CSC317/418 Computer Graphics

🅭 Tingfeng Xia

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Information

- Starting winter term 2021, Computer Graphics will be switching from its previous course code CSC418 to CSC317.
- Course webpage: `https://github.com/karansher/computer-graphics-csc317`

Contents

1 Raster Image

This section will be added later.

2 Ray Casting

This section will be added later.

3 Ray Tracing

3.1 Light and Surfaces

There are two types of lights, namely directional and point light sources.

- The directional light has its light direction independent of the object, this typically happens when the light is very far away. (e.g. the sun)
- On the other hand, point light are such that the direction of light depends on position of object relative to light. Think of this as a light bulb in a room.

3.2 Shading

The goal of shading is to compute the light reflected toward camera. As an algorithm it expects the following inputs: eye direction, light direction for each of many lights, surface normal, and surface parameters such as color and shininess.

The Surface Normal at a hit point can be computed, depending on the type of specification

- Polygon normal: cross product of two non-collinear edges,
- Implicit surface normal $f(p) = 0$: $gradient(f)(p)$
- Explicit parametric surface $f(a, b)$:

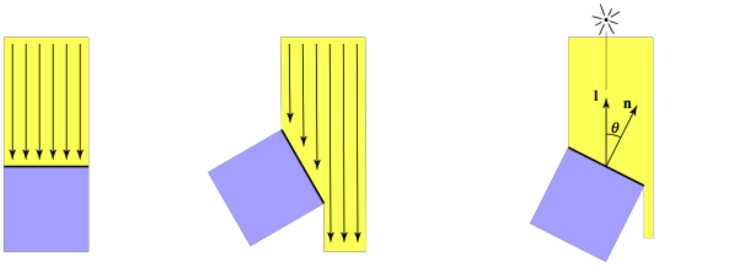
$$\frac{\partial f(s,b)}{\partial s} \times \frac{\partial f(a,t)}{\partial t} \tag{3.1}$$

3.3 Light Falloff

The light falloff aims to model the concept of diminishing light intensity based on distance. Suppose the light source has intensity of I, then, at a point that is r (Euclidean Distance) away from the light source, the light intensity from that particular light source would be

$$\text{Intensity}(I, r) = I/r^2 \tag{3.2}$$

Clearly, when we are at the light source, $r = 0$ and we attain the max intensity.



Top face of cube receives a certain amount of light

Top face of 60º rotated cube intercepts half the light

In general, light per unit area is proportional to cos θ = l • n

Figure 1: Illustration of Lambert's cosine law.

3.4 Diffuse Reflection

In the case of diffuse reflection, light are scattered uniformly in all directions, i.e. he surface color is the same for all viewing directions. The amount of light captured by a surface obeys Lamber's cosine law. (We call this Lambertian surface.) Figure 1 illustrates the relationship.

3.5 Lambertian Shading

The Lambertian Shading is independent of view direction. Let's call L_d := diffusely reflected light, k_d := diffuse coefficient, and I := illumination from source, then

$$L_d = k_d \left(I/r^2\right) \max(0, \mathbf{n} \cdot \mathbf{l}) \tag{3.3}$$

This produces a matte appearance.

3.6 Shadows

Surface is only illuminated if nothing blocks its view of the light. With ray tracing it's easy to check if a point in the scene is in shadow, all you have to do is just shoot a ray from the point[3.1] to the light and intersect it with the scene.

[3.1] This "point" means the actual location in 3d of what a pixel on the image projects to.