PART I

Introduction to 3D Concepts

CHAPTER 1

Scene

s0010 1.1. The 3D Scene

p0010 A typical 3D scene has several elements which, when combined, generate a picture. You can think of setting up a 3D scene in the same way you would set up a photography studio. You will need something to take a picture of (your meshes). These meshes will have materials on them such as wood, cotton, or metal. You need to provide lighting to the scene with one or more lights. Finally, you need a camera to take the picture with. The term rendering is the act of taking a picture of your scene through your virtual camera using the lighting, material and meshes you have set up.

s0015 1.2. Meshes and Vertices

s0020 1.2.1. 3D vs 2D

p0015 So, what exactly is 3D? You may recall from high school doing graphing in algebra. You would have two values (x and y) and then find their position on a graph along the x and y axis and use these positions to plot a point. If you made three of these points and connected them, you would have

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FIG 1.1

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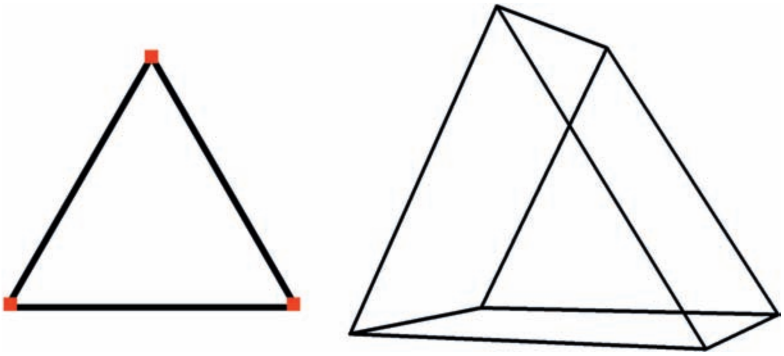

FIG 1.2 A triangle consists of three points on two dimensions (x and y). Extending this to a third axis (z axis) results in a triangle in 3D.

a triangle. If you extend this by adding a third axis (z), you can plot points anywhere in three-dimensional space to create 3D shapes (Figure 1.2).

p0020 Objects in a 3D scene are described as collections of 3D points, which are called vertices. These vertices are collected into groups of three, which form triangles. These triangles are contained in groups called meshes. Prior to the time that these triangles are actually drawn, meshes can be described in many different ways. For example, the equation for a sphere represents a 3D object. However, if it is to be drawn, it must first be broken down into an approximation of this shape using triangles (Figure 1.3).

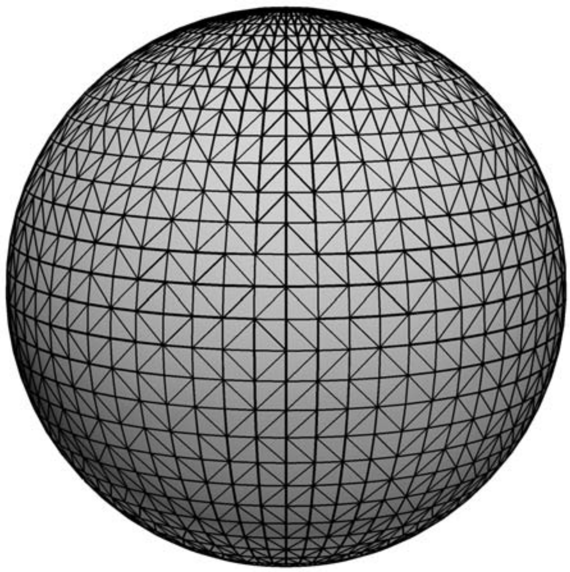

FIG 1.3 A sphere represented by triangles, used to define meshes.

s0025 1.3. Cameras

p0025 There are two types of camera supported by Photoshop — orthographic and perspective. Both kinds of cameras have a location (where is the camera in 3D coordinates) and a direction that it is pointed.

s0030 1.3.1. Perspective Camera

p0030 A perspective camera behaves like a “real world” camera. Perspective cameras also have a lens, which has a “zoom” that can be represented as a field of view in degrees or a focal length in mm. This kind of lens will have perspective distortions as you increase or decrease the field of view.

s0035 1.3.2. Orthographic Camera

p0035 An orthographic camera is mostly used in engineering and architecture — as well as in the 3D modeling process. It has no perspective distortion, which can be very useful when you are trying to align things in 3D space. Orthographic cameras have a scale, which represents the size of the slice it cuts through the 3D space. One thing of note here is that with an orthographic camera, moving an object further from or closer to the camera (or moving the camera) results in no change to the rendering whereas with a perspective camera, this will change the way things look dramatically (Figure 1.4).

