World in motion

It's a funny old world — or at least, it looks very different in 3D than the picture-book 2D views we're familiar with. Benjamin Woolley sets his sights on a more accurate projection.

The picture we have of the world is one that is fundamentally distorted because it is a two-dimensional version of a three-dimensional surface. If you look, for example, at the standard map of the world, the so-called "Mercator Projection", China appears to be roughly the same size as Greenland when in fact it is four times larger. This distortion occurs because the land nearer the poles is stretched out to the width of the equator (to form the rectangular shape of the map), so countries on the equator appear narrower than they should when compared to those closer to the poles. You can see how this happens in Figs 1 & 2. Fig 1 shows a map of the world. Note how huge Greenland is compared to China. Fig 2 shows the same map wrapped round a sphere, with Greenland now assuming its proper proportions. (I created the globe using Fractal Design's new Detailer package, of which more later.)

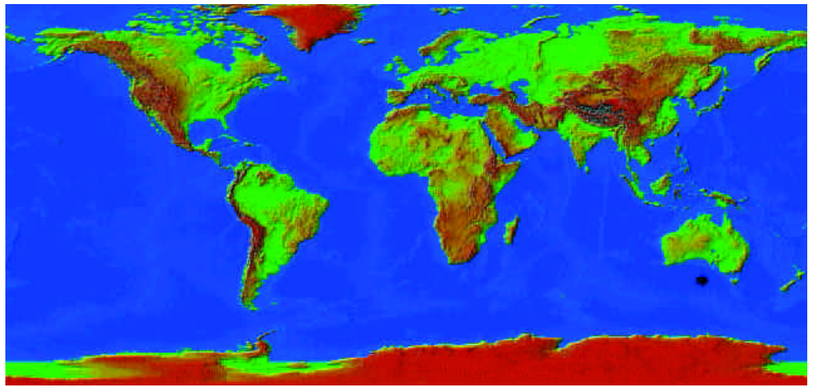

Fig 1 A texture map of the world. Note Greenland's size relative to China

There have been various attempts to produce more accurate projections (one of the best is said to be the Peters Projection, which makes Africa and other equatorial landmasses look huge, and more polar places, like our sceptred isle, teeny — you can have a look for yourself by browsing www.webcom.com/~bright/table.html), but none of them can be perfect. In the transition from 3D to 2D, something has to go, and in this case it is the true size and shape of each country.

As I have discovered from my email inbox, such problems are not confined to geography. A number of people have described the problems they have encountered trying get their texture maps to work, so I thought this month I would concentrate on this most perplexing area of 3D artistry, and at one tool that claims to make it easier.

Generally speaking, when you are trying to create a 3D scene, the sort of project you are dealing with is the reverse of Mercator's: you are trying to turn a 2D image into a 3D one, to take your flat map and wrap it round a sphere or, more usually, an irregular, complex shape. If you take another look at Fig 2, you can see quite clearly one of the first problems you encounter when trying to do this. Greenland's shoreline is slightly fuzzy, and there are two reasons for this. The first has to do with the size of the map: it has fewer pixels in it than there are on the surface of the object as seen from this perspective and at this size. You encounter this problem regularly, most obviously when the 2D bitmap, the texture, is placed on a wall or floor receding into the distance. As you can see in Fig 3, the bitmap is blurry at the point where the wall comes closest to the point of view. The solution to this problem is to match the texture's resolution to the wall's at the point closest to the camera. This means actually working out how many pixels there are down the edge of the wall, and making the appropriate edge of the bitmap the same number of pixels in size (in this case the bitmap is tiled, so I can divide the number of pixels in the rendered scene by the number of repetitions of the texture across the height of the wall).

The second reason for Greenland's blurriness is that where the map is approaching the poles, it is getting progressively scrunched up. There is no way of completely overcoming this problem unless you somehow manage to create a bitmap with progressively lower resolution towards the top and the bottom of the image. As far as I know, no image file format supports such variable resolution.

How, then, can you keep such distractions — "artefacts", as they are called in the business — to a minimum? By getting a grip on the way your 3D package projects or "maps" the texture onto the object. In all 3D packages there are basically three ways of mapping, usually known as spherical, planar and cylindrical. Spherical mapping is the sort demonstrated with the map of the world. Planar projects the texture onto the object as a film image is projected onto a screen. Cylindrical winds the image around an object like a label round a tin of beans. You can generally use these methods to texture simple objects: a vase, for example, can be textured using cylindrical mapping, especially if you use a paint program to stretch and contract the image to correspond with the vase's curves. However, some objects are just too complex to be textured using projected mapping, which means having to resort to a fourth method, surface mapping. A surface map is generated when the object is actually constructed, and if you think of the object as having a skin, the shape of the map is the shape of that skin carefully peeled off and laid flat.

