Intensity Attenuation

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Outline

- Basics of Intensity Attenuation
- Directional light Sources and Spotlight
- Angular Intensity Attenuation
- Combining Diffuse reflection-Ambient Light
- Combining Incident and Diffuse reflections

INTENSITY ATTENUATION

- As light moves from a light source its intensity diminished. At any distance d_1 away from the light source the intensity diminishes by a factor of $\frac{1}{d_1^2}$

- However, using the factor $\frac{1}{d_1^2}$ does not produce very good results so we use different strategies.

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We use instead in inverse quadratic function of the form:

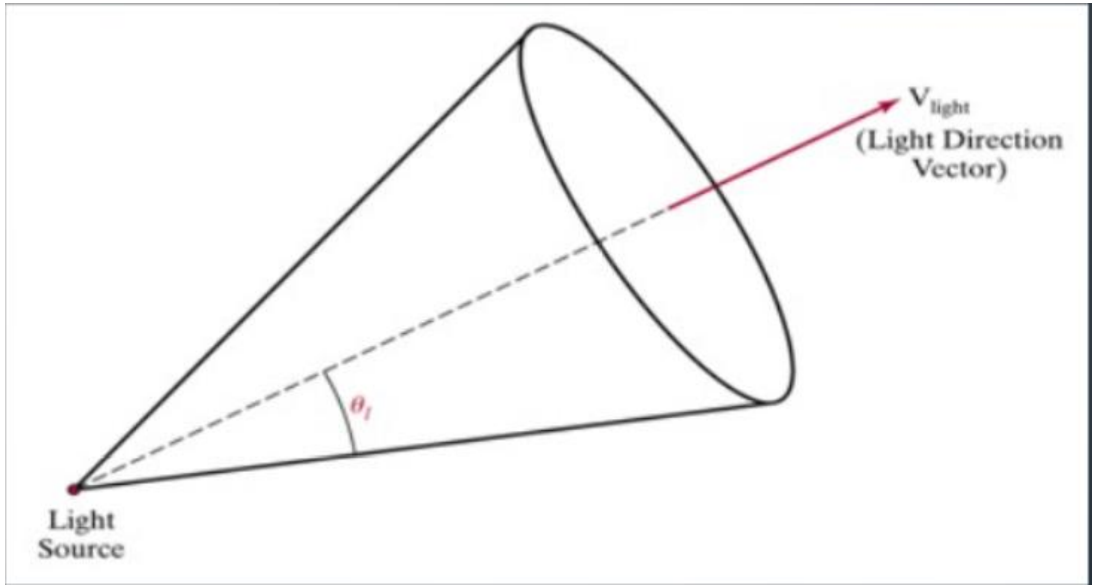
$$f_{radatten}(d_1) = \frac{1}{a_0 + a_1 d_1 + a_2 d_1^2}$$

where the coefficients a_0, a_1, a_2 can be varied to produce optimal results.

The intensity attenuation is not applied to light sources at infinity because all points in the scene are at a nearly equal distance from a far-off source.

Directional light sources and spotlight

To turn a point light source into a spotlight we simply add a vector direction and an angular limit θ_1



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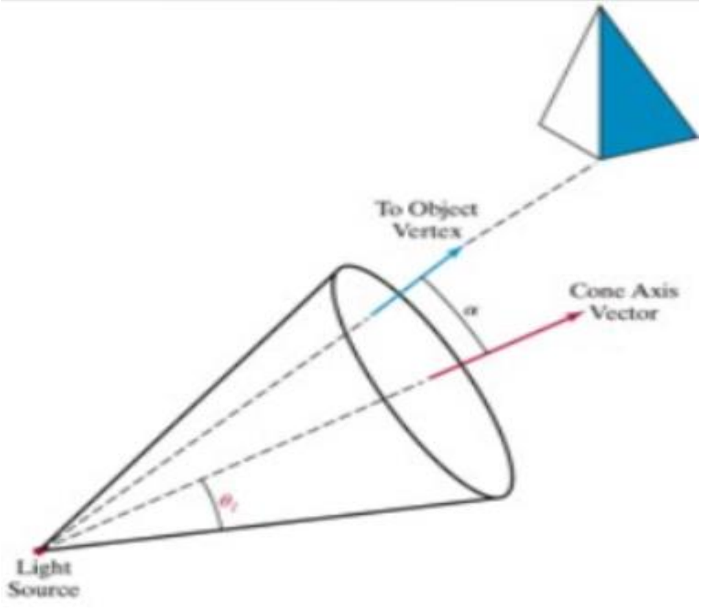
- We can denote V_{light} as the unit vector in the direction of light and V_{obj} as the unit vector from the light source to an object.

- The dot-product of these two vectors given us the angle between them

$$V_{obj}.V_{light} = \cos\alpha$$

- If this angle is inside the light's angular limit, then the object is within the spotlight.



Angular intensity attenuation

- As well as light intensity decreasing as we move away from a light source, it also decreases angularly.
- A commonly used function for calculating angular attenuation is:

$$f_{radatten}(\emptyset) = cos^{a1}\emptyset \qquad \theta^{0} \leq \emptyset \leq \theta$$

where the attenuation exponent $a_1$is assigned some positive value and the angle is measured from the one axis.