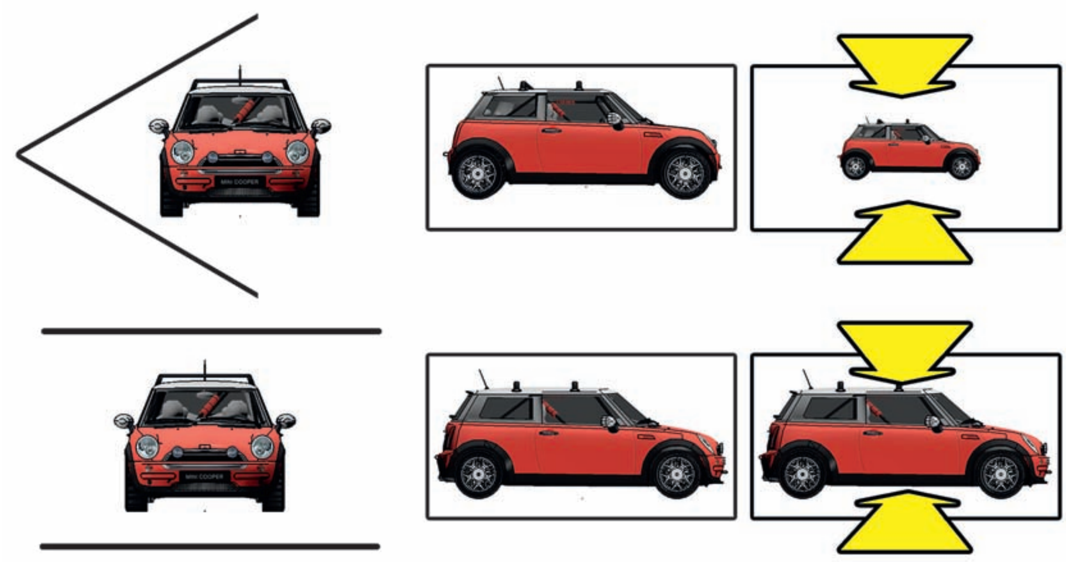

FIG 1.4 The top row shows a perspective camera where objects further away from the camera will appear to be smaller. The bottom row shows an orthographic camera where objects appear to be the same size regardless of the distance from the camera.

s0040

1.3.3. Depth of Field

p0040 In addition to the position and direction of the camera, Photoshop CS5 can also simulate the aperture of the camera. This is done using the depth of field settings. With these, you specify the part of your scene that is in focus and that which is not — in much the same way you focus a lens on a subject in a photograph (Figure 1.5a).

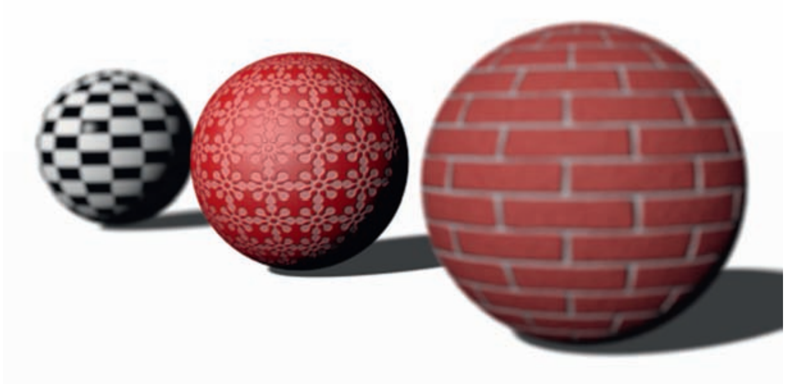

FIG 1.5a Depth of Field set so that the center sphere is in focus (the plane of focus) and everything else in front or behind this plane is out of focus.

