best key lights in Maya. This is due to their default lack of decay and well-defined shadows. When setting the key for 1-point lighting, choose a position that allows important parts, such as the face, to be seen. In addition, choose a position that generates the most interesting shadows. Although standard 3-point lighting suggests that the key be placed approximately 45 degrees off the axis of the camera, this is by no means mandatory.

When setting the **Intensity** attribute of the key light, choose a value that appropriately exposes the subject without allowing some parts to go pure white.

Four different key placements create significantly different results. The lower-right image uses a classic portraiture technique that places a triangular *Rembrandt patch* on the character's right cheek.



(Left to right) A key with a low **Intensity** value; a key with a proper **Intensity** value; a key with an inappropriately high **Intensity** value

Adding the Second Light

A key light and fill light are necessary for 2-point lighting. Fill light is simply the sum of all reflected light rays arriving from a particular direction. Maya ambient lights make excellent fill lights. This is due to their default combination of omnidirectional and directional light rays.

You can replicate many naturally occurring lighting scenarios with two lights. For instance, a character walking down a sidewalk receives key light from the sun and fill light in the form of light reflected up from the concrete. A second scenario involves a brightly lit interior. Key light arrives as sunlight through a window, while equally bright fill light arrives from large banks of fluorescent lights on the ceiling.

An indoor and an outdoor scene display 2-point lighting. *Photos © 2007 Jupiterimages Corporation.*

Painted portraits from the early Renaissance to modern times often display 2-point lighting. In these paintings, there is generally a strong key light, usually in the form of diffuse sunlight, and an even more diffuse fill arriving from the opposite side or from all other points in the scene.

If the source of the fill light is not defined, position the light opposite the key. If the fill light has a specific source, such as a window on a set, place the fill light in a position that mimics that source. Although standard 3-point lighting suggests that the fill light intensity should be approximately half the key, there is a great deal of flexibility. Choose an intensity that creates the most aesthetic result and/or best matches the location.

(Left) Giovanni Bellini. *The Doge Leonardo Loredan*. 1501. Oil on wood. The National Gallery, London. (Right) George Bellows. *Lady Jean*. 1924. Oil on canvas. Yale University Art Gallery, New Haven. *Photos © 2007 Jupiterimages Corporation.*

(Left) Fill light with a low intensity (referred to as a high key-to-fill ratio). (Right) Fill light with a high intensity (referred to as a low key-to-fill ratio). *Photos © 2007 Jupiterimages Corporation.*

Adding the Third Light

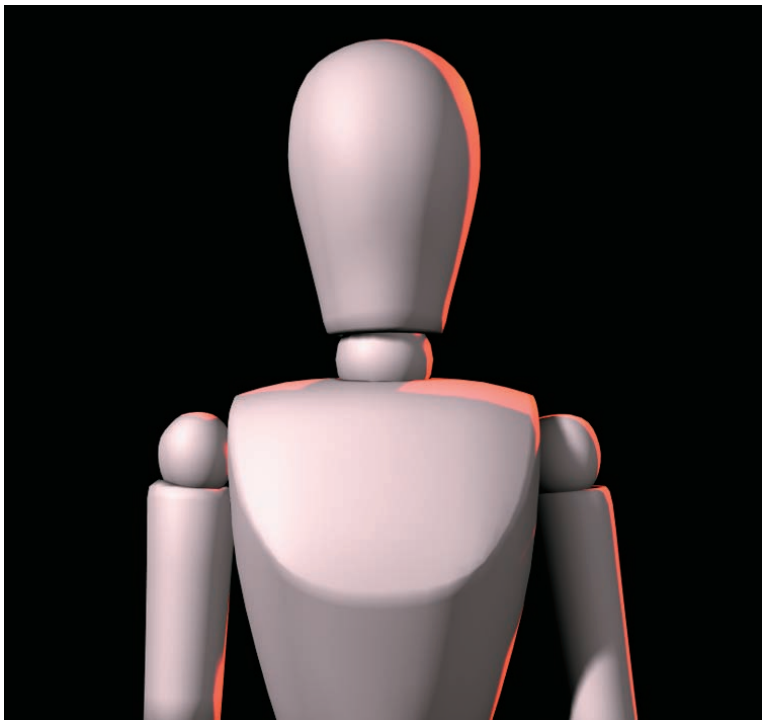
A rim light (also called a hair light or back light) is added to the 3-point lighting scenario. Naturally occurring rim lights are relatively rare in the world. They are most likely to occur when sunlight is arriving from behind the subject; in this case, the sun is actually the key and the remaining light is the fill.

Naturally occurring rim light provided by the sun. *Photos © 2007 Jupiterimages Corporation.*

Painting and other fine art rarely displays 3-point lighting. Historically, 3-point lighting was developed by the motion picture industry as an efficient method to light actors on a soundstage. Rim lights, in particular, were added as a means to separate subjects from their background and a way to impart fantastic, glamorous glows to the hair of heroes and heroines.

Katharine Hepburn and James Stewart in a still from the 1940 motion picture *The Philadelphia Story*. Rim light appears on their profiles and hair. *Photo © 2007 Jupiterimages Corporation.*

Should a third light become necessary, place it behind the subject so that it barely grazes the subject's edge. You may find it necessary to raise the Intensity of the rim to a value 5 or 10 times greater than the key.



A red rim light grazes the screen right side of a character lit by 3-point lighting.

Mastering Naturalistic Lighting

Naturalistic lighting is not dependent on a particular number of lights. Instead, the technique strives to match the lighting of the real world, whatever it might be. Every naturalistic lighting setup is different. Therefore, specific steps for achieving good naturalistic lighting cannot be written in stone. Nevertheless, some general guidelines are appropriate:

- First, identify the strongest source of light and determine its origin. Is the light coming from a recognizable object, such as a lamp? Is the light actually reflected from a floor, wall, or ceiling? If you're lighting a 3D scene that doesn't actually exist, think of a location in the real world that is a relatively close match. Once you've determined what the source is, place a key light that replicates its quality. For example, sunlight is best replicated with a directional light, a flashlight is best replicated with a spot light, reflected light from a large wall is best replicated with an area light, and so on.

