Texture and Reflection in Computer Generated Images

In 1974 Catmull developed a new algorithm that, instead of approximate the surfaces of the objects with planar polygons, works with the definition of surface patches, subdividing recursively until each patch correspond with a picture element. At that point, the algorithm calculates the intensity and visibility of each patch. For that, we need a Z-buffer or depth buffer to compare if the new point is farther than the current element of the buffer or if it is closer the element is updated.

Texture Mapping

The coordinates of the square is used as a curvilinear coordinate system for the patch and the parameter values is used as input to pattern definition function. The value of this function define the intensity of the element, that why this function have to be defined suitably. Sampling the texture pattern at the centre of the picture element is not enough; 2 adjacent picture elements can correspond to two widely points in the space and texture pattern. Intermediate regions should be skipped, what is known as “aliasing”, and it provoke the problem of “staircase edge” or “jagies”. To alleviate it, we apply a kind of controlled blur to the pattern.

Catmull save the fraction of the picture covered by patch fragments, he apply the texture pattern and the intensity is averaged proportionally to the amount of the picture covered. Is much better than point sampling but is not optimal.

Reflection in Curved Surfaces

The tipical way to define the intensity of a point is by using Lambert’s law, i=s(L·N), where i=intensity,s=surface shade, L =light vector, N=surface normal. But real surfaces tend to reflect more light in a direction which forms equal angles of incidence and reflectance with the surface normal, provoking a highlight. This can be implemented adding a virtual light, i=s(L·N)+g(L’·N)\*\*n, where L’=virtual light direction and g=glossiness. This technique is useful with satin surfaces but not with polished surfaces due to the lack of true reflections.

The simulation in curved surfaces requires a more accurate model of the surfaces and access to the normal of each point of the surface. The approximations with planes have been proved useless and It is require to use other techniques. The subdivision algorithm provides accurate information about the surface at every point. For each element, the vector object-observer and the surfaces normal are combined to determinate what is reflected. The view of the environment can vary depending the point of view, but It is assumed that the environment have objects and light greatly distant form the object and that occlusions are ignored, being able to modeled the environment as a 2D projection. Is a kind of huge sphere that surround the object that is being drawn.

Combination

The combination of both techniques can produce image of objects with shiny surfaces. When they are combined, only the component form the real light source should be scaled.