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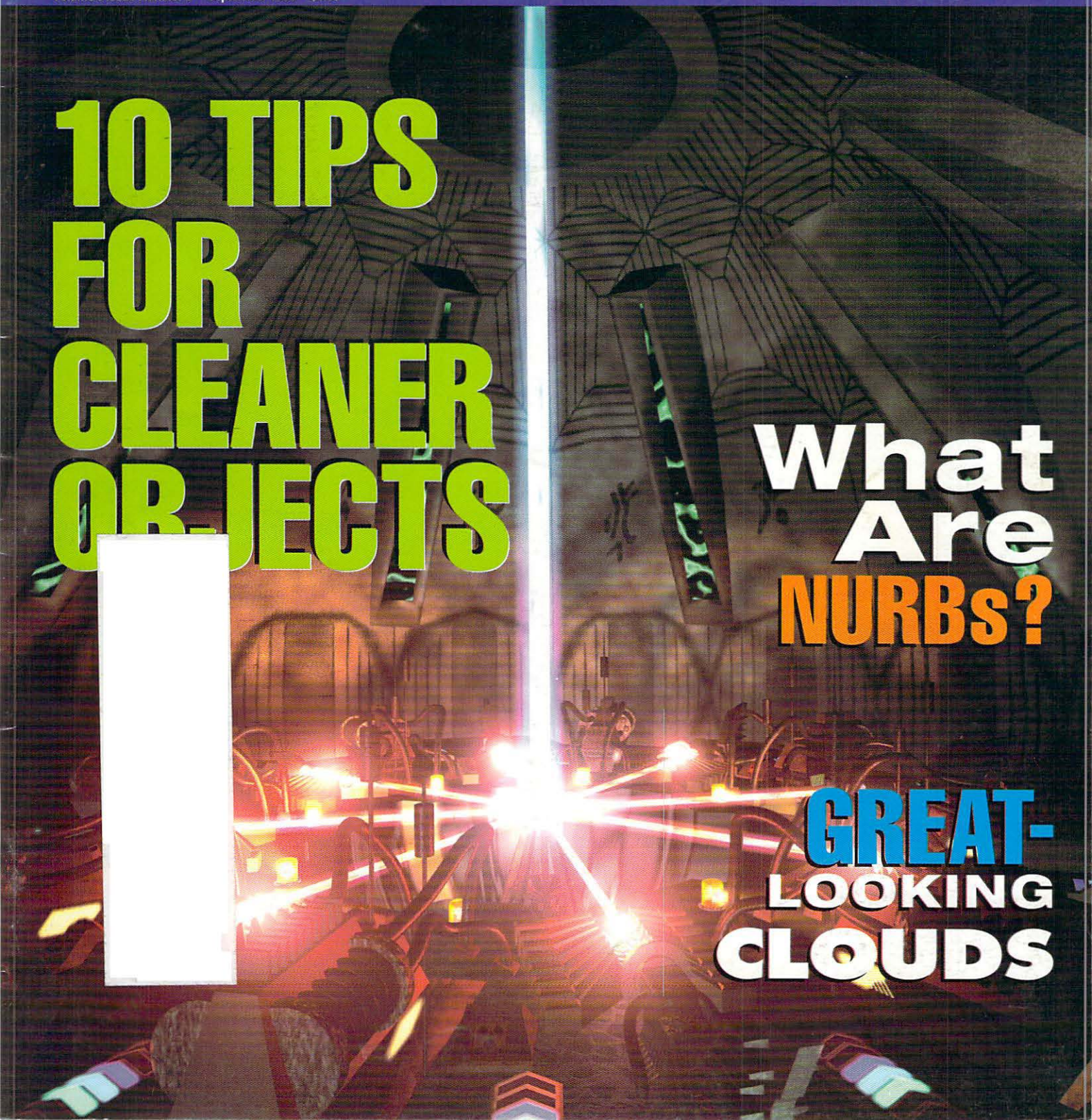

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RAPID TURN AROUND!

EDITOR'S MESSAGE

by John Gross

Well, it's been slowing a bit on the LightWave front. At press time, Intel and DEC Alpha final versions have shipped and SGI and Amiga versions are not far behind. The LightWave newsgroup and mailing list have gotten away from the "When's it going to ship?" questions and back to the "How do you do this?"-type questions.

I haven't received my final copies of LightWave yet, so I'm hoping that all the extra things, such as the HIIP loaders/savers and Pennello Lite, work as they should. The only thing that I've heard so far (but haven't tested myself) is that AVI saving does not operate under Windows 95. Hopefully, by this time next month, we should all know what works and what doesn't. With luck, everything does.

Speaking of Windows 95, if you are using NT (and if you are serious about LightWave, you should be), you can download a beta version of the new 95 style interface for NT from AOL, or by ftp'ing to ftp.microsoft.com (or www.microsoft.com). Look in the bussys/winnt directories for the new shell preview. Some early reports say that this beta interface is a memory pig and slows down rendering. I haven't seen any significant slowdowns with the *LIGHTWAVEPRO* benchmark tests, but remember, all of those scenes are small enough to render in RAM. One of the nice benefits about using the newest 95 shell for NT is that you can create/delete/rename files and directories in the Load/Save requesters. This is a really big plus! Just remember that it's not a good idea to use a beta interface like this for critical production work. You never know what might happen. I've been using it for awhile on my PC and Alpha and have had no problems other than some occasional slowdowns in dragging files from one window to another. However, I don't do a lot of heavy scene construction at home.

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This month's cover image is a still frame from a complex 43-second animated logo sequence (a Wavey award winner) for Fusion Films, a full-service digital production facility specializing in 3D animation and CGI visual effects. The scene contains over 120 objects (not including particles), 85 lights (22 shadow casting), 14 image maps and 70,000 polygons. It was rendered at 2261x2261 resolution in 30 minutes on a NekoTech Mach II Alpha workstation. The entire scene was modeled, surfaced and animated by Fusion Films Director of Animation Mark Thompson in under six weeks. Contact Fusion Films at (603) 424-1829.

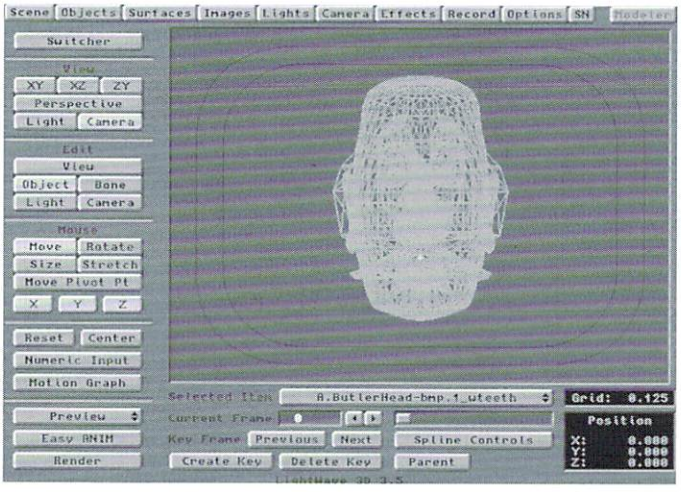
The Perfect Butler

by Dan Bloomfield

A "talking head" is a somewhat derisive term for news broadcast footage that, rather than showing cool video of mayhem and destruction, has a news anchor talking about events. Though a talking head may not be the most desirable shot in TV news, it is definitely better than a screen full of text and little icons, which is what most computer interfaces consist of. Wouldn't it be neat if your computer had a face and talked to you? In the home of the 21st century, in Orlando, Fla., a computer does. Thank LightWave.

Building a Butler

The home of the 21st century is one of the new breed of "smart homes" in which a computer controls heating, air conditioning, lights, home entertainment system and home security. Rather than have these functions programmed from a traditional computer menu, the client wanted an English butler to appear on the home's TV screen. From there, the character could set the various computer modes for the home owner, who would control the action through the special remote control that controls the Time Warner Cable Full Service Network interactive cable television system. Having decided on an interface, animators at my company, Gorilla Systems (based in Tampa Bay, Fla.), set out to build a better butler.



All morph targets are 100% dissolved.

After a script was written for the 22 different modes that could be set (and spoken by the "butler"), the dialogue had to be recorded to tape, then digitized into the computer using a SunRize audio board and Studio 16 software on an Amiga 4000. Any PC sound card with a waveform editor would do, however.

One of our animators, Bill Arbanas, having lived in England, was able to come up with a suitable accent. Once digitized, the dialogue had to be broken up into separate phrases, and the waveform analyzed in Studio 16's Editor module. By listening to the dialogue through headphones and looking at the waveform, we could break the speech down into individual phonemes and write down the exact timing of each phoneme, and the timing of any pauses. (Phonemes are the basic building blocks of human speech, corresponding to the different vowels and consonants of the English language.) An invaluable aid in this project was a phoneme chart that we digitized from a frame of Myriad Video Adventures' *Animation 101: How to Animate.* A similar chart is also in Preston Blair's "Cartoon Animation," and I'm sure in many other books about cel animation. The phoneme chart not only gives you a guide by which to break down the dialogue, it also gives you the mouth shapes that your model will need to make to mimic human speech.

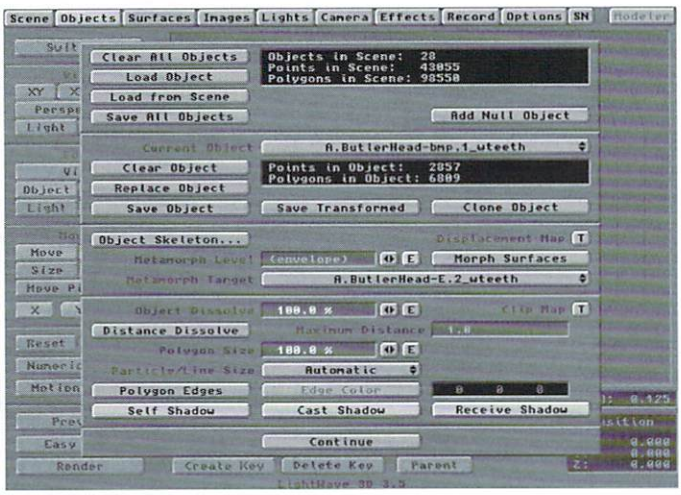
While the dialogue was being broken down and timed (a crucial step), "Alfred" was being modeled. The eyes, eyelids, mustache and eyebrows are all separate objects parented to the head, so that these areas can be animated separately to add extra expression. The mouth area had to be given the most attention, since this was the part that would have to form the different shapes corresponding to each phoneme. Consequently, the polygons in the mouth area were subdivided and tripled, to prevent any non-planar polygons when the mouth was distorted into a different shape.

A decision had to be made whether to use Bones or morph targets for the various mouth positions. Morph targets were the obvious choice for two reasons. First, LightWave does not have the ability to cut and paste motion files. So for Bones, you would have to set keyframes for each and every phrase, with no ability to paste the keyframes for a particular phoneme from one phrase to another. Second, Alfred's teeth needed to remain rigid. If Bones were used and the teeth were part of the head object, they would have to have their own set of Bones to stay rigid, and these Bones might tend to influence the jaw. If the teeth were a separate object, they would need their own set of keyframes to move for each phrase, since child objects will not follow the motion induced in a parent due to Bones (or a displacement map, for that matter).

Morph targets suffer from none of these problems. Keeping this in mind, let's take a look at how you could set up a string of mouth position morph targets, assuming you had already modeled a head. You could use the same technique with Crestline Software's Humanoid models, though, in that case, many of the phonemes and facial expression morph targets have been premodeled for you. (See "Raiders of the Lost Archives," *Video Toaster User*, October 1995.)

Say "Ah"

To model the morph targets, first load the base head model into Modeler. By making a separate IFF image of each mouth shape from our phoneme chart (which was framegrabbed or scanned in), we can load each image into the background in Modeler as a template for the mouth position. Just hit the BG Image button (Display panel) and either load in the images (version 4.0) or load the images in Layout first and then select the correct image in Modeler (pre-4.0). Be sure that, when using background images in Modeler, you

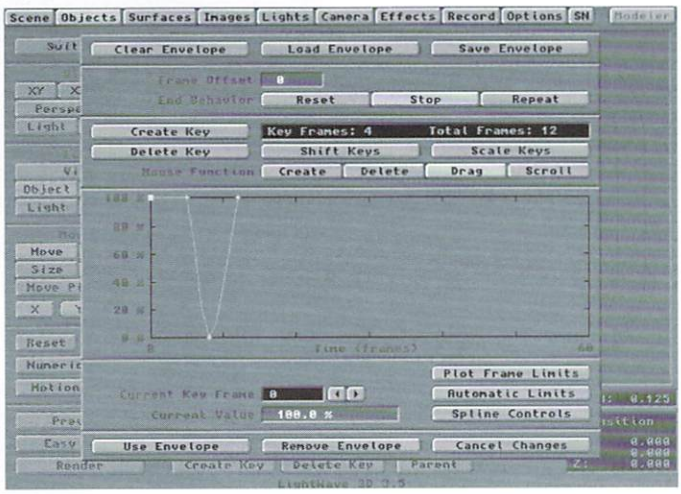


Each phoneme is targeted to the next.

use the correct aspect ratio for the image. If it was framegrabbed from an NTSC video source, you should make the image 1.346 times wider instead of the default 1x1, so the image retains the correct aspect ratio. If the image was scanned into a PC originally, you would want to use the proper sizes based upon the image's width and height. The image can be set to any desired size to fit the dimensions of what you are trying to model as long as you keep these distinctions in mind. Make sure Backdrop Visibility is toggled on with the Options button (Display panel, keyboard o).