- Shadows offer clues to the nature of the light source. For example, if a row of windows is shadowed and the shadows are hard-edged and all in parallel, the source is direct sunlight. If the shadows are fairly distinct but are skewed, the source is an artificial light fairly close by. If shadows are extremely soft and diffuse, the source either is very broad or consists wholly of reflected light. If you are lighting a scene that has a particular time of day or specific interior location, make sure your shadows match accordingly.

(Left) Sunlight creates parallel shadows of windows on a floor. (Middle) An artificial light creates heavily skewed shadows of a fence. (Right) A photographer's light umbrella creates a broad source of light and thus an extremely soft shadow.

- Color can also give clues to the nature of a light source. Natural sunlight has a blue cast when seen during the day. This is due to shorter wavelengths of light being more efficiently scattered by atmospheric molecules than longer wavelengths. As such, the human eye responds to these shorter wavelengths and the brain interprets the color as blue. In contrast, sunsets and sunrises appear more reddish because longer wavelengths have survived the trip through the atmosphere while the shorter wavelengths have been scattered away. As for artificial light sources, incandescent bulbs tend to produce reddish or yellowish light. Other bulbs, such as fluorescent and tungsten, may have blue casts. On a more technical level, light color is indicated by specific color temperatures, as measured in kelvins. If you are lighting a scene that has specific light sources, such a wall sconces, skylights, or even candles, make sure your light colors are appropriate.
- Once the key light is adjusted, continue on to the second strongest source of light. Determine its origin and its nature. Place a light to match. Continue the process, adding one light at a time. If it becomes difficult to tell what a particular Maya light is contributing to the scene, temporarily turn off all the other lights by unchecking their **Illuminates By Default** attributes.

One way to practice naturalistic lighting is to reverse-engineer photographs. That is, select a photo and try to determine what the light sources were at the time of the photography. For example, a sunlit scene makes for good exercise.

A girl is lit by direct and reflected sunlight.

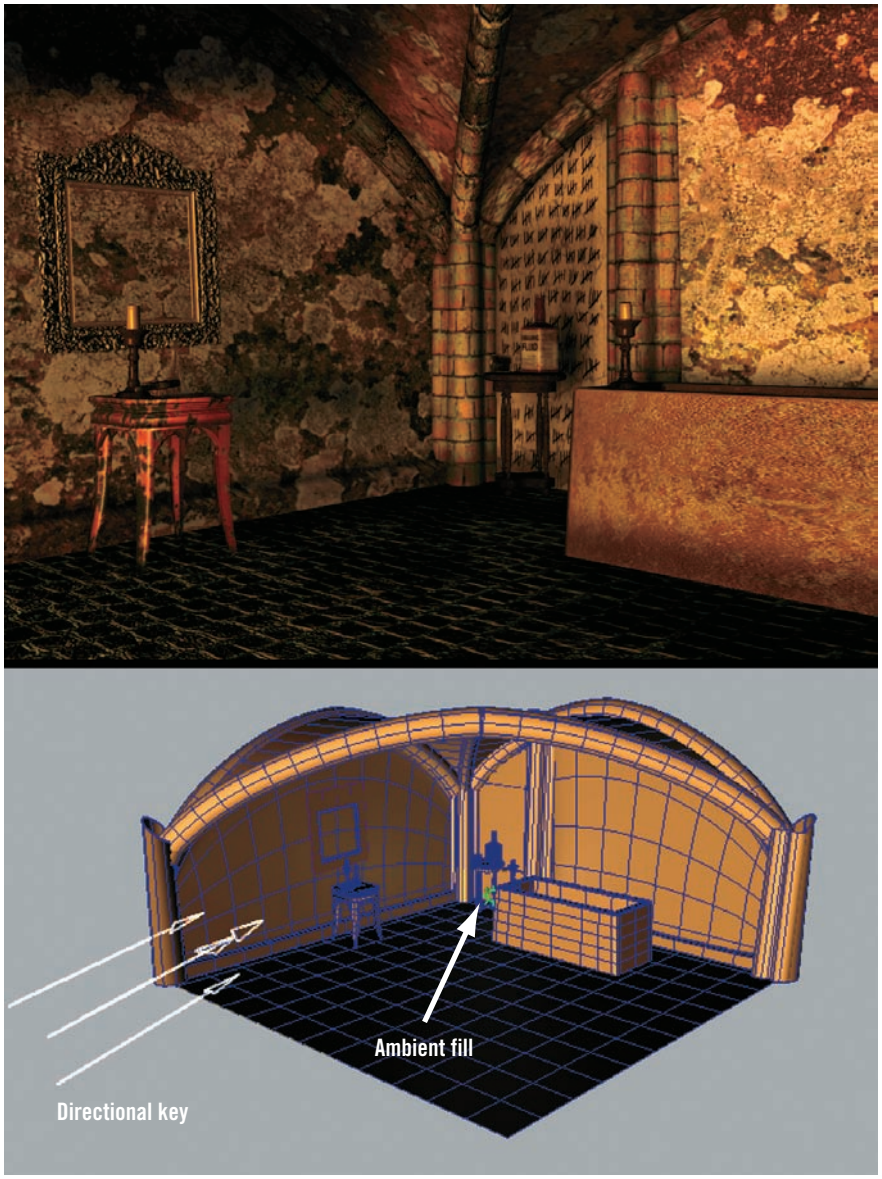
Based on the shadow of the girl's chin on her neck and the slight rim on her right shoulder, it's apparent that sunlight is arriving from screen left and from behind. The light is not strong, however. This could be due to an overcast day or the fact that nearby buildings are reducing the total amount of sunlight. Shadows on the screen right wall and window also indicate that bushes or other foliage may be reducing the light. A strong fill arrives from the photographer's position. Based on the light color and diffuse quality of the shadows, it's apparent that this light is reflected sunlight. The concrete, the white wall, and the etched glass of the window make excellent reflectors. In fact, the window is contributing a small amount of light to the edge of her left cheek, which fails to become overly dark.

