Greg Meyers

Interactive 3D with Shockwave

Macromedia Director sprang from the CD-ROM industry of the early 1990s, quickly earning its title as the premier authoring package for interactive multimedia content. In 1995, the introduction of Shockwave technology added a whole new twist. With Shockwave, Director programmers could embed code initially intended for CD-ROM directly into Web pages for delivery over the Internet. Before long, a cottage industry of Shockwave developers was producing original, fully interactive content for this new medium.

These days, Macromedia's other multimedia product for the Web, Flash, has stolen much of Shockwave for Director's thunder. With its more compact content, simple user interface, and a plug-in that comes as a standard install with most browsers, Web developers without a CD-ROM background have found Flash to be much more accessible than its more sophisticated, older cousin.

Shockwave for Director still offers some exciting capabilities that Flash can't match, however—especially in the most recent version, thanks to Macromedia's recent technology partnership with Intel. Although it's just a humble, half-point version increase from Macromedia's previous release, Director 8.5 now incorporates hardware-accelerated, real-time, interactive 3D graphics—not 2D that looks 3D, not faked 3D, but actual 3D rendered on the fly.

Applications for 3D

Many people have the same reaction the first time they see real-time, interactive 3D playing in a browser window. First their eyes get big. Then you see them peering around the side of the monitor, trying to find the hidden mirrors. But setting the wow factor aside, browser-based 3D has a lot of practical applications.

Communication problems in almost any industry can be overcome by converting the words of ideas into pictures. Interactive 3D technology takes this one step further. It lets your target audience not only see what you're developing, but also interact with it. Audience members can spin it around to view it at all angles. They can press any of the buttons or handles, open any doors, and flip switches.

Used as a pre-prototype production step, this technology can provide significant savings. Car manufactures might use it to see seamless compositions of new vehicles, both inside and out. Military or educational services could create training simulations. Medical courses could use Shockwave to take viewers on interactive tours of DNA chains, and interior designers could use it to model virtual rooms in real time.

online resources

Directing 3D

The learning curve for 3D animation can be steep. But if you want to start experimenting with browser-based, interactive 3D using Shockwave, these sites can help get you over the hump.

Macromedia Director homepage
www.macromedia.com/software/director/

Support pages for Shockwave for Director
www.macromedia.com/support/director/ts/documents/tn3104-dirWebsites.html

Demonstration hardware-accelerated 3D game, with Lingo source
stuntracer.sourceforge.net/stuntracer.htm

The Havok physics engine homepage
www.havok.com/xtra/

The Director Environment

To create interactive 3D experiences from scratch in C++ or Java, you would first need to spend literally years developing 3D and physics engines. This would also assume that you've assembled a team with a strong understanding of both math and computer science. By comparison, with Shockwave, the developers at Macromedia have already done most of the hard work for you.

Director's tools aren't perfect. For the amount of power that you now have with Director, its debugging facilities lag behind what you would find in a development environment for a language like C++. For example, in C++ you can inspect all the property of a given object in memory, while in Director this is only possible with third party add-ons. However, the sophisticated Director 8.5 authoring environ-

ment lets you produce real-time 3D content that rivals what you'd expect to see from a professional CD-ROM game, in dramatically less time.

As Director is an authoring tool, it doesn't create any assets directly. All sound files, and 2D and 3D art are created in other applications. Currently, Macromedia lists Alias Wavefront Maya, Caligari, Discreet 3DS Max, NewTek Lightwave 3D, Softimage XSI, and AMAPI 3D as applications that can produce 3D models for Shockwave.

Keep in mind, however, that only a subset of the features of 3D modeling applications will transfer to Shockwave. For example, it doesn't support morphing and animated scaling. Also, if you aren't already familiar with a high-end, 3D modeling application, it won't be easy to get up to speed. Although a novice can make simple forms in a 3D application, it really takes someone with experience to create sophisticated models. Fortunately, many companies already have existing 3D assets.

In addition, be aware that, while the high-level tools that Director provides can allow your team to be much smaller than its C++ equivalent, it may still be larger than you're used to for Web projects. For example, chances are you won't find anyone who's both a 3D modeling expert and a Director expert.

3D Lingo

The mathematics required to orient and manipulate objects in 3D space can be quite complicated. Some concepts and mathematical functions are unique to 3D. For example, there are several ways to specify an object's orientation in 3D space, as well as functions that describe the relative angle of rotation between objects.