Using the lasso tool (right mouse button) or dragging out a bounding box in Volume selection mode, surround the mouth area of your head object and hit the Hide Uns button (Display panel, keyboard +). If your model has teeth, you should use the Stats button (Display panel, keyboard w) to select the tooth surface, then Hide Sel (keyboard -). Now the rest of our head is invisible, and we can concentrate on the mouth area. By using a combination of the Magnet tool (Modify panel) and selecting individual points in Point select mode and moving them (keyboard t), you can drag the lips into the correct position for the phoneme you are trying to model. Be sure not to cut or paste any points while doing this, as you do not want to disturb the point order of the target object. If you can't get the lips to match the phoneme template exactly, don't worry about it, as long as it's pretty close.

At this point you should hit the Unhide button (keyboard \) and make the rest of the head visible. Use the stats panel again to re-select the teeth and move them into the proper position for this new mouth shape, and then save your modified model with a name like "Head_target_0". After saving a different head, load your new model into Layout and do a few quick renders from different angles to make sure you don't have any gross errors, flipped or missing polygons, etc. If you do, you'll have to go back and try again. If you find that you need more polygons around the mouth area, use Subdivide smooth (Polygon panel, keyboard D) on the original source model and then modify, as subdividing a morph target will cause it to have a different point count and generate an error when you try to morph. When you have created morph targets for all of your phonemes, it's time to make the character talk.



Morph envelope where 0% = fully morphed.

Chain Gang

In Layout, load your source model and all of your targets, making all of the targets 100% dissolved. From the Objects panel, you should make each succeeding object's Morph Target the next object (i.e., object 1's Morph Target should be set to object 2, object 2's to object 3, etc.). Finally, clone the source head and make it the target of the last phoneme. Then set all Metamorph Values but the clone of the source object—which has no morph target—to 100%. Why have we done this?

Normally, to morph object 1 into object 5, you would have to set the morph value for objects 1 through 4 to 100% and object 5 to 0%, resulting in a morph to object 5's shape. Suppose that you now wanted to morph to object 2. You would have to set a morph envelope back to 0% for objects 2, 3 and 4, leaving object 1 at 100%. If, at that point, you wanted to morph to object 6, you'd have to re-set the envelope for objects 2, 3, 4 and 5. For any kind of lengthy dialogue, this would quickly become a nightmare.

Fortunately, by setting up a morph chain, or loop, this process can be tremendously simplified. By setting all morph values to 100% and using a clone of the source object as the last morph target, the original geometry is maintained. Now, whenever you want to mouth a particular phoneme, just set the morph envelope for that phoneme to 0% during the frames you want. By setting the envelope to 0%, you have terminated the chain at that phoneme, and the source object will be morphed into that position. To go on to a new phoneme, simply set a keyframe back to 100% for the current phoneme, go to the next phoneme you want to pronounce and set a keyframe for it down to 0%. At any one time, all you have to concern yourself with are two envelopes!

Timing Is Everything

Now is when the timing sheet you created earlier that breaks your dialogue down into phonemes comes into play (you did break down your narration, right?). If you were accurate in your timing, you should be able to set morph envelopes for each phoneme based on your dialogue timing, and when rendered and synced to your dialogue tape, it will look like your character is saying the words. If you have a DPS PAR or Perception board, you can sync playback to your audio board and see if the timing is right.

From the Camera panel, you can choose Wireframe mode and render a wireframe preview to your PAR/Perception to check this. If you don't have a PAR, you can lay the wireframe to tape and then do an audio insert edit of your dialogue track. If the timing ends up being a little off, you may have to go back and tweak some of your envelopes. It may be that the speech is a little too fast to allow for a distinct mouthing of all the different phonemes. In that case, you can use morph values higher than 0%, and overlap keyframes to move more quickly through the mouth positions. It really shouldn't be necessary to say every letter of every word. Just a couple of key phonemes per word will prevent the mouth from jittering in an unrealistic fashion.

If you are still having major problems, you might have to go back and make sure your timing sheet accurately reflects the taped dialogue. When you have the mouth timing right, you can go back into your scene and add head bobs, blinking eyes, rolling eyes, arching eyebrows, etc., at appropriate spots to imbue more personality into your character.

By following these steps, we were able to make Alfred the Electronic Butler come to life. Now you can have your characters do the same.

LWP

Dan Bloomfield bought a Toaster in January 1991 so he could use LightWave, and was a freelance 3D artist until joining Tampa Bay, Fla.-based Gorilla Systems in 1994. Call him at (813) 855-7294, or send e-mail to dan.bloomfield@mercopus.com.

The Cumulus Effect

by Jim May

Obtaining photo-realistic effects in any 3D rendering package involves a large degree of complexity. Simulating lens flares, for instance, was a fairly elaborate procedure until LightWave 3.0 made it child's play. But this is not always the case. I'll show you how to render realistic, fluffy cumulus clouds in daylight, with only two polygons and no light sources.

This Isn't Kansas

Rendering authentic sky shots has always been a personal Holy Grail of mine. This fascination has been exacerbated by the fact that Vista Professional has shipped version 3.0 on the Amiga, and yet it still can't render decent clouds. Though VistaPro had Scenery Animator beat on many fronts, the latter does beautifully detailed clouds. World Construction Set doesn't even do clouds at all.

And none of them could do anything other than thin-wisp, flat, cirrus-type clouds. What about cumulus clouds? What could I do to simulate big, cumulonimbus thunderheads rolling across the sky (short of recording live cloud footage into a PAR)?

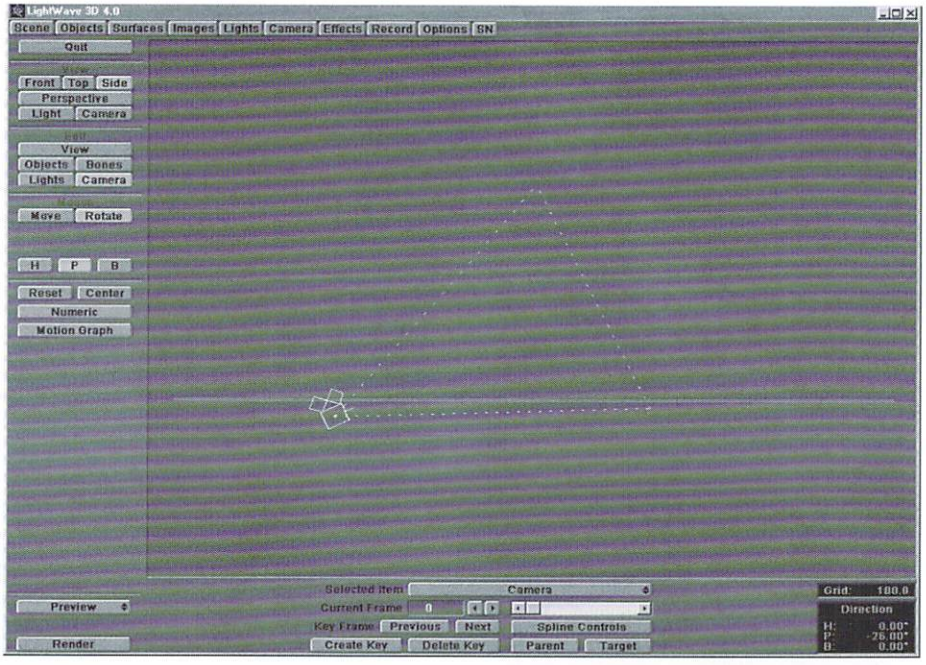
LightWave did not seem to be able to improve things, at first. Simulating clouds in LightWave consisted primarily of transparency-mapping a white polygon layer. Not only was this a flat, wispy solution, much like the others, but the resulting clouds had a 50 percent coverage limitation—no more, no less.

So I was stuck with using still images of actual sky to achieve particular weather. Then I pondered what would happen if I stacked not one, but two cloud layers, one on top of the other, with the top one white and the bottom one darker. The initial results were startling, and I wound up working into the wee hours of the night exploring the possibilities.

The Calm Before the Storm

- The first, essential step for this effect is to create two large, flat surfaces—in this example, two simple squares. Either single-sided polygons with double-sided surfaces or straight double-sided polygons will do. One will form the upper cloud layer (surface name Highclouds) and the other will form the underbelly of the cloud cover (Lowclouds).
- Make these two layers using the Box command (Objects panel) in Modeler with the Top view. Do not build actual boxes! Instead, we need two large single polygons. Be sure to make them very large, so that you can use them in scale with other objects. Our examples are one kilometer square.
- Assign surfaces (if necessary) using Surface (Polygon panel or (q)), and then Export or Save (Objects panel) each polygon as a separate object into Layout. We are keeping the polygons separate to retain control over the effect, as we'll see later. In our example, the final objects are named High and Low.
- Once in Layout, set the Grid Size under Options to a number at least 25 times smaller than the original object size; we want the polygons to extend far to the horizon from the camera's point of view. Now, switch to Side (ZY) or Front (XY) under View. In this example, the cloud polygons are one kilometer per side. With that scale, set the High cloud layer to 25 meters or so above the camera; set the Low clouds to be between 23 and 24 meters up. With different sizes, the numbers are different, but the distance between the cloud layers must be around 12 to 25 times smaller than the distance to the camera. Now, aim your camera up a bit, and create a key for all items at frame 0. It would also help to make the effect clear if you set the camera lens wide. (In the Camera panel, use 2.2 or so for Zoom Factor; in 35 mm SLR terms, you want between 17 mm and 24 mm.) It also helps to set LightWave to use Gradient Backdrop (Effects panel) to see your clouds against a blue sky.
- Now, go to the Surfaces panel. For the upper cloud layer (Highclouds), set the following:

  Surface color 255, 255, 255



A side view of our scene shows the camera pitched up at two closely placed cloud planes. Fog is used here to fade the distant clouds into the sky colors. See the color pages for the rendered image from this scene.

Luminosity	100%
Diffuse Level	0
Transparency	0%
Transparency Texture	
Texture Type	Fractal Noise
Texture Size	15.0 (X, Y and Z)
Texture Value	100%
Frequency	15 or higher (for detail)
Contrast	3.0 or higher

(Bigger Contrast values yield more cumuluslike, solid clouds with thin fringes and big areas of clear sky. Lower values will result in thinner, wispier, hazier clouds.)

All other settings are OK with defaults.

- For the Lowclouds surface, use the same values except for the following: Surface color of dark gray (96, 96, 96). Otherwise, Luminosity and Diffuse Levels are the same as for the Highclouds surface. Most crucial is the Fractal Noise texture map to be applied to Transparency; it must have identical values to that applied to the Highclouds transparency.
- From the Objects panel, select Save All Objects.
- Once everything is shipshape, go to the Camera panel and set your desired resolution, and then render the image. If you want to put my initial claim to the test, go to the Lights control panel and turn the only Light down to 0% intensity. If you really want to cover every escape hatch, don't forget to also set Ambient Intensity to 0.0.

Stormy Weather

LightWave's Fractal Noise texture uses a seed value in its random number generator. My cloud technique takes advantage of the fact that the seed value is the same each time out. As a result, the pattern on each cloud layer is exactly matched to the other, so long as your Texture Center, Texture Size, Contrast and Frequencies values are the same!

Now try the following:

- Alter the distance between the layers—try bigger distances. Try using a very wide angle on your camera to take in more (down to about 1.8). Then try slightly modifying the Texture Center values for the transparency map of only one of the layers, or simply move the cloud layers from side to side by small increments.

You will find that increasing the distance between the layers exaggerates the directionality of the apparent "sunlight," whereas moving the layers off XZ center from one another alters the direction of the "sun." In both cases, the effect ranges from "flat" at the apparent center of "sunlight" (whose direction actually corresponds to the line linking the cloud objects' axes) to fluffy, directional lighting as you look further away from center. Beyond a certain point, however, the effect breaks down as the two layers become distinct. There is a definite "comfort zone" ringing the center, in which the effect works. Its size (radius) is directly proportional to the separation of the cloud layers in relation to the distance to the camera.