Setting the Mood with Light Color and Position

You can establish the mood of a lit scene by carefully choosing a light's color, position, and shadow quality. Many lighting scenarios encountered in everyday life have specific looks that we are subconsciously familiar with. Additional lighting scenarios have been stylistically established by motion pictures, television, and video games.

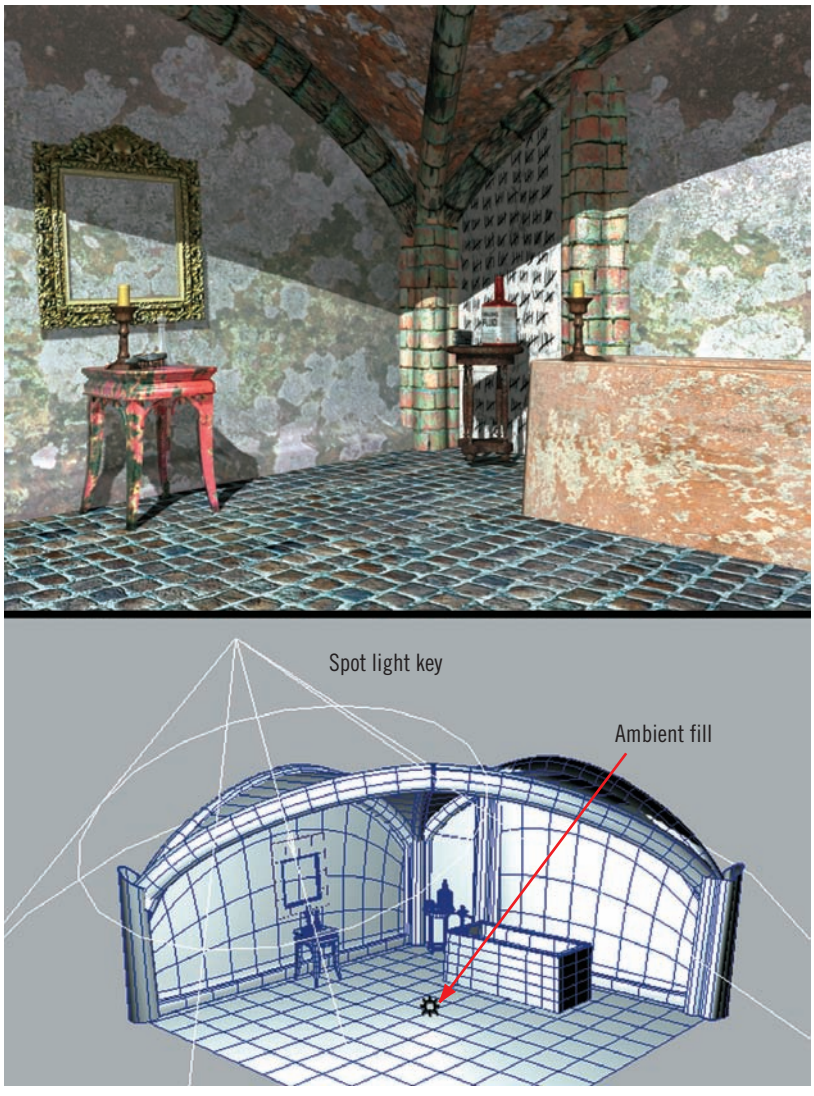
As an example, a single set is lit to emulate a warm sunset, a bright day, a moonlit night, and a scary hellhole.

To create a warm sunset, a directional light is used as a key. The directional is placed at a low angle to one side to replicate the sun low to the horizon. The directional's **Intensity** is set to 1.3 and its **Color** is set to a saturated orange. The directional has **Use Depth Map Shadows** checked, with the **Resolution** attribute set to 512 and the **Filter Size** attribute set to 12. This creates a diffuse shadow, appropriate for sunset light. (For more information, see the section "Producing Quality Depth Map Shadows" later in this chapter.) A single ambient light is added as a fill. The ambient's **Intensity** is set to 0.2, preventing solid blacks from appearing in the corners.



A warm sunset

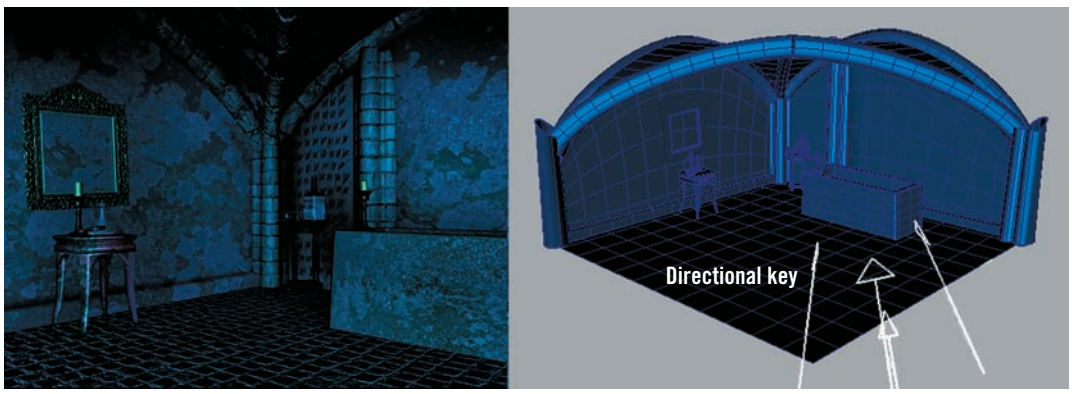
To create a bright, sunlit day, a spot light is used as a key. The spot light is placed high and is pointed straight down, thus emulating a noonday sun. The **Intensity** of the spot light is set to 1.75 and its **Color** is set to an extremely pale blue. The spot light's depth map shadow is given a sharp edge by setting the **Resolution** value to 2048 and the **Filter Size** value to 1. The spot light's **Cone Angle** is set to 100. The light is also given a fog cone by activating the **Light Fog** attribute. The resulting fog is given a low **Density** value of 0.2. This subtle addition of fog emulates the hazy scattering of intense sunlight, much of which is caused by dust and particulate matter in the air. A single ambient light is placed in the room's center and serves as a fill with an **Intensity** value set to 0.5. Since the sunlight is intense, a significant amount of reflected light would normally reach the ceiling and other shadowed areas.