With Director 8.5, you also get a number of high-level functions that shield you from some of the hairier 3D math. For example, orienting an object so that it faces another object usually requires complex 3D manipulations. With Director's high-level API, however, it's easy to write Lingo code to perform this task (see Multimedia Methods for more information about Lingo).

```
model1=member("scene").model("pointer")
model2=member("scene").model("pointee")
model1.pointAt(model2)
```

Simulating real-world physics is one of the great challenges of digital 3D animation. Fortunately, Director is extensible through plug-ins called Xtras, and Director 8.5 now includes the Havok physics Xtra at no additional cost. This add-on simplifies everyday physics enough to simulate motion in real time with enough realism to be convincing.

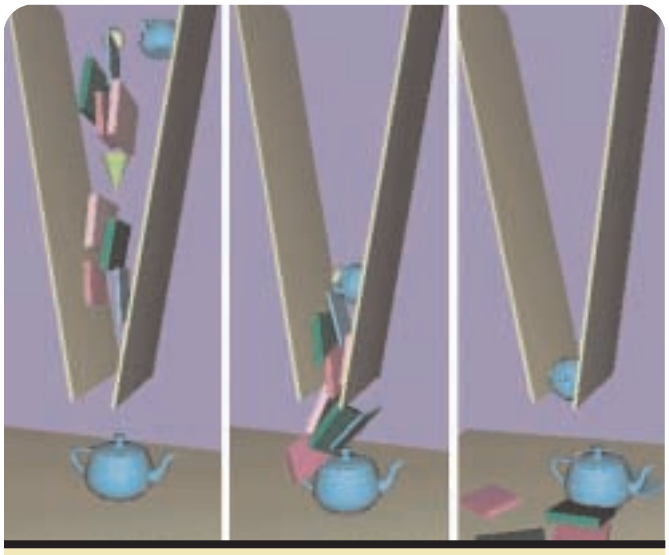

figure 1 **The Havok Xtra for Shockwave allows you to model complex physical interactions between objects with relative ease.**

The physical behaviors available with Havok are the kind that you'd expect to see in a cutting-edge CD-ROM game. Havok provides complete rigid-body physics, rigid body collision detection and resolution, stackable objects, and both sliding and rolling friction (as shown in Figure 1). And again, Lingo's simple syntax makes it easy to describe whatever properties you desire. Here's how you might program the virtual gravity for your simulation:

```
havok = member("physics.hke")
havok.gravity = vector( 0, 0, -9.81 )
```

Here's an example of setting physical properties for a specific model, including mass and relative friction:

```
model = havok.rigidBody("bowling_ball")
model.mass = 10
model.friction = .1
```

Of course, this is another area that has it's own learning curve for

multimedia methodes

Macromedia Director lets content authors build interactive projects using a fully visual environment, with drag-and-drop tools and a metaphor derived from filmmaking. Given all of this, it's tempting to regard Director merely as advanced presentation software—PowerPoint on steroids. But in reality, it's much more than that.

For those cases in which the visual metaphor isn't sufficient, Director also offers a complete programming environment of its own, built around a language called Lingo. Lingo isn't just a simple application scripting language. It allows coders to mix traditional procedural programming with advanced object-oriented techniques. Lingo was originally designed with a high-level, English-like syntax that was often cumbersome to experienced developers. Beginning with the Director 7 release, however, it has also supported the familiar "dot notation" of other object-oriented languages like Java and JavaScript.

Nearly every one of Director's functions can be manipulated using Lingo, such that many of the most advanced Director programmers forego the film metaphor completely for their projects. Instead, all of the action is executed programmatically, using a series of scripts attached to a single animation frame.

Lingo also offers advanced functionality beyond the basics of multimedia production. In addition to libraries for manipulating onscreen images and 3D graphics, programmers can also access such sophisticated features as floating-point math, string manipulation, and TCP/IP networking—all from within the Director environment.

—Neil McAllister

those not experienced with 3D. There's a whole new setup of terminology associated with a physics simulation. Fortunately, Havok supplies a solid collection of tutorials and examples for the plug-in, and its developer support is excellent.

Further, Shockwave 3D offers several visual effects that can be applied apply to your models. In 3D parlance, these effects are known as shaders, and all of them render in real time. Some examples include a cartoon shader that lends the look of traditional animation to your project, as well as pen-and-ink and newsprint shaders.

For example, Lingo to render a model in cartoon style looks like this:

```
model = member( "scene" ).model( "funny_car" )
model.addModifer( #toon )
```

All of these steps can be taxing on your CPU, so it's fortunate that the Shockwave plug-in supports hardware acceleration on some of the more popular video cards. Without acceleration, the quality of rendered textures suffers dramatically, as do the frame rates of the resulting animation. (On my own projects, I've seen frame rates triple when running on a machine with an accelerated card.)

