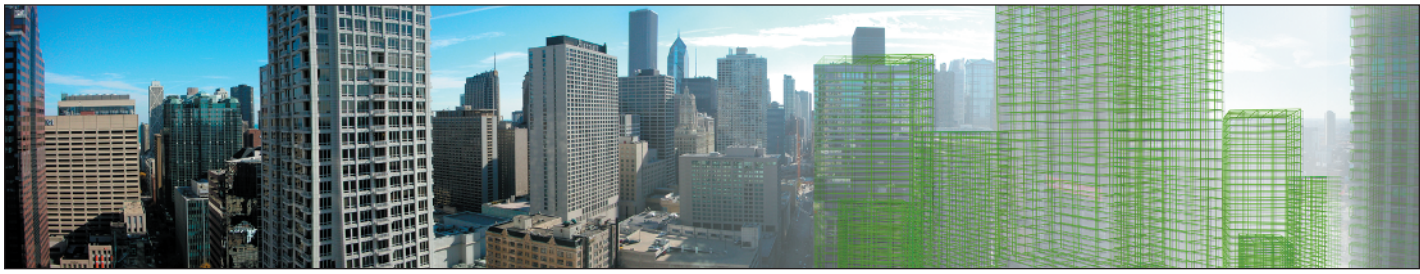

1 Photography and 3D

It wasn't too long ago that film, television, computers, and animation were completely separate entities. Each of these is an art form in its own right. Today, as you look to professional production companies, or even the home computer, all of these entities are wrapped up into one, thanks to the advances in computer technology.

Chapter Contents

Early Imaging

People have been trying to understand and record light for more than 2000 years. As early as the fourth and fifth centuries B.C., Greek and Chinese philosophers discussed the basic principles of optics. Today we still apply the principles they learned.

In the early ninth century, the Muslim astronomer and mathematician Ibn Alhaytham invented the camera. In fact, the word *camera* as we know it comes from the Arabic word *kamra*, which translates to the word *room*. After being adopted into Latin, the word became *camera* and then *camera obscura*, which means *dark room*.

A camera works on two basic principles, a positive process and a negative process. And although this had been known for hundreds of years prior, it wasn't until William Talbot pioneered the process in the mid-1800s in England that photography as we know it today began to take shape. Initially, a pinhole opening let a specific amount of light into a dark box; this was the first part of the process. The second part involved materials inside the box that changed when exposed to light. In the twentieth century, lenses replaced pinholes, and film was manufactured to permanently record the exposed image. Along the way, the art of photography has evolved, but the basic principles have remained the same. Light enters through a glass lens and is recorded onto a material, coated with specific light-sensitive chemicals, also known as *film*. And although many variations of film exist—from black-and-white to color to infrared—photographers have been rapidly migrating to the new, digital age, leaving all film behind.

Today, the chemical process has in most respects given way to a digital world. That's not to say traditional processes are completely a thing of the past, but in terms of general consumers, prosumers, and professional shooters, a good majority are going fully digital. In addition, a growing segment of Hollywood is leaning toward digital filmmaking. The differences of digital over film are as follows:

- Although film is nearly a 100-year-old process and digital is still in its infancy, film is more costly and more work.
- Film has a slightly different look than digital.
- Digital provides instant feedback.
- With film, photographers are limited to a relatively small number of shots before having to change film rolls. With digital, photographers can shoot thousands of images on one memory card, and changing memory cards is even easier than changing rolls of film.
- Film has a risk of being destroyed if not handled properly, both in the camera and in the lab. Digital shots are less likely to be destroyed. (However, the media that digital shots are stored on are susceptible to data loss, just like any computer hard drive.)

Clearly, choosing whether to shoot film or digital is a subjective choice for each individual. Not too long ago, film produced a much higher resolution than digital, except for a few top-end cameras costing as much as a small car. But today, when you

compare film resolution to digital resolution, even inexpensive digital cameras are now able to match film resolution. Therefore, even hobbyists can enter the digital photography market and shoot images with full-frame sensors.

> **Note:** A *full-frame sensor* is a digital chip in cameras such as the Canon 5D that is equivalent to a 35mm frame.

3D Animation

So as the film world transitions to the digital world, how does three-dimensional (3D) imaging and animation fit in? Aren't the two completely different? Yes and no.

3D animation has truly come of age in the past 10 years, but most people don't realize this amazing technology began as early as 1974. 3D technology then was not what we know today, with graphical user interfaces. And I won't even discuss what computer power was then, but let's just say your current wristwatch can do more. 3D in its infancy was nothing more than a series of numbers and code. The result was three-dimensional wireframes.

In the beginning, computer scientists (yes, computer scientists, not artists) digitized data by hand or sketched on graph paper and typed the numbers into a computer manually. But what did they create? One of the most common objects, still used today, was the teapot (see Figure 1.1). While simple in design and not too complex for systems to draw, the teapot is useful for testing because it has complex geometry, has self-shadows, and has convex and concave surfaces. Many 3D systems today come with a default teapot that you can use for testing scenes, reflections, shadows, bump maps, and of course image mapping.