A bright day

When switching between lighting setups, you may find that a material or texture no longer works. It may be too bright or too dark, possess too much contrast or too little, or have an inappropriate saturation or color tint. Hence, it becomes necessary to adjust the materials as the lights are adjusted. Such an adjustment should not be considered some kind of lighting cheat. Although large productions, such as animated feature films, go to great lengths to create materials and textures that work in all lighting situations, it is not always possible on smaller productions or projects. For example, generic rust, stone, and dirt bitmaps, few of which have been customized, are used as textures for the set featured in this section. The surfaces are assigned to standard Blinn materials. Hence, when switching from a sunset to daylight, the floor became too bright and green. The **Diffuse** attribute of the floor material and the **Color Gain** of the floor's texture were therefore adjusted. In addition, the walls became too bright and possessed too much contrast. The **Diffuse** attribute of the walls' material was lowered. The **Color Gain** of the wall texture was also lowered, and the **Color Offset** was raised, thus reducing the contrast.

To create a moonlit night, a movie convention is applied. When shooting a night scene, cinematographers are unable to expose the film with real moonlight regardless of the moon's fullness. Rather, the crews provide lights with blue gels. Audiences associate this artificial blue with nighttime scenes. On older films shoots, it was necessary to shoot *day for night* by placing a filter over the camera lens and shooting in sunlight. Although the resulting scenes were appropriately dark, the shadows were unnaturally black and well defined. As for the 3D scene, a directional light is made the key, its **Color** is set to a saturated blue, and it's placed high and at a moderate angle. The directional's depth map shadows are made extremely soft by setting the **Resolution** attribute to 256 and the **Filter Size** attribute to 24. Soft shadows accurately replicate the diffuse nature of moonlight. For this lighting setup, no additional lights are created.

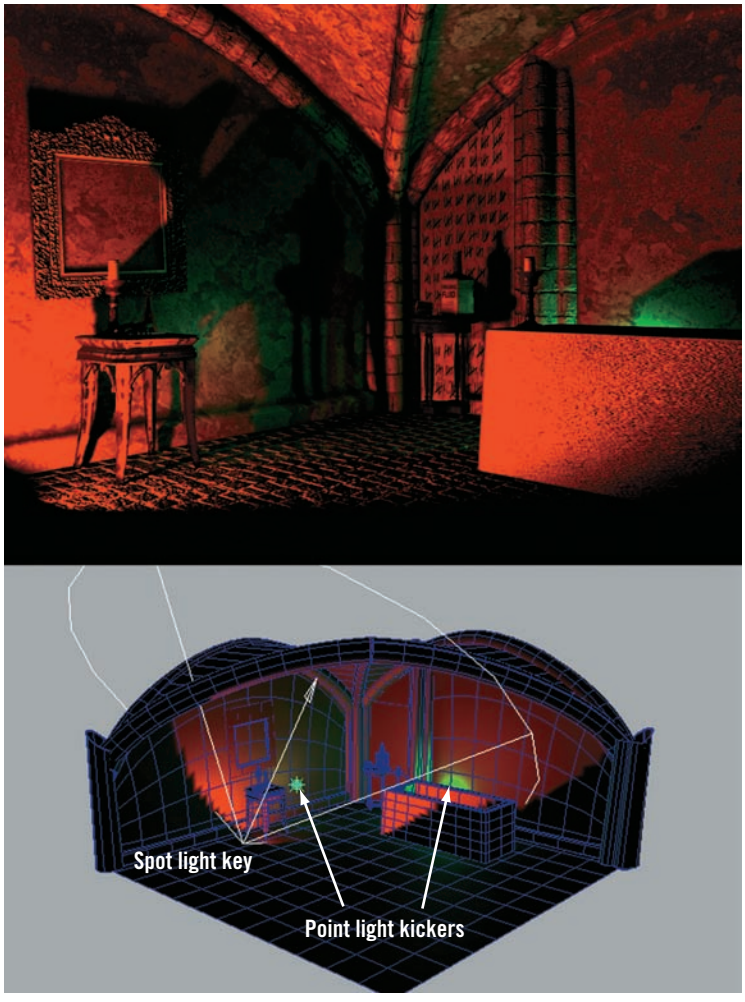


Moonlight

Creating Stylistic Lighting

Although the moonlit scene is somewhat unrealistic, it's intended to represent a real lighting scenario. You can make the lighting truly stylistic by divorcing it from any semblance of real-world lighting. For example, when lighting a scene that is intended to be spooky, scary, or disturbing, you can add lights that create unnatural shadows and utilize strange, saturated colors.

To make the example scene a scary hellhole, a spot light is used as a key. Its **Color** is set to a supersaturated red, its **Cone Angle** is set to 120, its **Intensity** is set to 20, and its **Decay Rate** is set to Linear. The decay weakens the light as it travels and allows various corners of the set to slowly go dark. The spot light is placed directly behind the table on screen left and is pointed toward to ceiling. This low-angle approach mimics a classic technique employed by horror films running all the way back to *Frankenstein* (1931). The end result is a set of strange, enlarged shadows.



A scary hellhole

Two additional point lights are added to accent various parts of the set. One is placed behind the table opposite the spot light. A second is positioned behind the stone coffin at screen right. Both lights have a supersaturated green for **Color** and a **Decay Rate** set to Linear. The point light behind the table has an **Intensity** of 1. The point light behind the coffin has an **Intensity** value of 5; this light also has **Use Depth Map Shadows** checked and creates the shadow of the bottle at the center of the image. Although the two point lights serve as a type of fill, their intensity and limited throw make them similar to rim lights. Perhaps the term *kicker* fits them best — they kick specific areas of the render to the forefront.

