Understanding Maps

Author: JonnyRay

Support Files

* Map_Template.zip

Introduction

This tutorial is intended to provide a description of three types of map files (bump, displacement and transparency) that are typically used to modify surfaces on your 3D objects. It describes each of the types and uses a simple scene created in DAZ Studio to illustrate the effects. The support file for this tutorial has the grayscale JPEG file which was used for all three of the map types.

Step 1 - Map Files and Settings

All three maps are created using 256 level grayscale images. Colors are ignored in these maps, it's the value (gray scale) not the hue (color) that makes a difference

Poser and DAZ Studio treat bump and displacement maps differently. In DAZ Studio, medium gray (128, 128, 128) is considered neutral. Darker shades simulate negative changes, lighter shades represent positive changes. However in Poser, black (0, 0, 0) is considered neutral and all changes to the surface of the object are in the positive direction only.

This difference is important to note when trying to re-create settings in DAZ Studio which mimic settings in Poser. Also when adapting material settings which are designed for Poser, the negative displacement setting in DAZ Studio should be set to 0 (zero).

Both programs treat transparency maps in the same way. For these maps, pure white is completely opaque and pure black is completely transparent with other gray scale levels providing varying levels of transparency.

The basic scene without any maps assigned to the sphere is shown above. I'm using a plain sphere colored a dark cyan (64, 128, 128) with three walls each colored a dark shade of a primary color. There are three lights - a key light above and to the right of the camera, a fill light below and to the left and a rim light behind the sphere at a very high angle.
Step 2 - Bumping and Displacing

To understand what bump and displacement maps do, a bit of physics may be necessary. When light strikes a reflective object, the light bounces away from the object at the same angle that it struck it. So if you shoot a light at a flat surface at a 45 degree angle, the light reflecting from that surface will also be at a 45 degree angle.

(We'll talk in another tutorial about the difference between diffuse, glossy and specular reflections, for now hang with me on this.)

When a bump map is applied to a surface, it tricks the rendering engine into thinking that the surface at that point is tilted. Darker settings indicate the surface angles down, lighter settings make it appear to angle up. It's important to note that the surface isn't actually changed, the bump map just fools the rendering engine into thinking it has been.

On the other hand, a displacement map does change the surface. It physically alters the geometry of the surface during rendering by raising vertices on the surface and creating a slightly different mesh.

The picture below illustrates what happens when light strikes a surface with or without one of these maps applied to it.

Step 3 - Bump Maps

Bump maps change the way that light interacts with the surface of an object. A bump map simulates bumps in the surface by creating highlights and shadows. However a bump map doesn't actually change the surface of the object, it just simulates the effect. Applying the texture as a Bump Map (by placing it in the Bump Strength channel on the sphere creates the effect shown below.

For comparison sake, I also created two series of pictures showing just the right half of the sphere.

The first series shows the same bump map applied at 50%, 100%, 150% and 200% strength (keeping the negative and positive settings at the default of -0.1 and 0.1 centimeters).

The second series keeps the bump map at 100%, but set the bump values at 0.1, 0.2, 0.5, and 1.0 centimeters.

Step 4 - Displacement Maps

Similar to bump maps, displacement maps change how light effects the surface of an object, however, displacement maps actually move (or displace) the surface of the object. The effect is
usually stronger than a bump map with the same settings and has the added effect of changing the silhouette of the object (note the changes in the edges of the sphere and the shadow in the example image.

Displacement maps have the added value of being able to cast shadows. A bump map lightens and darkens a surface by changing the angle, but a displacement map moves it in such a way that it casts a shadow across itself and other objects in the scene.

The scene below illustrates the same texture applied as a displacement map using the default 100% +/-0.1 cm settings.

Like with the bump map, I created a two series of images. The first showing the effects of keeping the displacement values the same and adjusting the strength of the map.

The second series shows the effect of keeping the strength consistent (100%) and varying the positive and negative limits.

**Step 5 - Choosing a Surface**

So if the displacement has advantages like realistic shadows, why would you use bump maps?

There are a couple of reasons you might choose to bump a surface instead of displace it. First is that your render engine might not support displacements. Using a displacement map requires that the rendering engine is able to change the geometry of a surface during the rendering process. Poser only added support for displacement maps in version 5. Bryce still isn't able to support displacement maps for this reason.

The second reason is that displacement is a bit harder on the processing time than bumping. Since the engine has to create new geometry as it processes your scene, displacement maps can create performance issues (albeit minor ones for most systems). However even a minor performance hit is significant in some areas (like games) so many systems prefer bump mapping over displacements.

Sometimes, both maps (using different images) may be the best way to go. For instance if I were modeling a basketball I might use a bump map to simulate the pebbly texture of the leather, but use displacement to create the indentions for the lines and logos.

Below I've included a side-by-side comparison of a close-up of the sphere. The one on the left uses bump mapping, the one on the right uses displacements. Both apply the map at 100% strength with -1.0 and +1.0 as their limit values.
Step 6 - Transparency Maps

Transparency maps allow you to hide parts of the surface of an object. Using a transparency map can allow you to completely change the outline of an object without having to change the geometry of the object itself. In the sample image below, you can see that by applying a transparency map to the sphere, we've changed the solid sphere into a ball of lace. Note that in some areas the surface is completely missing while other areas are merely translucent. You can also see the result of this in the shadows on the walls and floor where the light has shone through.

Step 7 - Summary

Applying these types of texturing maps to your models can allow you to easily create an entirely new look for an object without having to resort to modeling a new object yourself. A simple object (like a basic t-shirt or dress) can be transformed into many different looks using these techniques. This extends the usefulness of the original item and allows you, the artist, to create exactly the look and feel you want to have for the objects in your scenes.