FIG 1.5b With the Camera Zoom Tool selected, you can set the distance of the focal plane and the amount of blur.

p0045 In Photoshop CS5, cameras have a pair of new parameters that allow an artist to control depth of field. The Distance control determines the plane in the scene where everything is in focus and the Blur control determines how out of focus the areas behind and in front of the focus plane are (Figure 1.5b).

s0045 1.4. Lights

p0050 Visual perception is our perception of how light interacts with matter. Therefore lighting is a key component of a 3D scene, similar to the importance of lighting in photography. Generally, light interaction with an object is a very complicated process. Though the primary intent for 3D rendering is to reproduce the light interaction with materials, steps are taken to simplify and approximate these calculations. One such step is to limit the supported types of light sources.

p0055 In Photoshop CS5, four types of light sources are supported. The first three are standard lights that can be found, in one form or another, within any 3D rendering package (point, infinite and spot lights).

s0050 1.4.1. Point Light

p0060 In some applications, this also may be known as an “omni” light. A point light is a light source emitting light equally in all directions. You can think of this like a candle or a light bulb. These types of lights have position, but do not have a direction (Figure 1.6).

s0055 1.4.2. Infinite Light

p0065 In some applications, this also may be known as a “directional” light. An infinite light is a light source emitting light parallel to a certain direction. This is useful for simulating light sources that are very far away (e.g., sunlight). These types of lights have direction, but do not have a defined position (Figure 1.7).

s0060 1.4.3. Spot Light

p0070 Spot lights are similar to photographic spotlights or automobile headlights. These lights have defined positions, direction, and a hotspot angle (Figure 1.8).

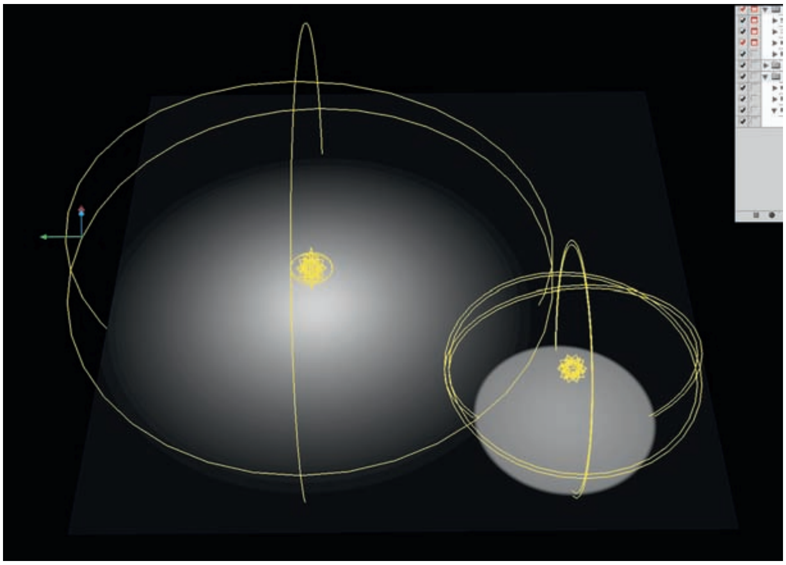

FIG 1.6 A point of light depicted by a spherical widget.