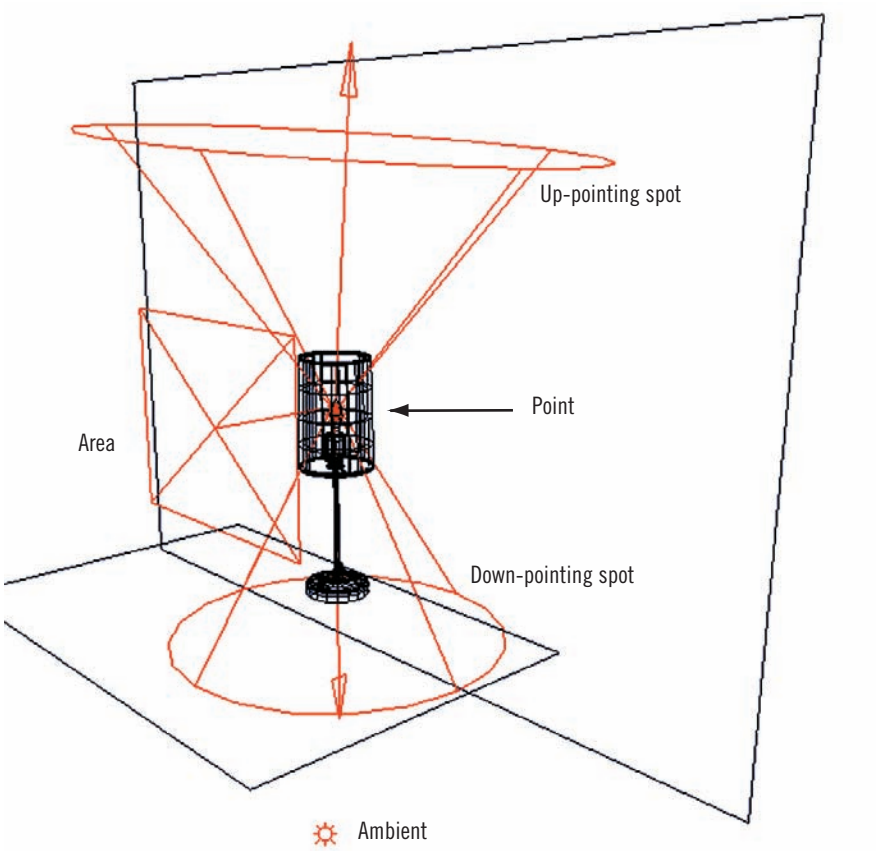
In each of the lighting examples in this section, no more than three lights were used. If characters had been positioned on the set, additional lights might be required. If it was necessary to emulate candlelight emanating from the two candle models on the set, separate lights would be needed for a flame effect. If you'd like to practice lighting this scene, a simplified version is included as `light_set.mb` in the Chapter 7 scene folder on the CD.

Setting Up Believable Lamplight

Table lamps, although seemingly innocuous, can present lighting challenges. Placing a single point light in the center of the lamp rarely produces a satisfactory result. Rather, multiple lights tend to work best. In addition, creating an appropriately illuminated lamp shade often requires special manipulation of the lamp shade material.

As an example, a modern table lamp is built in 3D. Five lights are used to illuminate the table and wall. Two spot lights are tucked inside of the lamp shade, pointing down at the table and pointing up at the ceiling. **Use Depth Map Shadows** is checked for both. The shadow edges are made soft with low **Resolution** values (256 for both) and high **Filter Size** values (18 for the up-pointing and 30 for the down-pointing). With such settings, a shadow of the lamp shade's wire support is barely visible on the table. The **Receive Shadows** attribute for the lamp socket geometry is unchecked, which prevents the socket from creating an unneeded shadow on the lamp base. The socket is useful, however, since it is visible through the shade as a slightly dark spot. Each spot light has a **Decay Rate** set to Linear and an **Intensity** value of 6.

A table lamp in 3D



The five lights

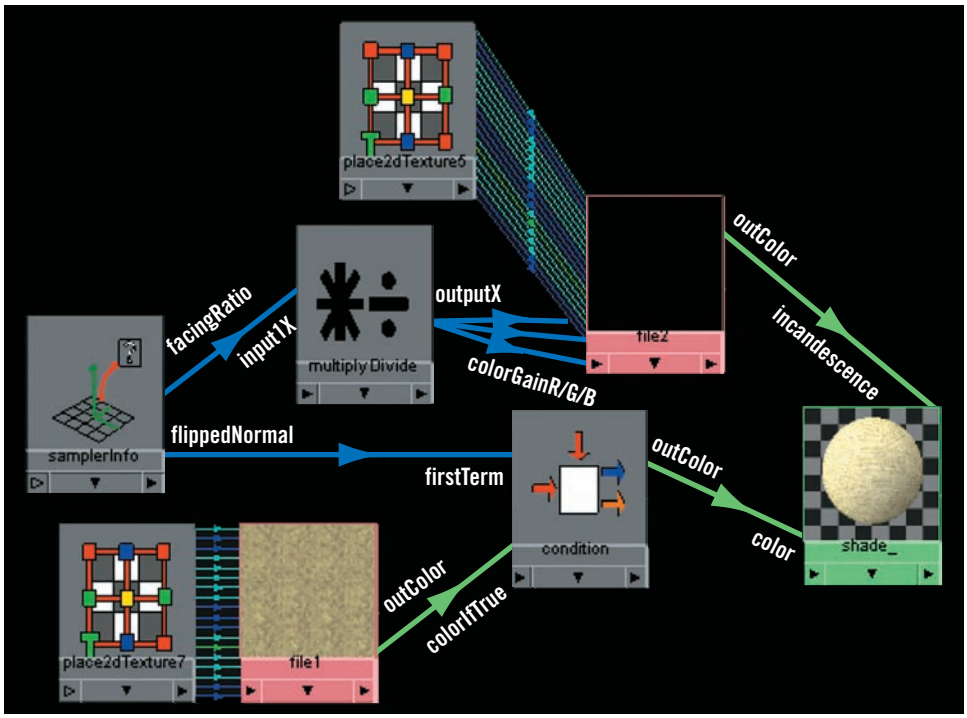
A point light is placed where the lightbulb would normally sit. The **Light Glow** attribute is activated for the light. The corresponding Optical FX utility has **Glow Type** set to Ball, **Star Points** set to 0, **Glow Intensity** set to 0.8, **Glow Spread** set to 0.6, and **Glow Opacity** set to 0.5. The Optical FX utility thereby creates a hot spot in the center of the lamp shade. The various attributes of the utility must be balanced with the attributes of the material assigned to the lamp shade; slight changes make the glow too intense or too dull.

