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3D Texture Mapping Mapping Script

Basic Structure of Presentation:

- Introduction to 3D Texture Mapping
- Different 3D Texture Mapping Techniques
  - Bump Mapping
  - Normal Mapping
  - Displacement Mapping
  - Relief Mapping
- Applications, Advances, and In-Depth Properties

Keywords:

- Nicola ➪ Ni
- Richard ➪ R
- Natalie ➪ Na
- Xiaoxi ➪ X

Start of Presentation

Slide 1

Ni: Hello, everyone. My name is Nicola…
Na: I’m Natalie.
X: I’m Xiaoxi.
R: And I’m Richard.
Ni: We are the Texture Meowpers, and we are your final group of presenters.
Na: Today, we’ll be taking a look at 3D Texture Mapping.
R: No need to worry if you have no clue what that is, as we’ll introduce the basics for each subject.
X: Also, we’ll be presenting a number of visuals and live demos to show everyone how it works.

Introduction to 3D Texture Mapping

Slide 2

Ni: So what is 3D texture mapping anyway? 3D texture mapping refers to a number of different techniques used in 3D computer modeling to give flat 2D surfaces the illusion of depth. But why is it that we need to create this illusion of depth? 3D models are already, as their name suggests, three dimensional, so why do we need to bother trying to make flat things look like they have depth? Also, how exactly can a simple texture give the illusion of depth, and how good can it really make something look? We will be answering these questions and more in our introduction to the principles of 3D texture mapping.

Slide 3

Na: The reason 3D texture mapping was created has to do with the processing power of computers, and wanting to add even more little details to 3D models. 3D models are primarily created using polygons that are stitched together to form a three dimensional object. It can take a lot of processing power for a computer to show what exactly a complex 3D model's polygons looks like, a process known as rendering. This means that, if a model is made up of a lot of polygons, it can take huge amounts of time for a computer to render an image of it. Thus, we use techniques such as 3D texture mapping to put less of a strain on our machines, and get the images we want more quickly.

Slide 4

X: Even though they simply alter two dimensional images, 3D texture mappings can do an amazing job of looking like they have depth. This is all thanks to the visual properties of lights and shadows. The human eye can often tell that an object has depth by how light falls on it. This is because of what we call "surface normals," which are representations of which direction a surface is facing. As shown in the image, if part of a surface is facing a light source, it will be brighter, but if it is facing away from a light source, it will be darker. This basic property allows 3D texture mappings to make things look like they have depth just by changing how bright or dark parts of a surface are, thus changing how light appears to hit them.

Demo

Bump Mapping

Slide 5

Ni: And now for the first and most common type of 3D texture mapping, bump mapping. Typically, bump mapping is applied to a 3D model by using a grayscale image known as a bump map, as you can see on this slide. As we mentioned before, parts of an object that recede tend to be darker, while parts that stick out are brighter. These bump maps can thus represent how deep or raised parts of the object are using this method, with the light parts of the bump map representing an area which should look like it's sticking out, and darker parts representing an area that should look like it's going inwards. When the bump map is properly applied to the object, this allows it to create the illusion of depth without physically changing the object at all.

<u>Slide 6</u>
Na: Here we can see what that brick wall looks like with and without bump mapping, allowing you to get a better sense of how the light and dark areas on bump maps can alter what an object looks like. Now, an important thing to note about bump maps is that they are limited to 8-bits of color information per pixel. Thus, only 256 variations of black, gray or white can be calculated to determine how raised or lowered a pixel should be. This limits detail to an extent, and makes it difficult for bump maps to make it look like things are sticking out in different directions, other than just straight up or down from the surface. Additionally, with few exceptions, the silhouette of the geometry that the bump map is applied to will be unaffected by it.

Normal Mapping

<u>Slide 7</u>
R: Normal Mapping is another technique which alters a 3D model's surface to appear to have more detail. When artists are creating normal maps, they will have two versions of a 3D model, one with a lot of polygons (high poly) and one with much less (low poly). The high poly model has the detail that we want to add to the low poly model by using a normal map. Normal maps are commonly stored as regular RGB images where each color represents the direction the surface normals were pointing on the high poly 3D model. This means that, unlike bump maps which can only stick in or out, every point on a normal map can appear to be changed on the X, Y, and Z axes with the information for each being stored in the red, green, and blue values.

<u>Slide 8</u>

Ni: In this slide you can see some examples of how an 3D model would look with an applied normal map. The tire's normal map is seen in the bottom right of the image, which is applied to the model in the top left. Once the normal map and other texture maps are applied to the tire, it appears to have the detail that the high poly 3D model had. Similarly, the low poly rocks in the center are given detail by applying the normal map to create the render on the right. This one (point to right) is not a high poly model, it simply has a normal map applied. Thus, normal mapping is like a more detailed and advanced version of bump mapping which still does not require much processing power.

Displacement Mapping

Slide 9

Na: Displacement mapping is an interesting alternative to some of the other mapping techniques which can be used on its own or in combination with the others. Unlike the other techniques, which only altered the surface normals, this one actually changes the surface of a 3D model when it is time to render. This makes displacement mapping useful for when the details of a 3D model have to visibly protrude from the surface. As seen in this slide, without the displacement map, the plane does not look like it has any depth. Simply adding this map will give the plane the indents and protrusions necessary to give the illusion of depth.

Slide 10-11

X: By combining the previous techniques, you can add small details to the displaced 3D model, and even change its silhouette. When it comes time to render, the model's surfaces will change according to the displacement map and the applied bump mapping and/or normal mapping can then add even more detail and realism without adding polygons to the model. This makes displacement mapping look quite good, but it comes at the cost of greater render time than other 3D texture mapping techniques, since the altered surfaces take time to create and render.

Relief Mapping

Slide 12

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Code Examples

Applications, Advances, and In-Depth Properties