In mathematical terms, the effect becomes more pronounced as the angular distance (as viewed by the camera) between two corresponding points on the surface of each cloud layer increases. When that angle exceeds a certain value, however, the two layers become distinct and the effect is lost.

The central cloud areas, in this example, are solid, featureless gray areas, suggesting flat-bottomed cumulonimbus clouds. You can mitigate this by taking advantage of Fractal Noise's static random seed. Simply assign another Fractal Noise texture to the Surface Color attribute of Lowclouds, again using the same values as the others. This adds detail to the solid areas of the lower layer. Use Contrast values below 2.0, and give the texture a color lighter than the original surface. This will give the effect of the cloud being lit from all sides, as the light/dark areas of the texture will align precisely with the clear/solid areas of cloud. Using a color that is darker than the original surface will make the clouds look as though they are being lit from below and above (useful for clouds over a city being lit by the moon).

Lighter cloud bottoms give the impression of light clouds, while darker colors suggest thick, lumpy cumulonimbus thunderheads. Making the texture X values greater than the Z values can yield a wind-streaked, jet stream stratus appearance.

You can also try adding light sources now, to have the upper layer cast shadows onto the lower, and you can now alter the Luminosity and Diffuse Level values to your taste. The goal I most often shoot for is to try to lighten up the fringes as much as possible to enhance the effect of bright sunlight filtering through the edges.

Time-Lapse Photography

After discovering this technique, I decided to simulate the effect of sunlight flashing through the clouds. By animating the Fractal Noise textures making up the clouds, I aimed to re-create some realistic and inspirational imagery.

- Starting with the scene assembled above, turn the light back on and set it above the clouds. Turn on Lens Flare (Lights panel), with Lens Reflections, Random Streaks and Fade Behind Objects activated, and use Texture Velocity to move the clouds. Take care to keep the upper and lower layers aligned and matched.

Using this technique, I got acceptable results with the flare set to a bright value (greater than 150%) and solid clouds (Contrast at 3.5). The effect of the sun bursting out was remarkable! However, there was no anticipation of its appearance, since the flare was completely dark until it was clearing the clouds. In reality, there is a skyglow surrounding the sun, and you know that it is about to come out as this glow brightens the blue sky beyond.

- To simulate this skyglow, add a second light behind the first, with a large, diffuse glow and Glow Behind Objects turned on. (Intensity high, but mitigated with a Flare Dissolve setting of 30%. Different Dissolve and Intensity settings for this flare will simulate different haze levels.) Make sure that this flare is a long way from the camera, or else it will "curve around" and pop through the cloud cover, especially with wide-angle camera settings.
- Here comes the best part. If you give a Y value to the clouds' velocity, you will see the clouds "boil"! Now, with the rolling, boiling clouds and the sun drifting across the sky, you can simulate time-lapse sequences with amazing realism. Your storm clouds can now have that tornado-suggestive turbulence, enhanced by the cumulus effect.

Using this effect, you can now simulate nearly any meteorological condition. For example, if you give the cloud textures large X and Z sizes, you will have a sky dominated by one or two large cloud masses with expansive, clear areas in between. Once you have this, you can position them by either moving the cloud objects or adjusting the Texture Center such that the sky is mostly clear, and then animating a huge, dark cloud mass to roll across the scene, blocking the sun. By hiding a light source between the layers, you can simulate lightning! (You can vary the appearance of this effect by setting the default Transparency value of the lower layer to 10% or so. This adjustment will preserve the cloud bottom effect, but will permit the lightning flash to show more clearly.)

Those skilled at simulating volumetric lighting can have sunbeams bursting through cracks in the cloud cover.

The Aftermath

One thing I haven't tried yet (due to its probable long rendering time) is placing a few buildings with reflective windows around a vertically facing camera, with the clouds high above. With Trace Shadows on (shadow maps, which render solid shadows, won't work for this effect), the clouds will cast shadows over the towers while their windows reflect the turbulent sky overhead. (You only need one of your cloud layers to cast the shadow. The other shouldn't cast any.)

Another application of this technique was used to simulate a twilight sky for use in Vivid's (the company I work for) up-and-coming VR simulation, Turbo Kourier. By reversing the color scheme and making the lower layer a light orange with a dark purple upper layer, I simulated a twilight sky with clouds lit from underneath by a setting sun—all behind the lights of a huge, bustling, 21st century city.

I will be using this technique to simulate clouds over a full moon in an upcoming animation based on the legend of the Internet CancelMoose, in which our hero will fight to clear the world of Spam. I look forward to seeing applications of this idea elsewhere, and hope you can make use of it yourself!

LWP

Jim May is the primary LightWave dude at The Vivid Group in Toronto, Canada. His specialty is the application of real-world photographic techniques and camera work to the realm of computer imaging. May can be reached at vivid@gpu.utcc.utoronto.ca.

LightWave 101: It Cleans!

by Paulo Felberg

I've seen a lot of people asking how to create good-looking, realistic wood surfaces, but no one is asking how to preserve them. Preserve them? Why, just save them on disk and that's it. But what about in the real world? There it's necessary to keep our floors well-cleaned and polished to maintain them. For that, we'll need a good wood cleaning and polishing product. Have you ever thought about using LightWave? Well, one client asked me to do just that. He wanted to create a 3D animation to show off his new wood cleaning product.

From looking at the color pages, you can see the effect is not a simple surface morph. The scene consists of the cleaning product package placed on a dark, dirty wood floor. A flannel cloth with the cleaning product rubs the floor, affecting only that part of the surface, cleaning and changing colors to a very shiny and reflective wood surface. This simple tutorial will show how easy it is to scrub away.

Building the Objects

I'm not going to get into the details of how the product package bottle was modeled and mapped. It's not essential for the cleaning effect. Anyway, if you wish, you can try modeling your own product package before continuing. For this tutorial, we will use very basic shapes. For an actual animation, you will most likely want to modify your objects to add more detail and realism.

Let's enter Modeler to make our floor object.

- Select Options (Display menu) and set Orientation to Logo (XY) and Unit System to Metric. All values will be entered in meters.
- Select Box in the Objects menu. Select Numeric (n) and enter the following values in the Box Numeric requester:

Low	High
X = -2	X = 2
Y = 0	Y = 0
Z = -2	Z = 2

- Leave the number of segments set to 1 for all axes.
- Press OK and then Make or return to make the box.
- Select the object polygon to see if it is facing up. If it's not, hit (f) to Flip (Polygon menu) it.

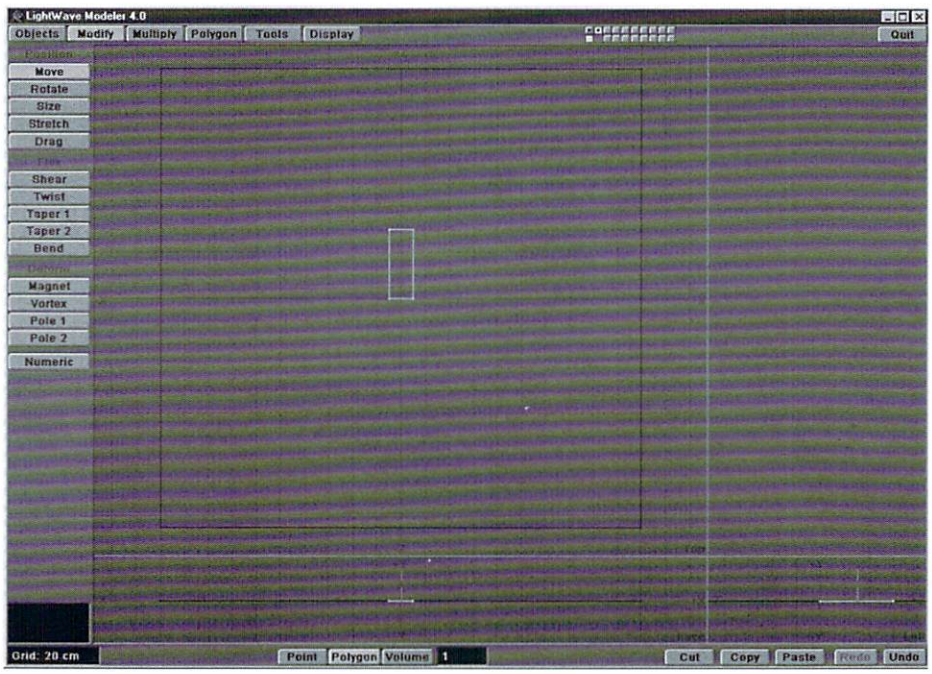


Figure 1

- To name the object surface, hit (q) for Surface (Polygon menu) and enter "DIRTY". Press return to change the surface name.
- Save the object as "DIRTY.lwo".

Now that we've built our dirty floor, we need a flannel cloth to clean it up. Let's make our flannel a simple flat box. While in Modeler, build it by using the Box tool again.

- Go to the next Layer by pressing 2.
- Again, enter the following values in the Box Numeric requester:

Low	High
X = -0.10	X = 0.10
Y = 0	Y = 0
Z = -0.15	Z = 0.15

- Leave the number of segments set to 1 for all axes, press OK, and then hit Make or return to make the box.
- Select the object polygon to see if it is facing up. If it isn't, flip it.
- Name the flannel surface by hitting (q) and entering "FLANNEL". Press return to change the surface name.
- Save the object as "FLANNEL.lwo".

The last object we need to model is the clean portion of the floor. Since the flannel cloth will clean only part of our dirty surface, we only need to model that part. Also, since our flannel cloth is the cleaning object, and in our scene it will be moving in the positive Z direction, we know our clean floor will have the same flannel X size. So, we'll model the clean floor from the "FLANNEL.lwo" object.

- While in the second Layer, hit (h) for Stretch, select Numeric and set Z value to 2.
- Select Move (Modify Menu) and select Numeric. Move the object to Z = 0.30. This will set the object's pivot point to be located on one side of the object. We want this because we will make our

clean floor grow from that side away as the cloth moves back and forth.

- Hit (q) for Surface, rename the object surface "CLEAN", apply it and Save the object as "CLEAN.lwo". Be careful not to overwrite the "FLANNEL.lwo" object.
- Press (ALT-1) to show the first Layer in the background, hit (a) to fit all views to the objects. If you did everything correctly, you should see something like Figure 1.

Surfacing

Before continuing this tutorial, consider creating your own wood texture. It would be better to have a seamless wood texture to avoid seams when rendering. If you have already performed Dan Ablan's "Lightwood in LightWave" tutorial in January 1995's *LWPRO*, you probably already have your favorite wood texture. But if you wish, you may use the Lightwood image from the wood directory. For this tutorial it will work just fine.

- Exit Modeler and enter LightWave Layout.
- Load the three objects modeled.
- Enter the Images panel and load your wood image texture or the Lightwood image from the Wood directory.
- Enter the Surfaces panel and set Current Surface to "DIRTY".
- Apply the Surface Color texture (T button) as a Planar Image Map using your wood texture or the Lightwood image. Select the Y Axis and World Coordinates. World Coordinates is essential to match the dirty and the clean surface sizes. It will avoid texture discrepancies while animating. If you are using the Lightwood image provided in LightWave, you must also set Texture Size to X = 3.0 to avoid a texture seam.
- Set Specular Level (Surfaces panel) to 20%, Glossiness at Medium and Smoothing on.
- To give the wood texture a dirty look, set Diffuse Level to 100% and apply a Fractal Noise Diffuse Texture (T button) with the following settings:

Texture Size	0.3, 0.1, 0.5
Texture Value	40%
Frequencies	3
Contrast	1

[For more information about Fractal Noise and dirty surfaces, take a look at Mojo's "Top 10 Uses for Fractal Noise" in May 1995's LWPRO.]

- Click on Use Texture.
- Select Save Surface (Surfaces panel) and save this surface as "DIRTY.srf".
- Save the object (Objects panel).

Let's set our clean surface:

- Back in the Surfaces panel, set Current Surface to "CLEAN".
- Select Load Surface to load the "DIRTY.srf" surface we just saved.
- Remove the Diffuse Level Fractal Noise texture applied (Shift-click on the T button).
- Set Reflectivity to 40%.

Adding a reflectivity level increases the clean polished wood look. So, any object placed near the clean area will be reflected in the "cleaned wood."

- If you are using LightWave 4.0, set Reflection Options to Ray Tracing+Backdrop.
- Save the object.