Illumination model

- A basic illumination model gives reasonably good results and is used in most graphics systems.
- The important components are:

- Ambient light
- Diffuse reflection
- Specular reflection

Ambient light

- To incorporate background light, we simply set a general brightness level for a scene
- This approximates the global diffuse reflection from various surfaces within the scene
- We will denote this value as I_a
- Multiple reflection of nearby (light-reflecting) objects yields a uniform illumination
- A form of diffuse reflection independent of the viewing direction and the spatial orientation of a surface.
- Ambient illumination is constant for an object

I=$k_d\ I_a$:the incident ambient intensity

:ambient reflection coefficient, the proportion reflected away from the surface

Diffuse reflection

- First we assume that surfaces reflect incident light with equal intensity in all directions
- Such surfaces are rendered to as ideal diffuse reflectors or Lambertian reflectors.
- A parameter k_d is set for each that determines the fraction of incident light that is to be scattered
- This parameter is known as diffuse-reflection coefficient or the diffuse reflectivity
- k_d is assigned a value between 0.0 and 1.0

 0.0: dull surface that absorbs almost all light

 1.0:shiny surface that reflects almost all light

Diffuse reflection-Ambient light

- For background lightning effects we can assume that every single surface is fully illuminated by the scene's ambient light I_a
- Therefore, the ambient contribution to the diffuse reflection is given as:

$$I_{ambdiff} = k_d I_a$$

- Ambient light alone is very uninteresting, so we need some other lights in a scene as well

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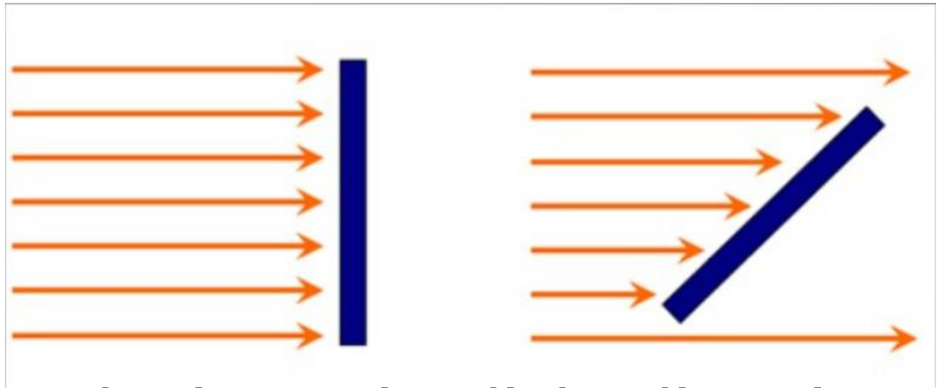
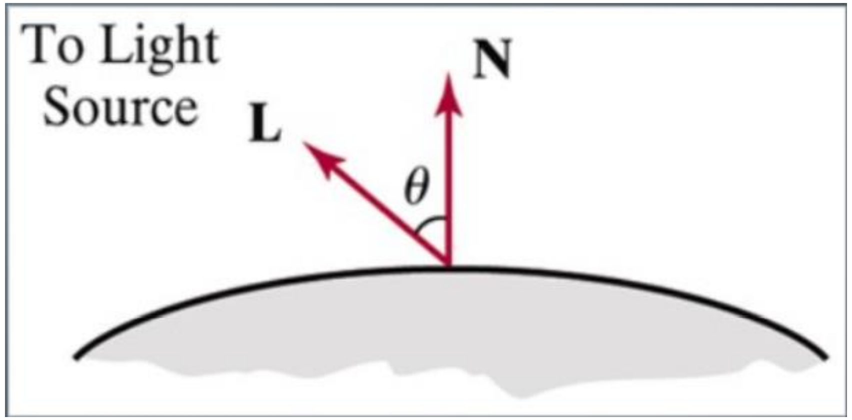
- When a surface is illuminated by a light source , the amount of incident light depends on the orientation of the surface relative to the light source direction.



- The angle between the incoming light direction and a surface normal is referred to as the angle of incidence given as θ



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- The amount of incident light on a surface is given as: $I_{l,incident}$=$I_l cos\theta$
- So, we can model the diffuse reflections as: $I_{l,diff}$=$k_d I_{l,incident}$

$$= k_d I_{l,cos\theta}$$

- Assuming we denote the normal for a surface N and the Unit direction vector to the light source as L:

N.L=cosθ

$$I_{l,diff} = \begin{cases} k_d I_l(\text{N.L}) & \text{if N.L} > 0 \\ 0 & \text{if N.L} \leq 0 \end{cases}$$

Combining incident and diffuse reflections

- To combine the diffuse reflections arising from ambient and incident light most graphics packages use two separate diffuse reflection coefficients.

$$k_a = for\ ambient\ light$$
$$k_d = for\ incident\ light$$

- The total diffuse reflection equation for a single point source can be given as:

$$I_{l,diff} = \begin{cases} k_a I_a + k_d I_l(\mathrm{N.L}) & \text{if N.L} > 0 \\ k_a I_a & \text{if N.L} \leq 0 \end{cases}$$

THANKING YOU