

Shading Models: Flat, Gouraud, Phong, and Simple Illumination Models Notes

Flat Shading

- A single intensity is calculated for each surface polygon
- Fast and simple method
- Gives reasonable result only if all of the following assumptions are valid:
 - The object is a polyhedron
 - Light source is far away from the surface so that NL is constant for each polygon
 - Viewing position is far away from the surface so that VR is constant over each polygon

Gouraud Shading

- Renders the polygon surface by linearly interpolating intensity values across the surface
- Gouraud shading Algorithm:
 1. Determine the normal at each polygon
 2. Apply an illumination model to each vertex to calculate the vertex intensity
 3. Linearly interpolate the vertex intensities over the surface polygon

Phong Shading

- A more accurate method for rendering a polygon surface is to interpolate normal vectors, and then apply the illumination model to each surface point
- Phong Shading Algorithm
 1. Determine the normal at each polygon vertex
 2. Linearly interpolate the vertex normal over the surface polygon
 3. Apply the illumination model along each scan line to calculate intensity of each surface point

Types of Light Sources Which Can be Used to Light a Scene

- **Directional light** - produced by a light source an infinite distance from the scene., All of the light rays emanating from the light strike the polygons in the scene from a single parallel direction, and with equal intensity everywhere.
 - Sunlight is for all intents and purposes a directional light.
 - Characterized by color, intensity, and direction.
- **Point light** - a light that gives off equal amounts of light in all directions. Polygons, and parts of polygons which are closer to the light appear brighter than those that are further away. The angle at which light from a point light source hits an object is a function of the positions of both the object and the light source. The intensity of the light source hitting the object is a function of the distance between them. Different graphics programs may (or may not) allow the programmer to adjust the falloff function in different ways.
 - A bare bulb hanging from a cord is essentially a point light.
 - Characterized by color, intensity, location, and falloff function.
- **Spotlight** - light that radiates light in a cone with more light in the center of the cone, gradually tapering off towards the sides of the cone. The simplest

spotlight would just be a point light that is restricted to a certain angle around its primary axis of direction - Think of something like a flashlight or car headlight as opposed to a bare bulb hanging on a wire. More advanced spotlights have a falloff function making the light more intense at the center of the cone and softer at the edges.

Characterized as a point light, an axis of direction, a radius about that axis, and possibly a radial falloff function.