Our flannel surface is not essential for the effect to take place, but it would help with the overall scene look. It was modeled very simply, with hard angles and little detail. So, let's apply a simple bump map to give it some dirtiness and some irregular surfaces:

- Set Current Surface (Surfaces panel) to "FLANNEL".
- Set Surface Color (Surfaces panel) to 0, 130, 0, Diffuse Level to 100% and Specular Level to 0. Turn Smoothing on.
- Select Bump Map (Surfaces panel) and set Texture Type to Fractal Bumps. Set Texture Size to 0.03, 0.03, 0.05, Texture Amplitude to 200% and Frequencies to 3. Click on Use Texture.
- Save the object.

Let's Clean It Up

First, we must load another object into the scene to represent our product package. If you haven't modeled it yet, you can use any simple object to represent it. Just position it close to the clean area, so it's reflection will be seen. Its position will vary according to its size and shape. Just be sure to position it close to the clean area and with its base touching the floor.

- Select Add Null Object (Objects panel) and save it as "TARGET".
- Position the "TARGET" object at 0.1, 0.0, -0.7 and create a keyframe at frame 0.
- Target the Camera to the "TARGET" object.
- Set the Camera position to 0.6, 0.6, -1.5 and set a keyframe at 0 for the camera.

Let's position our "CLEAN.lwo" object a little bit higher than the dirty floor to avoid render errors.

- Move it to 0, 0.001, -1.0 and set keyframes at 0 and 60.
- Now, set the "CLEAN.lwo" object Z size to 0 and set a keyframe at 0.

As you'll notice, our animation will be quite short (two seconds). You may increase time as you wish.

The last object to set up is the "FLANNEL.lwo" object. As we did with the clean floor, we need to position the flannel cloth higher than both floor objects.

- Move the "FLANNEL.lwo" object to Y = 0.002 and set keyframes at 0 and 60.

Now, let's set the flannel movement.

- Move the "FLANNEL.lwo" object to Z = -0.85 and set a keyframe at 0.
- Move the "FLANNEL.lwo" object to Z = -0.25 and set a keyframe at 60.

Lighting

You don't need to add any special lighting for the effect to take place. But, you may try these settings to increase the dark, abandoned, realistic look.

- In the Lights panel, set Ambient Intensity to 0 and Light Color to 255, 255, 190.
- Set the Light Type to Spot, the Shadow Type to Shadow Map and set the Spot Soft Edge Angle to 30. Click Continue.
- Set the Light Target to the "TARGET" object and position it at 0.5, 1.5, -1.5. Create a keyframe at 0.

The Results

- In the Camera panel turn the Trace Reflections option on. This will enable the product object to reflect in the clean floor.
- Set Backdrop Color (Effects panel) to 0, 0, 0, so our floor will not reflect any colored sky.

You may adjust the other settings in the Camera Panel as you wish.

- Don't forget to change the Last Frame value (Scene panel) to 60.
- Save the scene as "CLEANING.lws".
- Since we made a short scene, you should try to render it all. But, if you don't have time to spare, just render frames 0, 30 and 60. With them, you'll have the beginning, middle and end of the animation, giving you an idea of how movement would work.

If you did it correctly, your images should look like what's displayed in the color pages.

The clean-floor effect.

One Step Further

You could try making your own floor surface, giving it more realism. Of course, you'll have a better look. Also, try adding some more texture and maybe some displacement mapping to your flannel cloth. Don't forget that it must be tripled and subdivided first.

Add more objects to the scene: a chair, a table. Make it real. You can also model your package and even the liquid itself, giving your scene a better look.

Of course, you're not obliged to work only with wood surfaces. You may use your favorite; just be sure it looks real. You can't clean rocks with a flannel cloth!

LWP

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10 Tips for Cleaner Objects

by Tom Williamson

Modeling is one of the hardest things in computer graphics to do correctly. With LightWave Modeler's easy-to-learn interface and powerful tools, a reasonably trained chimp could bash out objects. But it takes experience to recognize what needs (or doesn't need) to be built. It doesn't take much to get so caught up in an object that instead of spending time figuring out if you can build it, you never stop to think if you *should* build it. What I have compiled here are some tips for creating cleaner objects. By "cleaner" I mean more logical, better-thought-out objects that are not only more efficient but a lot more fun to work with.

Watch Your Polygon Count

There seems to be a serious misconception that the more polygons there are in an object, the better it is. Well, that simply isn't true. You can take a cube and subdivide until your face turns a lovely shade of red (with a little fractal noise thrown in). When you're done, it'll still be a cube. A cube with an impressive polygon count, yes, but still a cube. Now, I realize that's an extremely oversimplified example, but I believe I've made my point. Probably the most important step to modeling is preparation. Before you can build anything you must first determine what it is you really need. Will you be getting really close to this object? If so, more detail is necessary. If not, perhaps a simple flat plane with an image map and clip map will do. As you can see, there's quite a range, and where your model falls in this range depends greatly on the project.

Pre-visualization, storyboards and production sketches are very important to the modeling process. If you don't plan ahead you'll probably end up in Modeler again. The detail of your object depends on how it will be seen and the inherent complexity of the piece you're creating. Take, for instance, an airplane. If your animation has an airplane flying through the background of the scene, a simple object will do. Perhaps a count of 300 polygons. If your animation has the plane flying past the camera, you should probably boost the quality up to 3,000 polygons, maybe. If your animation has the plane fly toward the camera as we swoop in to count the rivets holding on the canopy, you better go for that big daddy-mac plane you've always wanted to build with 30,000 polygons! Then there's the topic of overdetailing small parts of an otherwise simple object. If your plane fuselage has only 200 polygons, why have a 1,200-polygon Pitot tube (a device used to measure the total pressure of a fluid stream)?

I call this polygon balancing: keeping the detail logical throughout the model. Of course, there are times when an unbalanced model is desirable. Say your animation starts by flying out of the Pitot tube to reveal the plane, which then flies off into the sunset. If that's the case, then by all means detail that tube! In fact, you should do the surrounding area, too. But the tailgear? If it's not necessary, don't do it! As my good friend David Ebner likes to say, "Work is work." Here's my loose rule of thumb: determine what you need and add 20 percent. This works in all aspects of life and will keep you from going back into Modeler in the 11th hour instead of just hitting "F10" (render scene). Every so often you will have to go back and add detail to an object because a shot was added or the camera angle changed. But overall, this rule works. (It doesn't work in marriage, however, so make the number 40 percent. Those who didn't order their spouse fries because they said "I'll just have some of yours" can vouch for this.)

Figure 1: A typical smoothing problem...

Hierarchies That Make Sense (The Art of the Null)

Another purpose of clean objects is to make animating a simpler task. A clean object is easier to see and work with, while a complex object can turn into a black blob very quickly. A group of objects in a hierarchy can get very messy if some thought doesn't go into keeping it clean. The order in which the objects are parented is also important. Try to think ahead when it comes time to build your scene. Let's use the

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12:00 p.m. Open Session: "The Future of LightWave 3D" with creators Allen Hastings & Stuart Ferguson and LightWave Product Manager Brad Peebler

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- **Modeler Essentials: A Beginner's Guide** ..... Bob Anderson
  From flying logos to broadcast television, LightWave 3D's Modeler is able to create simple text objects or complex spaceships. This beginner's class will introduce you to the basic operations required for getting started in the program. The basic modeling tools will be demonstrated and easy-to-follow techniques for creating great logos will be covered.

••• **Organic Modeling** ..... Jason Linhart
Copy Nature in LightWave! Re-create what Mother Nature did long ago. This class will cover using Modeler to create landscapes, trees and other organic objects, along with surfaces, lighting and other "cheats" necessary for completing these effects in LightWave.

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- **LightWave Essentials: A Beginner's Guide** ..... Brad Hayes
  If you are new to LightWave or just want to review the basics, this is the class for you. We will go through LightWave's Layout in detail, including Camera, Lights and Surfaces. We will also cover an array of helpful tips, workarounds and shortcuts.

••• **Bones & Character Animation** ..... Jason Linhart
Learn the techniques that can bring your characters to life. Character creation in Modeler and animation with Bones are the major topics of this course.

Thursday, November 2

9:30am - 11:30am

- **Power ToasterPaint Techniques** ..... Bob Anderson
  In this class, Bob Anderson will reveal the secrets he uses to create great-looking broadcast graphics. All of the new (4.0) features and tools will be covered, as well as many power tips and tricks for all versions of the program. Image compositing, broadcast backgrounds and text tricks will be explored, as well as the Toaster/Flyer processing tools for rotoscoping and animating. Attendees should know the very basic operations (loading, saving, modes, and drawing tools), as they will *not* be covered.

••• **More Character Animation—Techniques from Amblin Imaging** ..... Fred Tepper
This class will cover the three important elements of successful character animation: planning the shot, setting up the scene (inverse kinematics, hierarchies, bones, etc.), and the animation itself. The goal is to enhance both the quality and the efficiency of your character animation. Although geared toward the experienced LightWave animator, this class will be helpful to anyone already familiar with LightWave and its terminology who would like to explore the world of character animation.

1:00pm - 3:00pm

•• **Envelopes, Motion Graphs & Keyframing** ..... Brad Peebler
Learn the ins and outs of these powerful animation tools, including how to use spline controls and achieving advanced morphing effects.

••• **Displacement Mapping & Surfaces** ..... Dan Ablan
Displacement mapping, though often overlooked, has many useful and interesting applications. Even your everyday animations can have a unique look with proper displacement mapping and surfacing. Get away from the usual, boring surfacing and learn how to make grungy, dirty-looking surfaces and more...

3:30pm - 5:30pm

- **3D Logo Basics** ..... Dan Ablan
  Everyone curses them, but it's a fact— 3D logos pay the bills. Learn what you need to do to create a 3D logo, from business card to TV. Explore unique avenues of animating simple but effective 3D logos.

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9:30am - 11:30am

- **Flying Logos** ..... Dan Ablan
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••• **Metaform and Spline-based Modeling—LightWave Techniques** ..... Jason Linhart
From telephones to creatures, Metaform is one of the most powerful modeling tools available for object creation. Spline-based modeling rounds out the field to provide a complete set of tools for complex objects. This advanced course in LightWave Modeler covers the use of splines and Metaform.

1:00pm - 3:00pm

- **Forensic Animation** ..... Don Pence
  A wide range of forensic graphics and animation are used in litigation. This class will give you an overview of the types of projects you can provide attorneys. We will focus on the methodology of gathering and using necessary data to create valid and admissible reconstructions and the basic math formulas involved in reconstructing accidents. Calculator recommended.

••• **Advanced Modeler—Tips, Tricks & Problem Solving** ..... Brad Peebler
This class will be an open forum Q&A covering advanced Modeler techniques such as Metaform, Boolean operations and Text options. Bring your questions to be answered and problems to be solved.

3:30pm - 5:30pm

•• **Editing with the Video Toaster Flyer** ..... James Hebert
Learn the Video Toaster Flyer non-linear editing system in this intensive class. Topics will include integration of the Flyer with LightWave 3D, creating Flyer DVEs in LightWave 3D, integrating graphics into your show, and high-end audio editing tricks.

••• **Advanced LightWave & Modeler—Open Forum Q&A** ..... John Gross
Now is your chance to get your questions answered and those tricky problems solved. This class is an open forum for advanced LightWave 3D users. We will cover some advanced LightWave/Modeler tips and tricks. Feel free to bring examples of your work demonstrating problems with which you need help.

Saturday, November 4

9:30am - 11:30am

- **Lighting & Camera Angles—Production Workshop** ..... John Parenteau
  The ultimate goal of the digital cinematographer is understanding a real-world camera and lighting design, and having the ability to re-create this in the computer. This seminar will cover lighting with practical lights and how to create different moods with the camera. You will then learn how to take these techniques and re-create them with the computer tools at hand.

••• **Forensic Animation II—Advanced Techniques** ..... Don Pence
Finally, you can use that math you learned in school! This class goes into detail regarding the requirements necessary to set up complex animations for use in trials. We will focus on the areas you must consider when animating for courtroom playback— i.e., what you need to know in order to verify the data from engineers and reconstruction experts in a case. Designed for those who have a working knowledge of LightWave and want to create valid, admissible animations for trials.

1:00pm - 3:00pm

•• **Live Production with the Video Toaster and the Flyer** ..... Chris Fenwick
This class will cover the live and live-to-tape production techniques which, though at the very roots of television, are extremely necessary and profitable in today's market. Learn valuable pointers and steps to build your system to best cope in the demanding world of Live Production.

••• **Advanced LightWave—Tips, Tricks & Problem Solving** ..... Grant Boucher
This class is an open forum Q&A for advanced LightWave 3D animators. We will cover things like fall-off, radio fall-off, animated textures, layering and image sequences. Feel free to bring examples of your work demonstrating problems with which you need help.