Figure 1.1
Used primarily for testing 3D elements, the teapot has become an industry standard.

In the 1980s, computer graphics technology matured as the personal computer (PC) revolution began. Yet, this budding technology was available only to massive computer systems and those with massive budgets. In the 1990s, everything changed as computer power became faster and cheaper. Emerging 3D software companies perfected and released better graphical user interfaces and offered much sought after tools such as ray tracing, bump mapping, refraction, and caustics. Today, these features are commonplace in 3D applications, and you rarely see rendered images without them.

By the mid-2000s, video cards in computer systems were able to process millions of bits of data. This is mostly thanks in part to the ever-growing PC video-game industry. The demand for high-end graphics in games led to a demand for high-end graphic cards for computers. 3D animators were the beneficiaries of this demand because the video card that was once more than $2,000 could now be purchased for less than $200 at the local computer store.

Merging Technologies

You might be asking yourself how these two technologies, one very old, one just kind of old, can come together in this modern-day technoplasmic world we live in. Good question! This book will help you explore all the possibilities of digital photography and its uses in 3D imaging and animation. Specifically, this book will guide you through the following:

- Digital photography methods such as megapixels, f-stops, apertures, and lenses, as well as how they all relate to 3D applications
- How and what to shoot with your digital camera for use in 3D
- How you can apply your everyday photographic composition in 3D
- How to use 3D technology to apply digital photographic quality to your rendered 3D images
- How to apply digital photography to your 3D workflow and thought process
- How to use digital photographs as 3D textures and image maps
- How to create image-based modeling from digital photos
- How to create compositions with 3D objects and digital photos
- How to use digital photography to light your 3D scenes through high-dynamic range (HDR) imagery

You'll find when you discuss the idea of digital photography to someone and also mention 3D animation that most people do not consider these to be related fields. Go a step further, and talk to anyone in the 3D business who has been doing it since the early 1990s. You'll find they come from one of three backgrounds, if not all of them: photo/video/film, art, or engineering. Today, 3D animation is studied widely across the world in not only colleges and universities but even in high schools. When the medium was just beginning to emerge as a business and entertainment resource in

the early 1990s, those in the video business jumped on board to enhance their products. Engineers and draftspeople realized the potential of 3D imaging to bring their ideas to life. And artists who wanted to add that "something extra" to their drawings and paintings found 3D to be the perfect solution. So when you think about digital photography and how you can use it in 3D imaging and animation, the possibilities are truly endless.

For example, Figure 1.2 shows a photo of a traffic light. The original high-resolution photo was taken in midday sun in downtown Chicago. Figure 1.3 shows a 3D model created in Luxology's modo. The 3D image does not use any image maps or textures from the real photo, and it's not used for lighting the scene, which leads to the question, what's the use of the image?

Figure 1.2
A photograph of an everyday traffic light. Although seemingly ordinary at first, it has many details upon closer inspection, all of which are important when re-creating images in 3D.

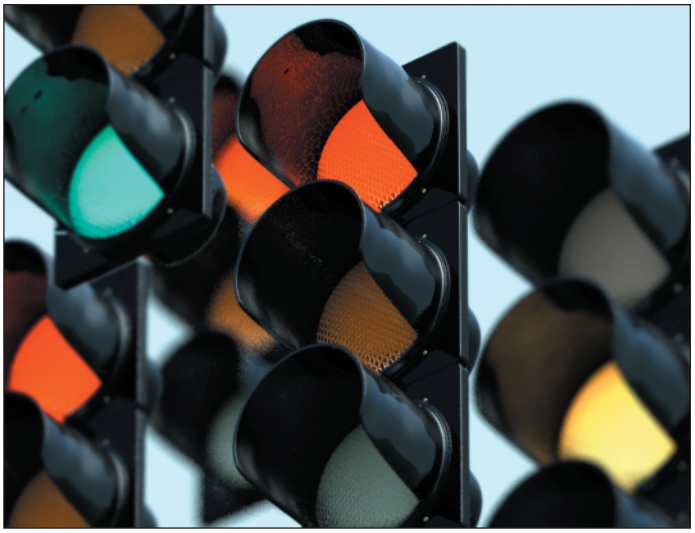

Figure 1.3
Based on the photograph in Figure 1.2, this 3D-generated image uses details from the real model, such as the grid pattern on the lenses, as well as lighting and reflections.

The use of Figure 1.2 for creating the 3D image in Figure 1.3 is simple: reference. On its simplest level, digital photography serves as an open door to real-world references. For example, pretend your client comes to you and says they need a model of a traffic light for an illustration in an upcoming meeting. They want to go 3D so they can control the angles and time of day and also can make the traffic light look newer. But at the same time, they want it to look like the current models they're using. Unbeknownst to you, many companies manufacture traffic lights, and the lights come in many shapes and sizes. There's a lot more to them than just red, yellow, and green.