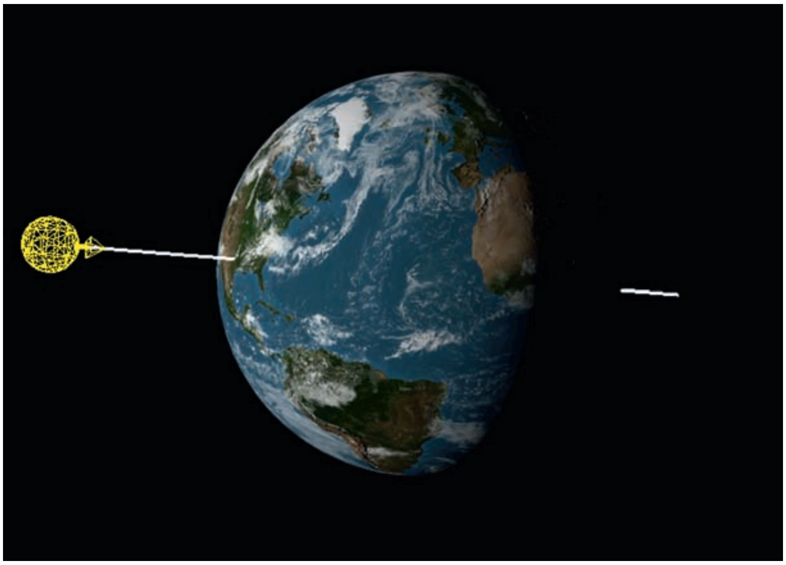

FIG 1.7 An infinite light source depicted by the yellow widget with an arrow pointing in the direction of the light source.

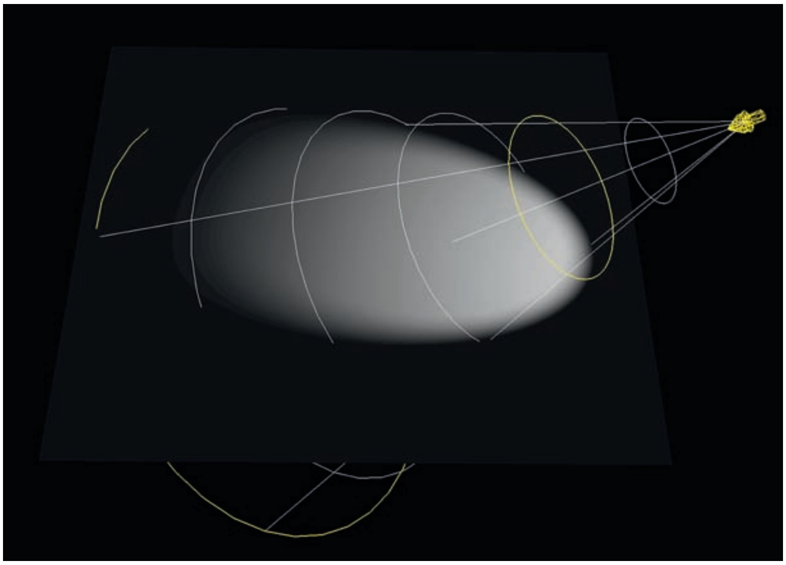

FIG 1.8 A spot light depicted by the widget pointing in the direction of the light.

s0065 1.4.4. Image-Based Light

p0075 An image-based light in Photoshop CS5 provides an “environment” light source, where the light source is not a point or a beam, but a texture map, spherically wrapped around your scene (spherical panorama). One way to imagine such a light is to think of it as a set of tiny point lights mounted on the spherical cage all around your scene where every point light corresponds to a single pixel in your texture map. In natural scenes, objects are rarely illuminated by simple light sources only. For example, if we consider an object within an empty room with a single lamp on the ceiling, while the lamp provides most of the lighting (called “direct” lighting), some of the light
AQ1 from the lamp gets scattered by the walls back at object (called “indirect” lighting). Similarly, an object in an outside scene is illuminated not only by the sun, but also by the sky and the ground. Thus, an image-based light greatly facilitates modeling of real-world lighting environments. Instead of
AQ2 approximating every light of your scene with a basic light source, you can now just use an image-based light textured with a spherical panorama, which is usually much easier to create (Figure 1.9).

s0070 1.5. Materials

p0080 Materials define the appearance of the object. These parameters include diffuse (main color), specularity (highlights), transparency, reflectivity and more. This derives from the notion that by setting all the properties in a given way, one can create the impression that the rendered object is made of some

FIG 1.9 Image-based light used to light this sphere. This light source is depicted by the spherical widget with the image wrapped around it and handles that allow you to rotate the map and reposition the lighting.

FIG 1.10 Sample materials found in Photoshop CS5 Materials Library presets.

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