3:30pm - 5:30pm

•• **Video Titling with the Toaster Character Generator** ..... James Hebert
Learn the ins and outs of Toaster CG. This class will focus on Toaster CG 3.0, 3.1, and the new 4.0 versions, and show you many "little-known facts" about quirks and tricks in Toaster CG. Extensive Q&A session included.

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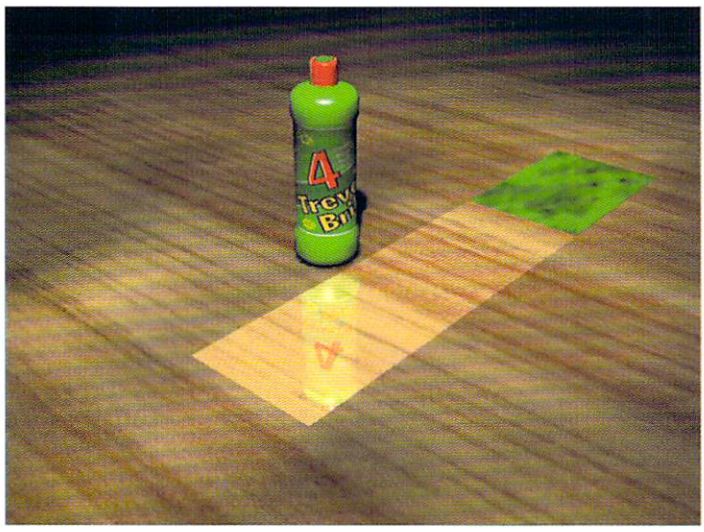
ANIMATION STILLS

It Cleans! Frame 01

In the first frame of the animation, the flannel cloth begins to rub the dirty floor.

It Cleans! Frame 30

During the middle of the movement, the product package and its reflection become visible.



It Cleans! Frame 60

By the end of the animation the flannel cloth has already cleaned a reasonable portion of the dirty floor.

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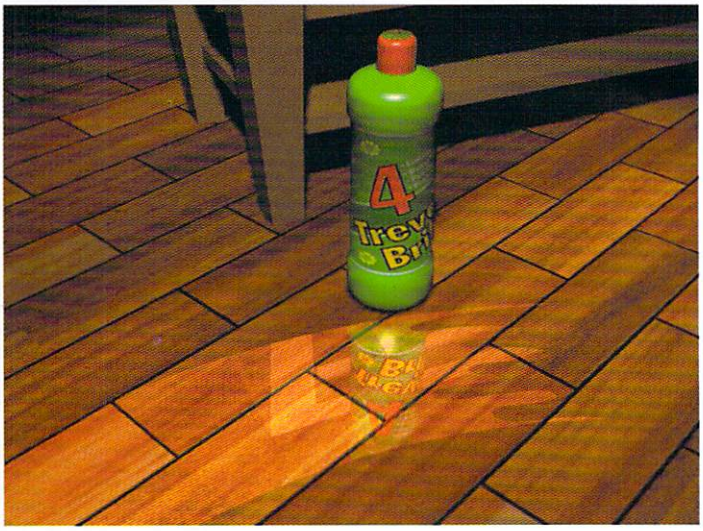


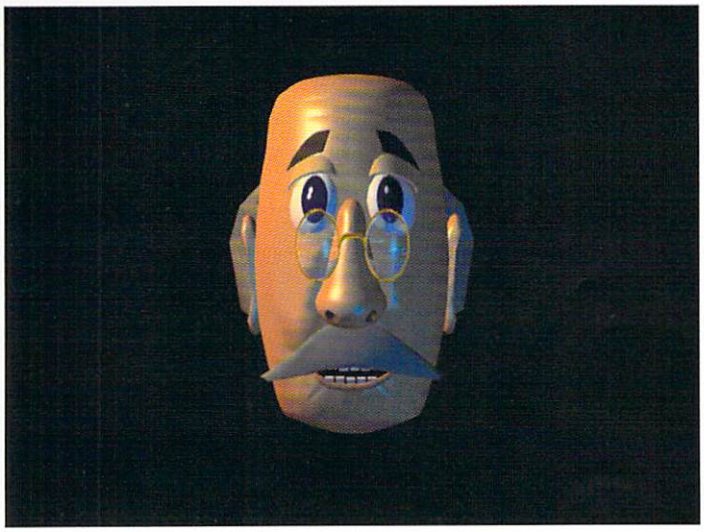
Clean Floor

By using two objects—one clean, one dirty—and revealing the clean one in a clever manner, you can create the effect of wiping a dirty surface clean.

All Clean images copyright 1995 Paulo Felberg

The Cumulus Effect

The clouds in this image are generated by LightWave's Fractal Noise texture used in Surface Color, Luminosity and Transparency. The sun popping through the clouds is simply two flares, one with Glow Behind Objects selected.



Alfred the Electronic Butler

The basic head has 14 child objects and 14 morph targets, with a total of 98,550 polygons.

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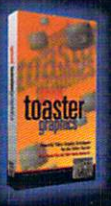

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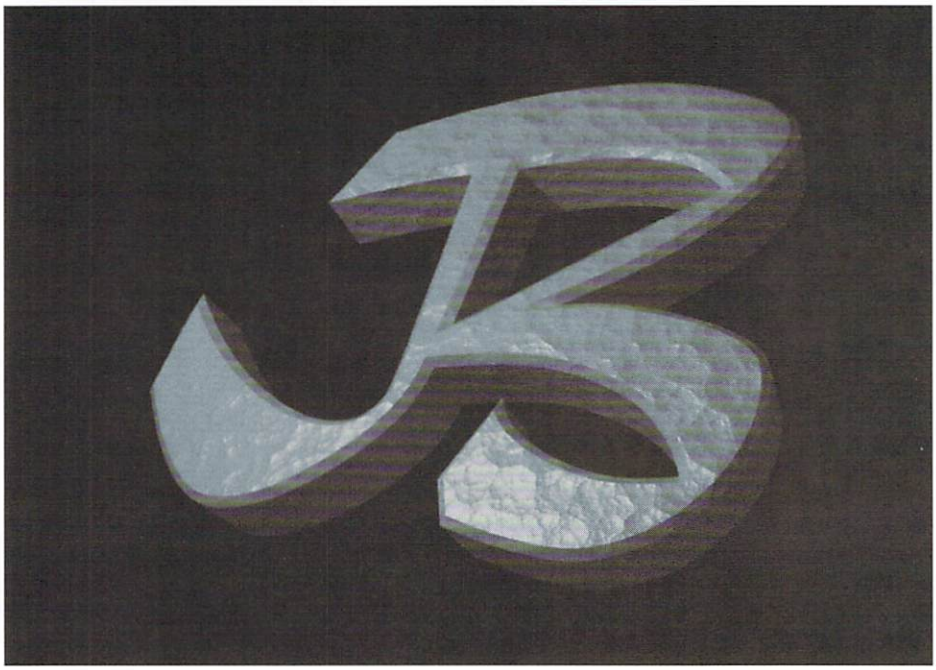

Figure 2: ...and a way around it!

example of a robotic arm. If your arm is going to be used in several shots, it would benefit you to make what I call a "master" scene. A master scene is made up of only one set of objects in a hierarchy. Once you've created it, you can use Load From Scene in the objects panel to bring the objects into the new shot. The first thing I usually do when creating a master scene is add a null object and name it after the object I'm going to put together. In this case we'll call it "ArmNull". Then all the objects are loaded in (in order) and parented to each other. The order in which you load the objects in can make a big difference in how easy it is going to be to animate your scene later. I try to import objects in the order of their parenting, which allows me to slide up and down in a logical order. For instance, if we load our arm base object first, then our fingers, then our elbow, then our upper arm and then our wrist, the object will be totally "out of order" when parented. When I'm animating, if I want the arm to reach up, I'll adjust the upper arm first, then the elbow, then the wrist, and so on. If the objects were loaded in this haphazard way, I'll be constantly shuffling through the list looking for the right object. If they were loaded in order, all I have to do is pop up the list and slide down one (or up one) to the next joint. The null is sort of an insurance policy. It allows for gross repositioning, regardless of what keyframes have been set with the objects.

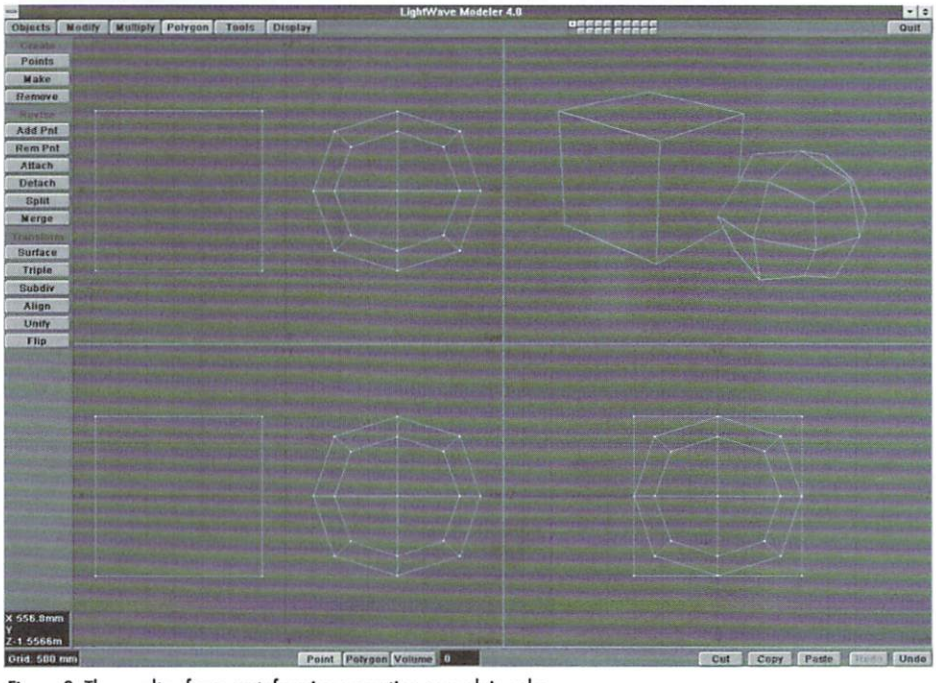

Figure 3: The results of one metaforming operation on a plain cube.

Build to Scale

Most of the time I try to build objects to scale, which makes it much easier to set up the scenes later. Not only do the objects load in ready to parent, but they also load in scale with previously built objects. With a car, for example, if you build the tires at 2.6 times the scale you built the body in, it's going to be difficult to get all these objects scaled and parented later.

There are several tools for keeping track of the size of objects in Modeler. First, the grid. The grid can be set to metric (default) or feet and inches—quite handy if you're using existing blueprints or plots. Another tool to remember is the old numeric button (n). If you're going to build a 10-foot globe, use the numeric button to make your ball exactly 10 feet. There's also the Measure tool (Display). This works like a virtual tape measure (oh no, I used the "v" word!). Just click and drag. The distance will read out in the coordinates box.

Round Those Corners

Another rendering pitfall is sharp corners. Take, for instance, a lamp base. The quick way of making the base is to pop down some points, make a polygon and lathe it. If you'll just pause for one moment and consider how it will be rendered, you'll get better results. Just go back and add a few more points to the sharp corners of the polygons and drag them into a rounded corner. It doesn't have to be a lot—maybe just a three-point curve—but the results are dramatic (or at least as dramatic as a lamp base gets). This process gets a little more complicated when it comes to extrusions and other solid objects. For a lot of objects, a simple bevel will do the trick; just use what amounts to a 45-degree angle (or equal shift and offset). This creates a very crude rounded shape, but can make a difference. The macro "shape text" (Amiga 3.5) or Polygons Edge Shaper (PC) is also very handy. It can round corners with little effort.

Hard or Smooth?