An area light is positioned in front of the lamp between the camera and the wall. The light brightens the wall directly behind the lamp shade. Although the **Intensity** of the point light is set to 0.2, the hot spot it creates on the wall is too small to look good by itself. The area light **Intensity** is set to 0.125. Finally, an ambient light is positioned behind the camera, thus raising the overall brightness of the scene. The ambient light Intensity is 0.2. Each of the five lights has its Color attribute set to a pale orange.

The lamp shade geometry is assigned to a Lambert material. Ambient Color is set to a dark gray. **Diffuse** is set to 0, thereby skipping the diffuse contribution of the scene's lights. **Transparency** is raised slightly above 0, allowing the socket and wire support to peek through. **Translucence** is set to an artificially high value of 5.5, encouraging the light from the spot lights and

point light the pass through the surface. **Translucence Depth** is set to 5 and **Translucence Focus** is set to 0.4, spreading the translucent light out over the majority of the shade surface.

The Lambert material's **Color** attribute is provided by a custom network. A Condition utility switches between a File with a loaded cloth bitmap and solid white. The input for the Condition utility is the **Flipped Normal** attribute of a Sampler Info node. With this setup, the flipped side of the surface receives the white and the nonflipped side receives the cloth texture. Thus, the inside of the lamp shade is rendered white, as can be seen at the top of the lamp, while the outside is rendered as cloth. (In Maya, the flipped side becomes invisible when the **Double Sided** attribute of the surface is unchecked.)



The shade material's custom shading network

The Lambert's **Incandescence** attribute is also connected to a custom network. In this case, the **Facing Ratio** attribute of the Sampler Info utility is fed into a Multiply Divide utility before it is connected to **Incandescence**. In short, this creates the greatest amount of incandescence on the faces of the surface that point toward the camera. Thus, the sides of the lamp shade are slightly darker.

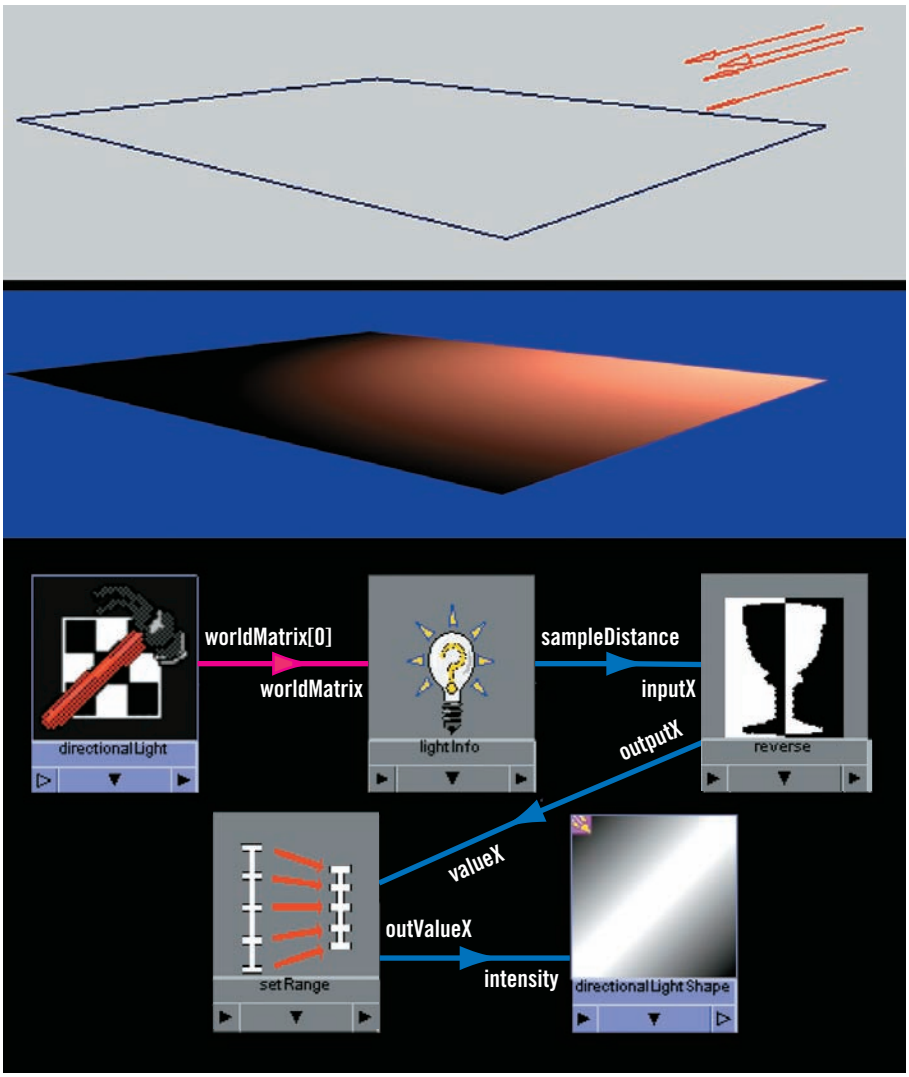
As a final trick, a duplicate of the lamp shade is scaled down slightly and assigned to a Lambert material with 100 percent white **Transparency**. Although this prevents the duplicate from rendering, it allows it to be shadowed by the spot lights. If the duplicate lamp shade is removed, the original lamp shade would receive the light of the spot lights in an uneven manner.

A final version of this scene is included as `lamp.mb` in the Chapter 7 scene folder on the CD.

Forcing Decay on Directional and Ambient Lights

By default, directional and ambient lights do not possess decay. You can create a custom shading network, however, to control the distance a directional or ambient light can travel.

If you're familiar with custom connections in Maya, you need only replicate the following network.



(From top to bottom) Directional light next to a plane; render with custom decay shading network; shading network in Hypershade

With this network, a Light Info utility reads the distance from the light to the shaded surface point. The distance is made negative with a Reverse utility and its range of values is rescaled with a Set Range utility. For example, the Reverse utility converts a distance of 20 into –19 and a distance of 5 into –4. In turn, the Set Range utility rescales the Reverse utility's output of –19 to 0 and –4 to 1. Thus, points far away from the light are given small values, which are ultimately fed to the light's **Intensity** attribute. Points close to the light are given higher values.