If you are having problems getting a surface map to work, a weirdly distributed surface map could well be the cause. One way of solving it is to create a texture covered with a grid, using a gradation of colours so you can distinguish the position of the lines. Apply this grid as a surface-mapped texture to the object and see if that throws any light on how the map is arranged. Another easier solution is, of course, being able to paint and stick textures directly onto the surface of objects without bothering about technicalities like mapping co-ordinates. Which brings me on to Fractal Design's Detailer.

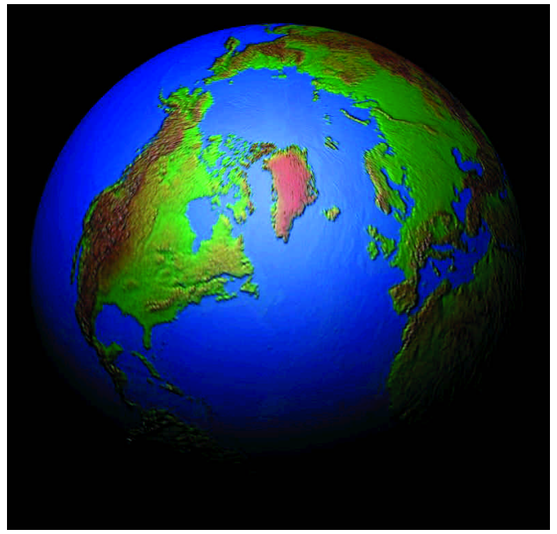

Fig 2 The texture map in Fig 1 wrapped round a sphere. Greenland assumes its proper proportions

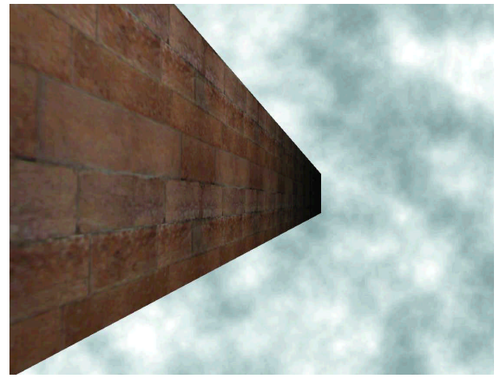

Fig 3 The purpose of this rather surreal image is to show a texture map being stretched beyond its resolution. Note the blurring where the wall is closest to our point of view

Detailer

When I first read the blurb about Detailer, I could barely believe it. "Amazing 3D Paint Program" proclaimed the press release. "A stunning new graphics application that allows users to paint on the surface of 3D models in real time." This could be the answer to all my prayers, I thought; 3D painting on the PC platform.

After spending a few weeks with Detailer, I have to say that it only partially lives up to its promise. It *can* work in real time, but most PCs will be stretched to the limit to keep up. And the design is fussy, introducing a whole new set of terms and concepts to a field already overburdened with both. However, I should point out that even if it is not quite 3D painting in the full-blown sense, it does offer one crucial new capability: it brings 2D and 3D together.

Generally, when I am working with textures, I have a paint package like Photoshop and a 3D package open on the system simultaneously. I edit the image, save it, load it into the 3D package's texture editor, apply it and then render the object to see what has happened. When, as is inevitably the case, I find the texture is too big, too small, too bright, too dark, too whatever, I have to start again. With Detailer, these two functions are combined. You have one window showing the 3D model being textured, another showing the 2D texture. When you change the texture, you see the result immediately in the model window. And there is another facility that helps deal with the surface mapping problem: being able to overlay a "mesh" that shows in 2D the surface ("implicit" in Detailer parlance) map of the object being worked upon — the skin, if you will. You can then paint over the mesh, building up a texture that maps directly onto the surface of the object.

Fractal Design is an interesting and increasingly influential company in the graphics field. Painter 4, Ray Dream Designer, Poseur, and now Expression (my favourite: a program that allows you to use drawing tools to paint) make up a more than adequate toolkit for the budding computer graphics artist. Detailer will be a perfect complement to this developing suite once certain shortcomings are dealt with: when there is some sort of mechanism for importing surface/implicit mappings or, even better, deriving them from the geometry; when the interface and jargon is simplified; when you can export the flattened-out meshes of objects with implicit mapping so you can use more sophisticated 2D packages to paint over them. I hope this is not unreasonable. I only suggest it because Detailer so tantalisingly holds out the prospect of making texturing a simple, even intuitive process.

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