Here's a little tip: adjacent polygons that don't share points will not get smoothed. Some of you may have stumbled across this situation accidentally, when it wasn't to your liking. It can work to your advantage. A good example of this is a beveled font. Most of the time, adjusting the smoothing angle will solve the problem illustrated in Figure 1. If you don't want to mess with that or if you have a fairly complex font object, you can go for the sure-fire fix. Just go back to Modeler and select the polygons that make up the

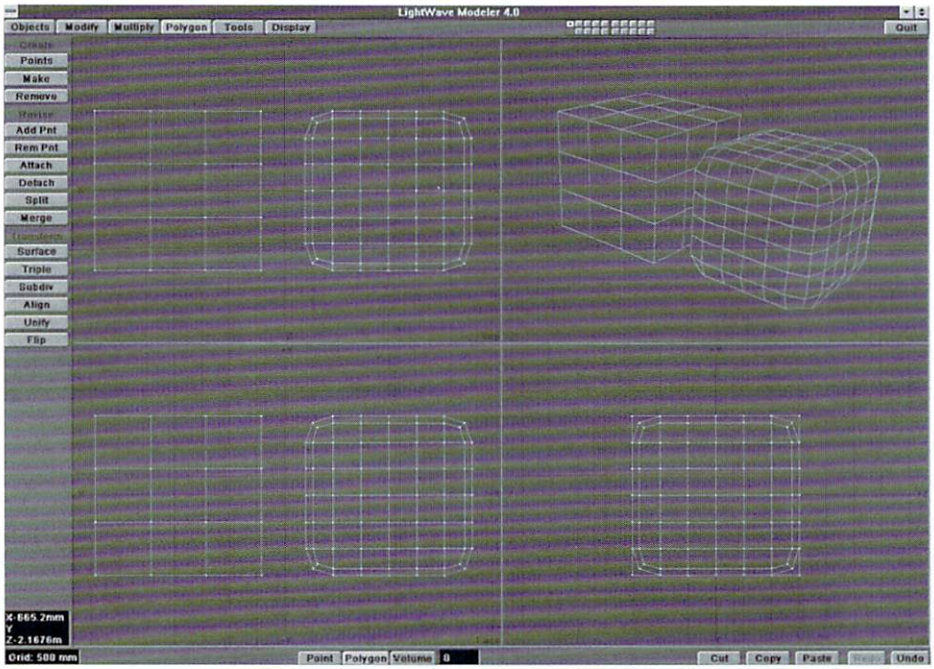

Figure 4: Multiple segments provide better, cleaner results.

bevel (you did save them as a separate surface, didn't you?). Now hit Cut and Paste. Looks the same, huh? Well, the difference is that the polygons of the bevel no longer share points with the front or sides. When rendered in Layout, the edges between the bevel and the front will be sharp, but the sides and the bevel will be smooth (Figure 2).

Non-Planar Polygons

Nothing will boggle your brain more than an unexplained rendering error. If this should happen to you, don't panic, but do check for non-planar polygons. Identifying these little boogers is easy:

- Go into Modeler (if you aren't already there).
- Load your object.
- Click on the Polygon select button.
- Hit the (w) key (Polygon statistics).
- Find the non-planar field (at the bottom).
- Click on the (+) next to the field.
- Stare in amazement!

All of the non-planar polygons should now be selected. If there are no selected polygons, your model is probably correct. Of course, this means something else is wrong, and you're back to square one. If you had a few polygons light up, then you've found the culprits. Now we must get rid of them. The simplest way to correct the problem is to triple the polygons. The logic here is that a triangle can simply never be anything but a plane. If you're feeling adventurous, you can go in and drag some points around. Or use the Set Val (Ctrl v) tool to flatten those suckers out, but this will probably give you more pain than pleasure. Usually about the time you get one polygon flattened, the one next to it gets whacked out of shape.

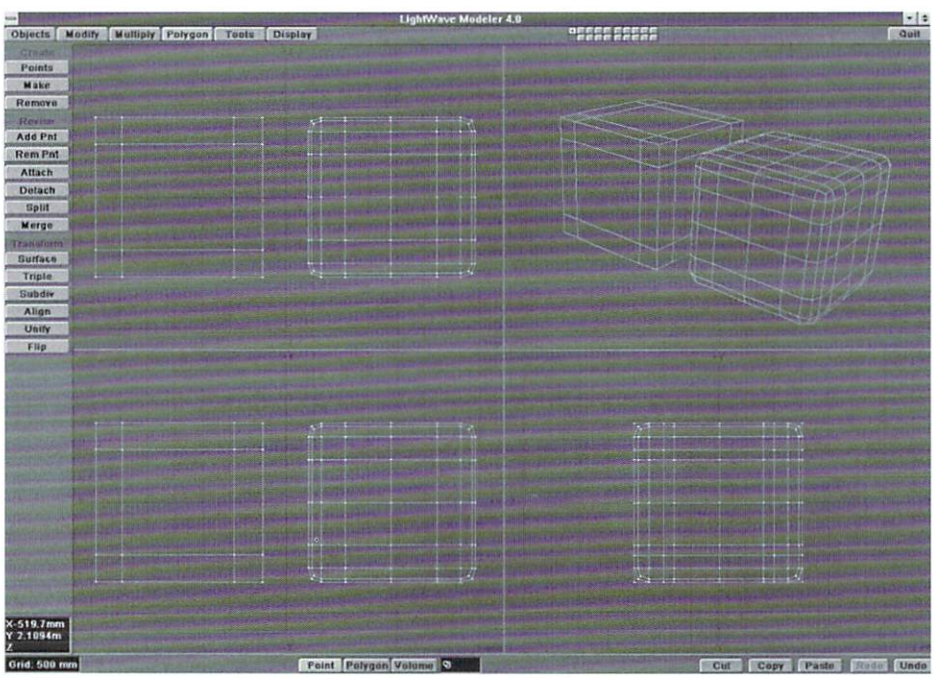

Figure 5: With a little preparation, the results are dramatic.

Metaforming

Ah, Metaforming—what a cool feature! This is a very handy tool for smoothing objects, but it can be a little unpredictable. The best way to get the results you want is to prepare your object and experiment. For example, look at the results of Metaforming the cube in Figure 3 (straight cube) compared to the subdivided one in Figure 4 (a cube created with three segments in all directions). The difference is clear. Now look at the cube in Figure 5 (same cube in second example with points moved to corners). With just a little preparation, the results are far better. Try changing your object in a few ways. You'll probably get different results every time. I try to think of Metaforming as sort of a rock tumbler for computers. Give it a blocky object and it'll give you a gem. One last thing: Try not to go too crazy with this tool, since you can rack up the polygons very quickly.

Detail vs. Image Mapping

A classic trap with object creation is determining what will be object data and what will be image-mapped. Again, this must be determined by how the object will be seen. Is it going to streak past the camera, or does it just sort of sit there, waiting for something to happen? If your object is barely going to be seen, an image map (or bump map) may be all you need. If you're going to dwell on the object, you're probably going to need that detail in true relief. Take, for example, my magic wonder sphere in Figure 6 (sphere with object detail) compared to wonder sphere lite in Figure 7 (sphere with bump-mapped detail). If they're just sitting there, the choice is obvious. But what about Figure 8 (sphere flying past camera, motion-blurred)? Can you tell which one I used? (If you must know, it's the bump-mapped one!)

The Edge

Here's a short tip: never use a flat plane to represent a flat object. Well, almost never. Every so often I see an animation of something "flat," or an object made up of flat surfaces, like a cereal box. The person who modeled it simply made a box and opened the top flap. He or she even made sure to flip the polygons and assign a separate surface for the inside of the box. Maybe the animator even subdivided the box and animated it with Bones (being sure to triple those poly-

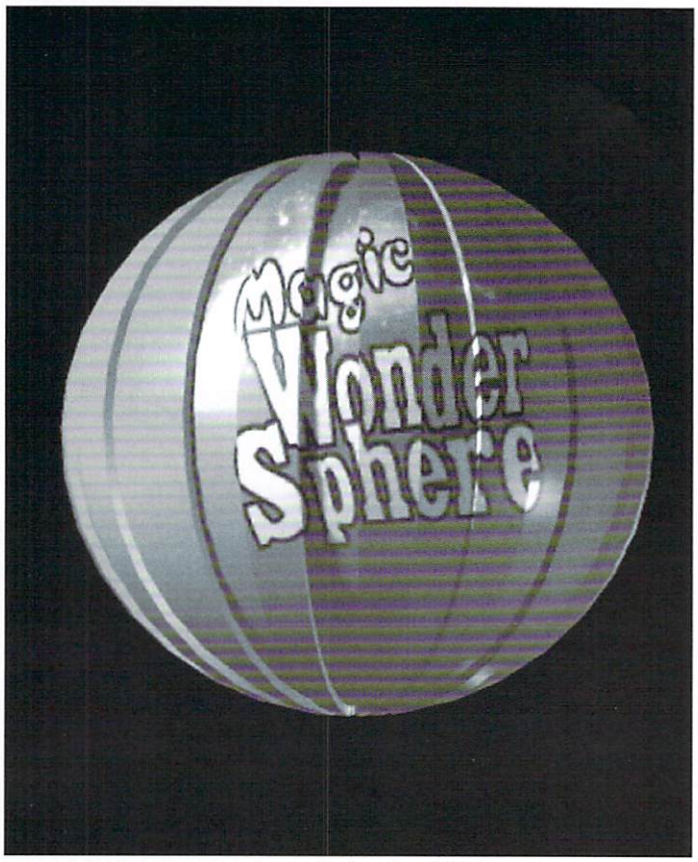

Figure 6: The Magic Wonder Sphere with object-based detail.

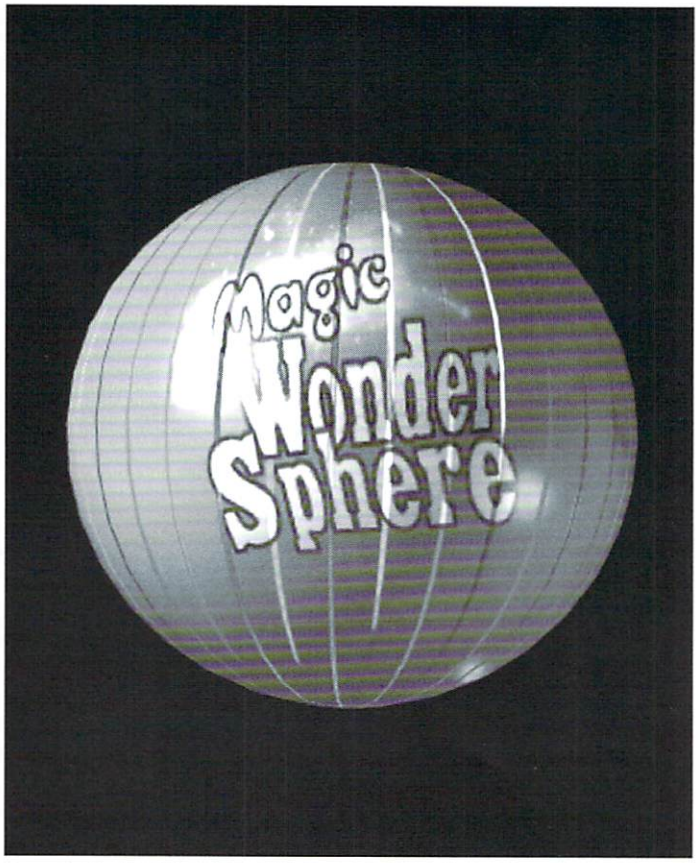

Figure 7: Wonder Sphere Lite with bump-mapped detail.

Figure 8: Which sphere is it?

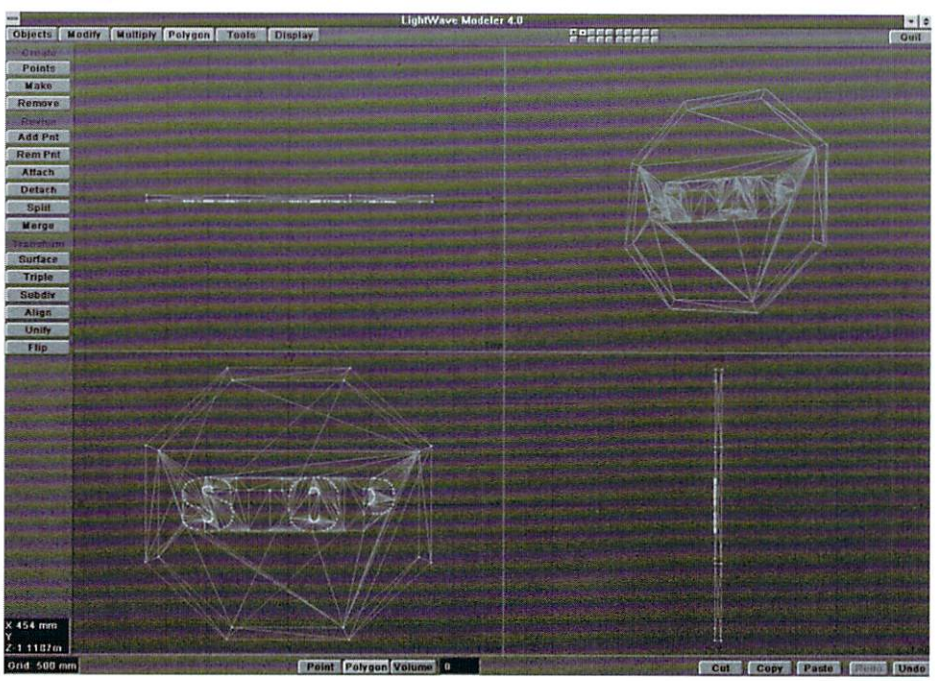

Figure 9: A triangled stop sign that's hard to look at.

gons). So what's my beef? That whirling box of Super Sugar Blamo Pops has no mass, no dimension. Take a good look at your cereal box tomorrow morning (you do start off with a balanced breakfast, don't you?). Even the thinnest cardboard has a noticeable edge, so why doesn't that object? Of course a piece of paper is pretty thin, and you can get away with a flat object. But very few other things are as thin as a piece of paper.