If you've never created custom connections, follow these steps:

1. Create a new scene. Create a NURBS plane. Open the Hypershade and Hypergraph Input And Output Connections windows. In the Hypergraph, select the directionalLightShape1 node and MMB drag it into the Hypershade work area. Switch to the scene view by choosing **Graph → Scene Hierarchy** from the Hypergraph menu. Select the directionalLight1 transform node and MMB drag it into the Hypershade work area.

2. Close the Hypergraph window. In the Hypershade, MMB drag a Light Info utility, a Reverse utility, and a Set Range utility into the work area. (You can find the utilities in the General Utilities section of the Create Maya Nodes menu). MMB drag the directionalLight1 node on top of the lightInfo1 node. Choose Other from the Connect Input Of menu. The Connection Editor opens. In the left column, highlight **World Matrix**. In the right column, highlight **World Matrix**. A connection is made. Close the Connection Editor.

3. MMB drag the lightInfo1 node on top of the reverse1 node and choose Other from the Connect Input Of menu. In the Connection Editor, highlight **Sample Distance** in the left column and **InputX** in the right column. Close the editor. MMB drag the setRange1 node on top of the directionalLightShape1 node and choose Other from the Connect Input Of menu. In the Connection Editor, highlight **Out ValueX** in the left column and **Intensity** in the right column. Close the editor.

4. MMB drag the reverse1 node on top of the setRange1 node and choose Other from the Connect Input Of menu. In the Connection Editor, highlight **OutputX** in the left column and **ValueX** in the right column. Close the editor. Select the setRange1 node and open its Attribute Editor tab. Change **Max X** to 5 and **Old Min X** to –5. Render a test frame. The light illuminates the plane unevenly, ultimately fading out within 5 world units. To increase the overall intensity of the light, raise the **Max X** value. To increase the distance the light travels, reduce the **Old Min X** value; that is, enter a larger negative number, such as –20.

You can create the same network for an ambient light. Simply add ambientLight and ambientLightShape nodes to the network. In such a case, the **Ambient Shade** attribute, which normally mixes omnidirectional light rays with directional ones, is overridden. The values of the setRange1 node continue to determine the distance the light is able to travel. A sample scene using a directional light is saved as `directional_decay.mb` in the Chapter 7 scene folder on the CD. An ambient light version is included as `ambient_decay.mb`.

Industry Tip: Unusual Lighting Techniques

Although professional lighters tend to follow the same basic tenets of lighting theory, they each have their favorite techniques. One example is Joshua Perez, a environment artist at Spark Unlimited. Joshua offers his own set of unusual tips:

- Three-point lighting is one lighting option. However, it can pay to experiment. For instance, place two keys on the main subject. One key is a traditional key that emulates the main light source, such as the lamp. The second key is placed on the opposite side as a type of *kicker*, which helps outline the geometry. The kicker light is given a higher **Intensity** value than a normal fill light; in fact, it sometime rivals the key.

A stylized samurai. Note the strong key on the left and strong kicker on the right, as well as the use of colored lights. *Render courtesy of Joshua Perez.*

- If the scene you are lighting is destined to be a still image, consider rendering multiple passes and combining those passes into a digital imaging program. For example, if you cannot decide what colors to tint the various lights, render out different combinations as multiple frames. Bring those frames into Photoshop and flip through the layers. You can pick and choose specific areas of each frame by erasing various parts out.
- When it comes to fill light, never leave any part of your scene pitch black. Although a single fill light often does the trick, you are not limited to the number of lights you use. In fact, it can sometimes pay to use a large number of fill lights that have a limited throw due to the **Decay Rate** set to something other than None. In this situation, point lights will do the trick.
- Don't underestimate rim lights. Adding rims is a great way to lend depth to the 3D models. Rims also help draw the viewer's attention to specific parts of the frame. (For some great examples of rim lighting, watch *Monsters Inc.*).

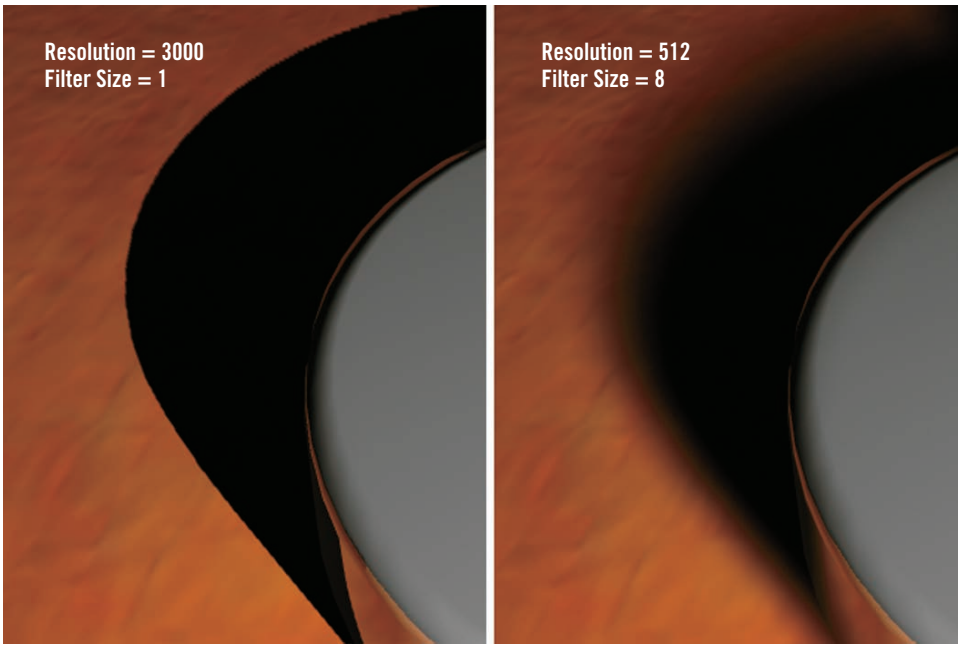
JOSHUA PEREZ

Joshua graduated from the Art Institute of Las Vegas in 2006. Two days after graduation, he was hired as an environment artist by Spark Unlimited in Sherman Oaks, California. Spark Unlimited is best known for developing the *Call of Duty: Finest Hour* console game. The company is currently creating a new series of games based on the Unreal engine. While in the Media Arts and Animation program, Joshua specialized in lighting and developed his own unique approach in both 3ds Max and Maya. To learn more about Joshua's work, visit `www.sparkunlimited.com` or `www.darknessraven.com`.