Often when 3D artists think of digital photos as reference, they think only in terms of X, Y, and Z. That is to say, to them, a reference photo should be of an item in three forms: front, side, and top. Then in their 3D program, they use these reference photos as a background template from which to model. Consider a filmmaker who is rebuilding old New York for their next hairy-gorilla movie. They too use photos as reference; granted, the photos might be 50 or 60 years old, but to them, the more reference they have, the better. How the filmmakers use these references is also how the 3D artist can use them. Rather than using an image to "trace over" the reference, they can use images to call out fine details such as the design of a building, the height of a bridge, or the shape of a street.

3D models created today are open to artistic interpretation. That's not to say the result shouldn't resemble the original or that a client should not get what they're paying for. The point is, a digital photo can go a long way when it comes to 3D modeling when used as a reference. For example, Figure 1.4 shows a shot of a city street, which was used as inspiration for the 3D image in Figure 1.5.

Figure 1.4 A photograph of a city street is a top-notch reference for creating details in 3D.

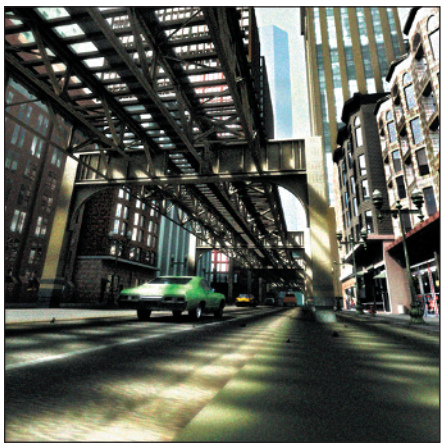

Figure 1.5
Based on the image in Figure 1.4, this 3D image was generated using only a few photographs as reference. Fine details found their way into the El tracks thanks to the photo reference.

Digital photos are not only good as model references but as lighting references as well. When you talk about lighting in 3D, however, you should assume you're considering the environment as well. As many photographs know, light is everything. The same applies to 3D. Well, not exactly! In fact, 3D is so much more. Light is almost everything, as are the quality of your 3D models, the details in your texturing, the balance of reflection vs. shadows, and so on.

For instance, Figures 1.6 and 1.7 have a similar lighting situation. Figure 1.6 relies on reflections and indirect illumination with an overcast sky to create an outdoor courtyard. Figure 1.7 also uses reflections and indirect illumination but to create a studio look. Both 3D images have minor differences when it comes to lighting, but because the models are so diverse in their size and surfacing, they have entirely different looks.

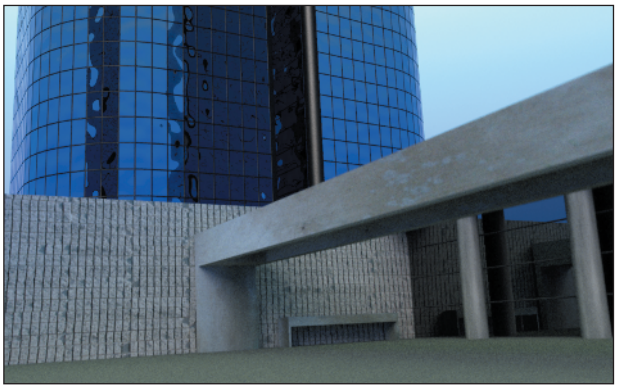

Figure 1.6
Lit with the environment around it, these buildings rely on global illumination and reflection for their result.

Figure 1.7
Also lit with the environment around it, this teacup relies on reflections and soft shadows for a studio look.

Digital Incorporation

It's clear that digital photography plays a strong role in 3D imaging and animation. It's used on so many levels, and as you've seen here, just as reference alone, digital photos can greatly enhance the detail and realism of your 3D work. But how can you incorporate a digital workflow beyond just reference images? Where do you begin, and where do you go once you've started?

The following chapters in the book will take you on a step-by-step journey of not only understanding digital photography but of specifically using even the simplest digital camera to take excellent photos. Beyond that, you'll learn what to shoot, learn how to shoot, and learn to differentiate good light from bad light. Later, you'll go far beyond just photo references and learn how the right series of photographs can become a beautiful 3D environment in your scenes. You'll learn how to create your own HDR images using Adobe Photoshop. You can use the HDR images you create to light your 3D scenes for the ultimate in rendering realism. From there, you'll learn how powerful digital photographs can be not only for texture mapping in 3D but also for image modeling. Complex images on simple 3D objects can yield high-end results.

If you're ready, get out your camera, turn the page, and read on to learn about digital photography methods—from megapixels to lens types to f-stops to apertures—and to learn how they all play an important role in 3D applications.