A rendering effect that's unfortunately absent is anti-aliasing. Anti-aliasing gives objects smooth-looking edges, and gives an almost photo-realistic visual effect. This is especially critical for e-commerce applications where clients want their products to look as good as possible. Most likely this wasn't included for performance reasons. And hopefully, Macromedia will adopt the compromise strategy used by some competing tools, such as the Web 3D plugin by Viewpoint, and add an option that lets you activate anti-aliasing when an object isn't in motion.

Delivery Bottlenecks

The total file size of your compiled project obviously correlates directly with download time for your users. You may be prepared to pay a bit more in file size for the opportunity to deliver a fully interactive 3D experience, but remarkably, you don't have to. Because 2D images (textures) are loaded once for each object, and then rendered on the fly for different angles, even complex 3D scenes can actually be quite small. If your project is still too large, you also have the option to reduce the quality of your models or textures as you export them from your 3D modeling package.

While you can make a nice interactive experience for less than 500KB, the wide range of functionality that Shockwave supports brings the plug-in size to over a megabyte. Time-consuming downloads have historically discouraged end users from installing browser plug-ins, so this is where broadband comes into play. With a high-speed connection, users can download and install Shockwave in just a few seconds, compared to the minutes it would take over a modem line. Upgrading the plug-in is now easier than ever as well, as the latest version includes an auto-update feature that significantly shortens future downloads.

Even so, the Shockwave for Director plug-in is not a transparent download like its cousin Flash. It presents the user with a dialog box to install and register the plug-in, as opposed to just quietly auto-installing, then playing the content. This, in my opinion, is the single largest barrier to the widespread use of Shockwave. On a broadband connection, the time it takes the user to decide whether or not he or she wants to install the plug-in and then fill out a brief registration form will likely be greater than the time it takes to download the plug-in itself.

Fortunately, thanks to Macromedia's marketing efforts, both the

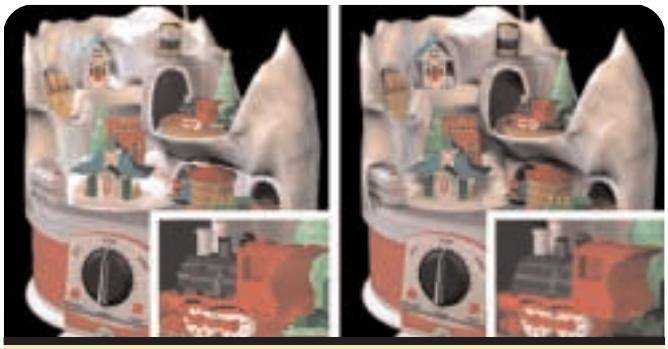

figure 2 **Since the Shockwave plug-in doesn't support anti-aliasing, in the browser your models can appear blocky, like the image on the left. On**

Flash and Shockwave plug-ins now come pre-installed on new Windows and Mac OS machines. In the past, this was only true of Flash. Still, Flash remains the more popular choice, and is virtually ubiquitous; its plug-in comes bundled with Real, Prodigy, AOL, Excite@Home, and other services. By comparison, many users will still need to download the Shockwave for Director plug-in themselves.

A New Dimension

Macromedia, Intel, and Havok have come together to bring a mind bogglingly powerful 3D development tool within reach of the average developer. Sophisticated 3D models can be imported into Director and then scripted with complex interactivity and realistic physical behaviors. The combination of mature, high-level tools, fast CPUs and broadband Internet connections has made rapid development and deployment of interactive 3D a reality. And best of all, there's no licensing fee for developing Shockwave applications.

Even with all of the groundwork that's laid for you, however, creating complex interactive 3D experiences isn't for the faint of heart. While you can get up and running quite quickly, refining your first attempts into polished products will take some time. For example, you can quickly create a sphere that can be manipulated with the mouse, but creating a volleyball game is a much more daunting task.

Luckily, you're not on your own. As a mature product, Director has a large and thriving development community. This includes active newsgroups and mailing lists, many of which are frequented by the actual developers of Shockwave 3D.

An even bigger challenge might be to convince your clients of the value of interactive 3D. The technology has not yet been widely seen, and many companies have adopted a back-to-basics Web strategy while the tech economy recovers, so in many cases, interactive 3D could be a tough sell.

But don't get me wrong. This is an incredible package and my overall recommendation is a strong buy. By pointing out the pitfalls of Shockwave 3D development I didn't mean to discourage you, but to prevent you from encountering any surprises, so that your development experience is as smooth as possible. Once you start developing 3D content with Director 8.5, you will be hooked. Send some flowers to your significant other and hire someone to walk your dog!

Greg lives in San Francisco where he heads up ForgeFX, a leader in Shockwave 3D content development. Current projects include a Shockwave 3D mountain biking game. You can email him at gmeyers@forgefx.com.