Producing Quality Depth Map Shadows

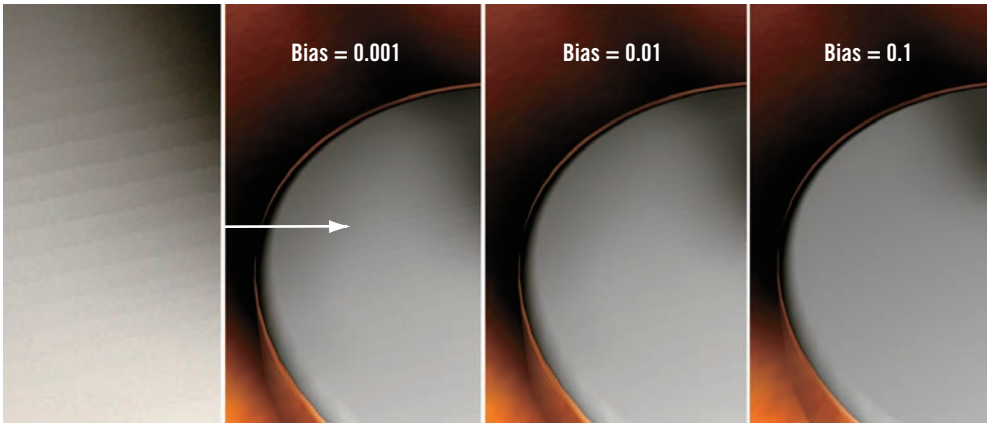
Depth map shadows, although easy to apply and quick to render, can be frustrating to adjust. Here are a few tips for creating clean depth map shadows:

- If you want a sharp, hard-edged shadow, choose a high **Resolution** value and a low **Filter Size** value. If you want a soft depth map shadow, choose a low **Resolution** value and a high **Filter Size** value. These attributes are found in the Depth Map Shadow Attributes section of the light's Attribute Editor tab. Depth map shadows are available to all lights but ambient. Maya can handle **Resolution** sizes as large as 3000 and continue to render quickly. If you feel the need to choose a **Resolution** size larger than 3000, it may be best to switch to raytrace shadows.



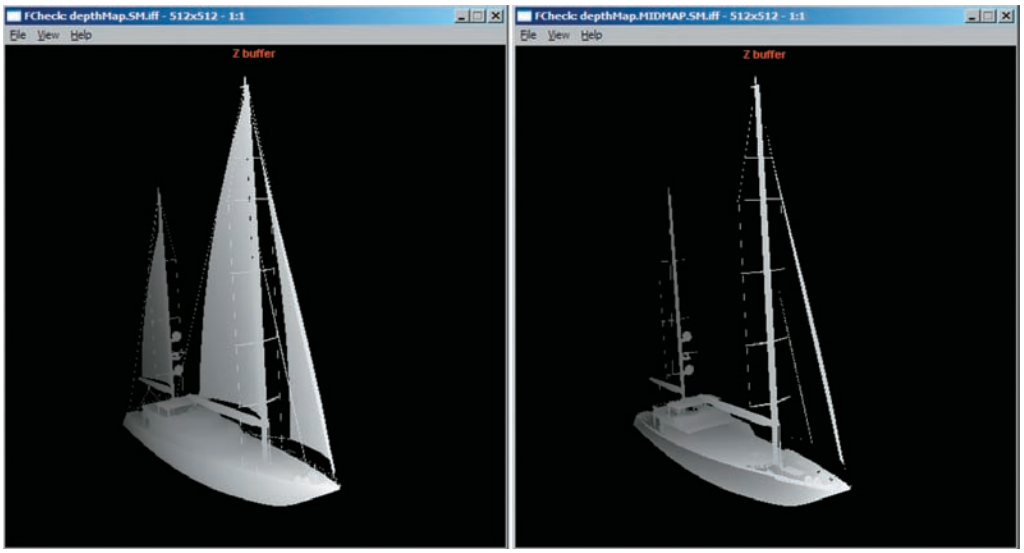
Depth map shadows

- If shadow artifacts are present, slowly raise the **Bias** attribute from 0.001 to 1. High **Bias** values may remove an artifact but are likely to erode other sections of the shadow.



A depth map shadow artifact appears as banding across a surface. A **Filter Size** of 0.1 reduces the artifact significantly.

- If you want to emulate shadows created by the sun, choose a directional light with depth map shadows. Directional lights produce parallel light rays, whereas spot lights do not.
- By default, depth map files are destroyed after the rendered frame is complete. To force Maya to save a depth map, switch the **Disk Based Dmaps** attribute to Overwrite Existing Dmap(s). The depth maps are thereafter written to the default project directory as IFF files. You can choose your own depth map name by changing the **Shadow Map File Name** attribute.
- By default, two depth maps are created per shadow: a standard map and a MIDMAP. The standard map records all the first-surface intersections of the shadow rays. The MIDMAP records all the second-surface intersections of the shadow rays. MIDMAPs are a product of the **Use Mid Dist** attribute, which is checked by default. **Use Mid Dist** is able to average both maps and thereby reduce shading artifacts common to depth maps.
- To view a depth map written to the disk, choose **File → View Image** and browse for the depth map. The FCheck window opens. While the mouse arrow hovers over the FCheck window, press the Z key. The depth map is revealed as a grayscale image from the view of the light. Objects captured as lighter grays are close to the light. Objects captured as darker grays are farther from the light.



(Left) A standard depth map viewed in FCheck. (Right) A MIDMAP depth map.