Cleanup

One of the last things you should do in Modeler is an overall cleanup. First, are there any one-or two-point polygons? You can check by clicking on Polygon select and hitting (w) (Polygon stats, again). The point count of all the polygons is given here. If there are any one- or two-point polygons, and you wanted them there, leave them alone. If not, hit the (+) button next to the appropriate field to select them, and then hit the (z) key (delete).

see 10 Tips, page 17

Reader Speak

by John Gross

Lately, I've received a few queries regarding the lack of NURBs in Modeler. "Why doesn't LightWave include NURBs support?" "When will it get NURBs?" These questions reminded me of a similar discussion on the Net some months ago, one to which Stuart Ferguson, LightWave Modeler's programmer, had the definitive answers. With Stuart's permission, we reprint his text here.

Re: What Are NURBs?

NURB (Non-Uniform Rational B-spline) is a cool acronym that everyone knows is a good thing, though few can tell you why. NURBs are a "checklist" item that every 3D graphics program has to have for marketing reasons. Users and NewTek marketing alike are constantly asking me about NURBs, but no one can tell me what they would do if they had them.

NURBs are a special type of B-spline developed for use in 3D graphics. A cubic spline is a piecewise-cubic parametric curve used to approximate a shape that may have an otherwise more complex parametric form. There are a wide variety of cubic splines used in graphics applications, each with different properties and uses. The most common by far is the Bezier spline. These splines are used in 2D drawing applications and are usually controlled by a set of points along the curve, with "handles" at each point that control the shape of the curve at that point. The handles control the slope of the curve through the point and how flat or round the curve is there. In normal cases, the interface will constrain the slope and roundness to be the same on both sides of the control point (C1 continuity). In some cases, however, the symmetry can be broken so the slope is the same but the roundness is different (G1 continuity), or both the slope and roundness are different (C0 continuity).

LightWave uses a special form of cubic spline to interpolate keyframes while animating. The positions to interpolate are the keyframe locations, and the curvature information is computed using the tension, continuity and bias values at each key. These are equivalent to the handles on a Bezier spline. If continuity is zero, the curve is C1; if continuity is non-zero, the curve is C0. Note that G1, so-called geometric continuity, is only useful for making curves to fit shapes, not for animation. LightWave's splines are non-uniform—the number of frames between each key can vary.

Modeler's splines use a formula for the curvature at each knot that makes them smoothly interpolate all of their points. The reason for this is interface simplicity, so that moving points control the shape of the curve exactly. They are always C1.

The nice thing about all these types of splines is that they interpolate their control points. The curve actually touches each knot or key that the user sets down. The bad thing about these curves is that they are only C1. This means that while the tangent to the curve is continuous across the knot, the tangent's rate of change is not. You can see this sometimes when animating as a sudden change in acceleration as an object passes a keyframe.

B-splines are the next class of cubic spline that address this issue. B-splines are C2, which means that the tangent and the tangent's rate of change are continuous across control points, making this type of curve very smooth both when animating and when creating 2D shapes. The cost is that B-splines do not interpolate their control points. The points laid down by the user become more of a rough guide for the shape of the curve, which winds it way smoothly between the points but rarely touches any of them. There are no handles—the shape of the spline is given entirely by the control points.

There is one more step to get to NURBs. NURBs are a type of B-spline and have all the properties that generic B-splines have: C2, no handles, no passing through control points. They are also non-uniform, which is useful for setting keyframes at arbitrary points in time but isn't really a useful property when modeling. NURBs have two additional properties that distinguish them from generic B-splines. Before I get to those, I'll talk for a second about homogeneous coordinates.

People who work in 3D graphics really like matrices. They like the fact that any move in 3D space can be defined by a matrix that can be multiplied by a vector to get the vector after the move. To add a new move, you just compose the matrices, and the composite move can then be applied en masse to a set of points. Things are also easy to solve using matrices since it is all linear algebra. The thing they don't like is the perspective transform, which actually uses a division (gasp!), taking it out of the realm of things that can be done with matrices and linear equations (egad!). So the academics in the field invented homogeneous coordinates.

A position in 3D space can normally be given by a vector of three values (X, Y, Z). In homogeneous coordinates a position is given by a vector of four values (X, Y, Z, W) whose three-space position is given by (X/W, Y/W, Z/W). Note that this contains a division, so the homogeneous coordinate transform (a 4x4 matrix) can encode the perspective transformation in three-space. Oh, happy day, we're back to linear algebra to do the whole 3D-to-2D transformation, including rotation, scaling, translation and perspective transform.

So NURBs are non-uniform B-splines in homogeneous coordinates. The "Rational" part refers to the division you do to get from homogeneous coordinates to ordinary three-space coordinates. The first result of this is that you can put the control points of a NURB through a perspective transform and get a new NURB, which is just what the original curve would look like from that same perspective. This is no surprise, however, since to compute each point along the NURB you have to perform two divisions—just what you would have to do if you computed the curve in three-dimensional space and applied the perspective transform yourself. This property is therefore of no value to the end user and is of only theoretic interest.

The other property is more interesting to end users. Because of the additional division used to compute each point along the curve, it is possible to make NURBs that exactly fit circles and ellipses. This makes NURBs of great interest for CAD/CAM and mechanical simulation applications. For animators, however, the circles that can be made with generic B-splines, or even ordinary C1 splines, can be made so close to actual circles that no one could ever tell the difference.

In my opinion, NURBs are only interesting to the typical animator as a buzzword. If you are truly more interested in the art than the technology, forget NURBs. They solve nothing for you. B-splines, on the other hand are extremely interesting because of the very nice smoothness that stems from their being C2 continuous. It's very probable you'll see B-splines in Modeler soon. NURBs, probably never.

—Stuart Ferguson

LWP

Editor's Message

continued from page 3

This issue of *LIGHTWAVEPRO* marks the return of "LightWave 101." Instead of having a regular writer for this column, we will have various "guest authors."

Finally, for those interested, my "PC situation" is now in the hands of my attorney. The last time I talked to my PC vendor, I was told that even if they replaced the motherboard again, they couldn't guarantee that it would work with NT. I've had enough of trying to settle this myself and thought I would call in the big guns. Hopefully, by this time next month, I'll have a new PC (or at least one that works)!

"If you are using NT, you can download a beta version of the new 95 style interface for NT from AOL."

One last thing before I wrap up: You may be interested to hear that *Star Trek: Voyager*'s pilot episode, "Caretaker," recently won an Emmy award. As part of the effects team for *Voyager*, Amblin Imaging (and in a sense, LightWave) also received an Emmy. As the heads of the digital effects team for the show, Grant Boucher and I would like to thank all the folks (you know who you are!) who helped get *Voyager* off the ground (plane)!

The Emmy award-winning artist formerly known as John Gross, Editor

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Model Shop

Welcome to the first installment of "Model Shop," the new *LIGHTWAVEPRO* column dedicated to the use of LightWave's Modeler. Many of you have read my tutorials in *VTU*. My approach to Modeler here in *LWPRO* is to respond to as much input submitted by you, the reader, as possible. Hopefully, you will steer this column in a direction that'll meet your modeling needs. My strongest commitment is to giving you the information you require. It doesn't matter if you have just bought the program or have spent many a day in front of LightWave—you'll learn to create quality models for everyday use. Now, let's get started.

Six Steps to Success

I have found that anything you do for an extended period of time forms habits or steps. There are six steps that I use when I sit down to model an object.

The first step is Geometric Construction. Simply put, geometric construction is the process of breaking objects down into their simplest forms and shapes. A soda can's simplest shape, for example, is a cylinder; a TV's basic form is a rectangle or cube. Many objects may seem too complicated to construct, but if you break them down into their simplest shape(s), you will find that complex objects are just as easy to build as the two listed above.

The second step is Measurement. Measurement, I find, is the most overlooked part of modeling. It relates directly to Scale. Scale has to do with how your 3D environment is constructed or laid out: How do objects relate to themselves and their surroundings? In a nutshell, I'm talking about size. How do you measure objects? If all you have is a ruler and a compass, you're set. Simply use the ruler to take large or overall measurements, then use the compass as a set of dividers for smaller measurements.

The third step is Pre-Planning. Once you have considered the basic shapes of your objects, you need to determine how they will be constructed. The easiest way is to make a simple sketch using the measurements from the previous step. Make sure to include the overall length, width and depth of your object on your sketch first. Next, you may need to make additional detail sketches showing centers for holes or offsets for bevels. Keep in mind that you don't have to be a draftsman or artist to make a sketch. It's only a rough plan.

The fourth step is Tools and Techniques, which will be used during construction. Now that you have a plan to follow, what tools will you call on to build your object? Are there special techniques you can apply to lower polygon counts? Will you use quadrangles or triangles, single- or double-sided polygons, Primitive or free-Form shapes to construct the parts of the object in question? Do you need other software/hardware to assist you? Wow, so many questions to answer! These are just a few. The more you model, the easier the answers will become. It is important to remember that the fourth step is one that will constantly challenge your knowledge of Modeler.

The fifth step is Construction. During construction it is very important to use tools and techniques at their maximum efficiency. Poorly built objects will slow down rendering and will not meet your expectations.

Finally, there's Function. Function refers to surfaces and object local origin (where the center of rotation will be). How and will the object(s) fit or interact with other parts of the object in question? Notice that the latter should not be a problem if you have followed the first five steps.

Again, here are the six steps for your review:

Geometric Construction	Measurement
Pre-Planning	Tools and Techniques
Construction	Function

Take a serious look at this list. Not only are these steps a way to model objects, but they provide a framework by which to work quickly and easily. Next time we will be applying some of these methods as we start the journey toward objects that look and perform in the real world. Until then, send questions or ideas to Synthetic Design Images, Attn: Kyle A. Thatch, 4328 Annshire Ave., Louisville, KY 40213, Phone: (502) 459-8829; or to *LIGHTWAVEPRO*, Attn: Kyle A. Thatch, 273 N. Mathilda Ave. Sunnyvale, CA 94086. Send e-mail to avid@cup.portal.com. LWP

10 Tips for Cleaner Objects

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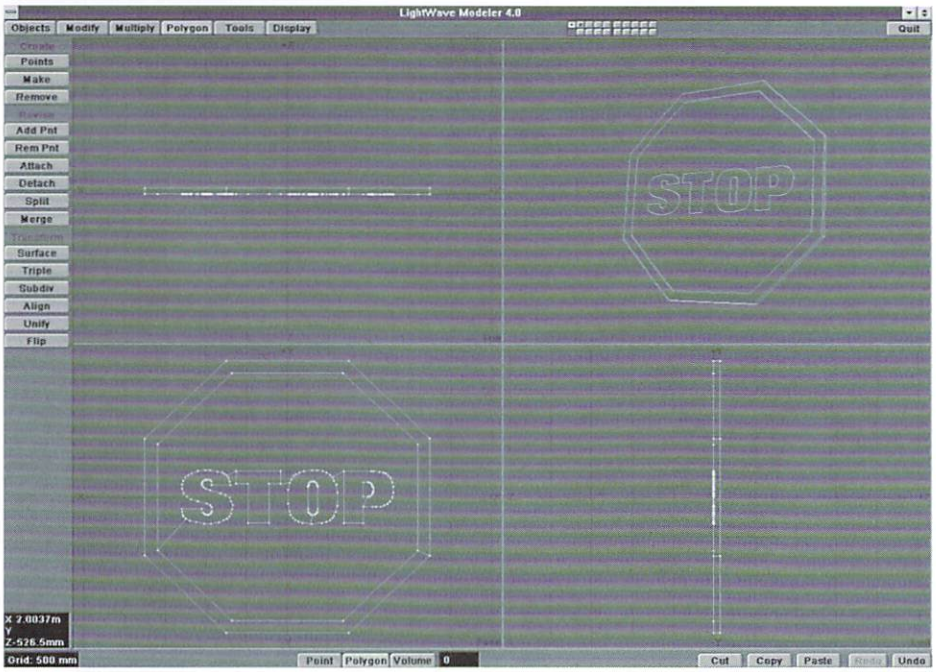

Figure 10: A cleaned-up stop sign is much better!

Next, check for any sneaky non-planar polygons that may have cropped up, and fix them (see above). Are there any groups of connected polygons on the same plane (for instance, the stop sign in Figure 9)? If there are, you can join them by selecting all of them and pressing Merge (Polygon menu) or (Shift + z). A cleaner object is easier to see and work with. Note the difference in the cleaned stop sign in Figure 10.

Now check your surfaces using the stats. All of your surfaces, and the number of polygons assigned to those surfaces, are in the pop-up list at the bottom of the Polygon Stats requester. To check the polygons, just select a surface and hit the (+) button. All the polygons having that surface are now selected.

Another annoying and invisible pain is duplicate points. A simple Merge Points operation (Tools menu) will fix this, and it's a good practice anyway. Note: If you used the sharp edge trick described earlier, you do *not* want to merge those points. Just cut them to an empty layer to keep them separate.

Duplicate and double-sided polygons are also not readily visible. Use Unify (Polygon menu) after merging points to fix these (unless you wanted some double-sided polygons, of course). If you are experiencing the problem of alternating flipped polygons (common in cross-program object exchange), use the Align button. This function should flip the renegade polygons so they face the same way as all the others, though sometimes they all end up the wrong way. If they do, just hit the (f) key (Flip polygon). Lastly, double-check the orientation, position and scale of your object, remembering that the world center (black crosshairs) will be your pivot point.

Well, that's 10. Of course, there are hundreds of little tricks that you will learn with experience. I've only begun to scratch the surface. Just keep some of these tips in mind next time you're staring bleary-eyed at that screen. You'll be building better objects in no time. Remember, a little preparation goes a long way, and will save you tons of time later. One last hint: try a little spray lacquer on your Super Sugar Blamo Pops. They'll stay crispier in milk longer!

LWP

Tom Williamson is an animator at Computer Cafe, in Santa Maria, Calif. He spends way too much time using computers and is wondering why these bios are written in third-person when everyone knows we write them ourselves.

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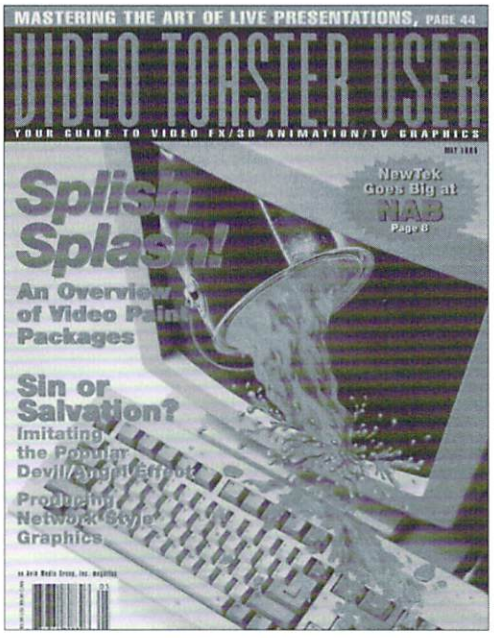

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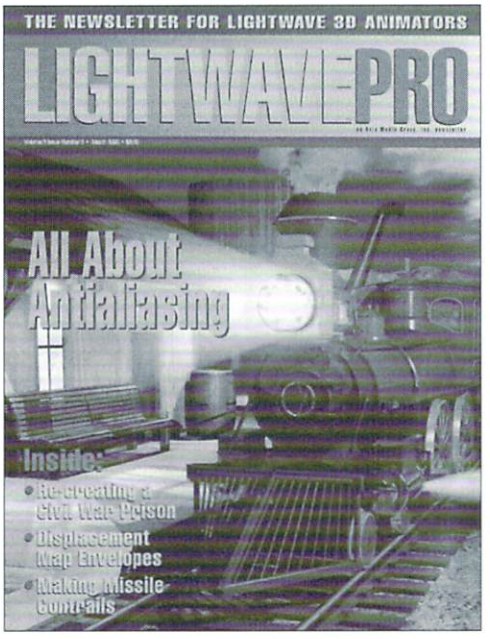

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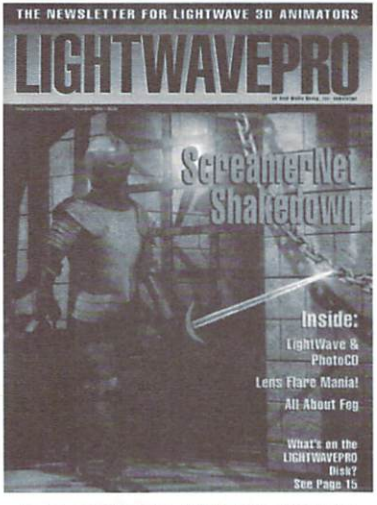

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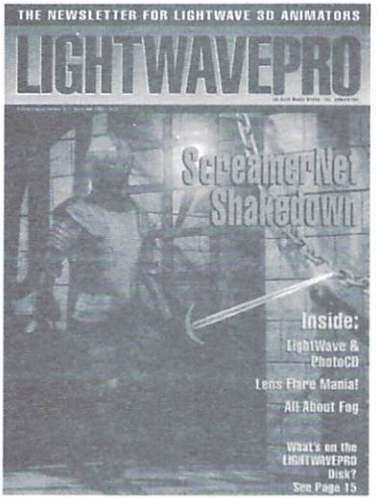

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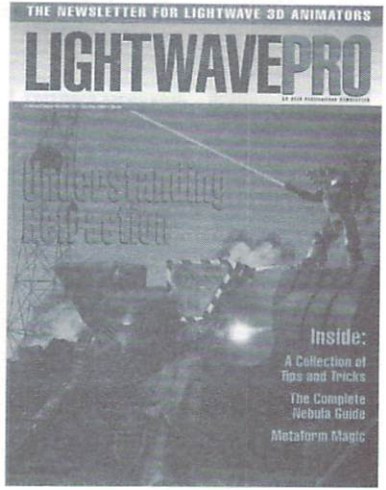

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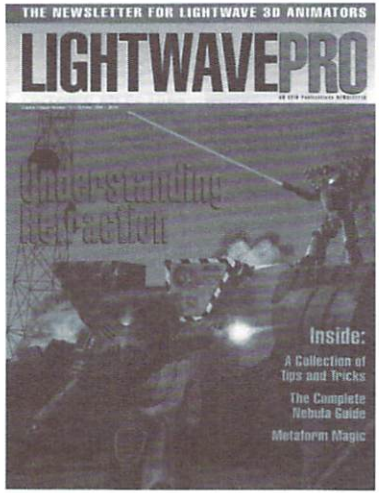

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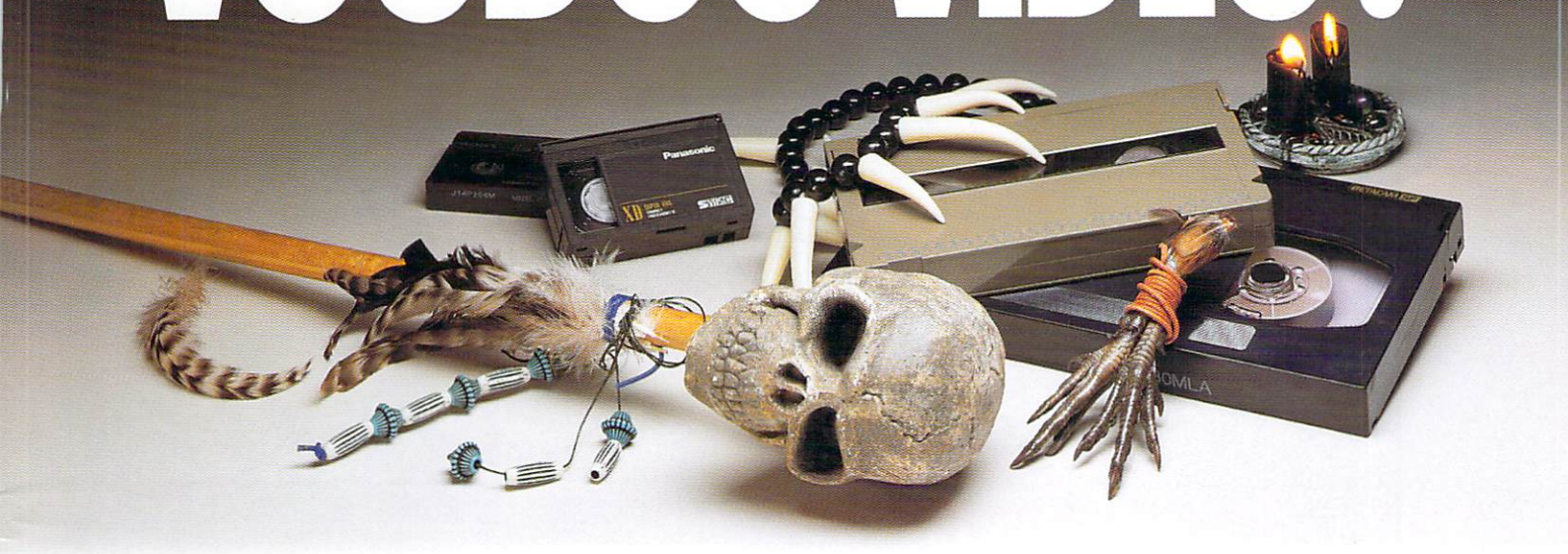

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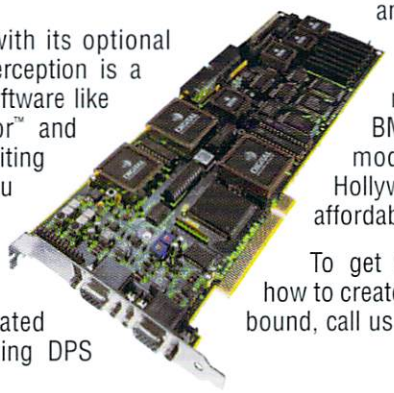

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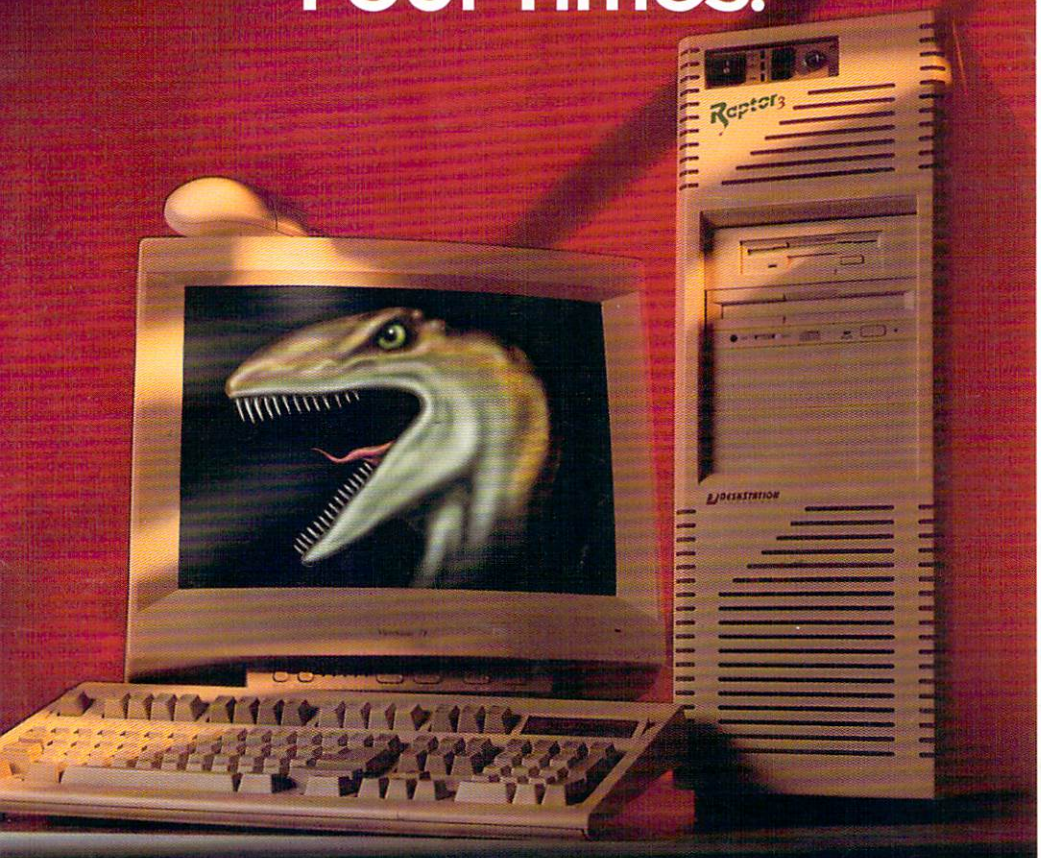

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