CS6533/CS4533 Lecture 8.2 Slides/Notes

Shading and Illumination (Notes, Ch 14)

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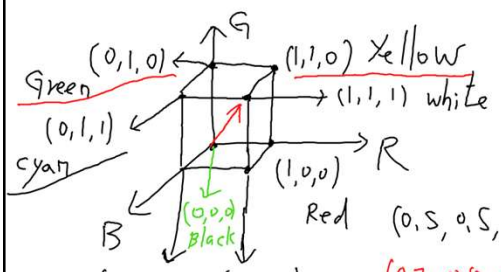
Shading and Illumination

We need light-material interactions to produce realistic-looking images (photo-realistic images)

Color Cube: R.G.B color mode.



(0.5, 0.5, 0.5): gray

(0.7, 0.8, 0.2) ?

= (0.2, 0.2, 0.2) + (0.5, 0.6, 0)

brightness yellowish.

* 3 Types of surfaces:

1. Specular surfaces: shiny
most reflected lights are scattered in a narrow range of angles. eg. Mirrors, metals.

2. Diffuse Surfaces: reflected lights are scattered in all directions.
eg. Walls with flat paint.

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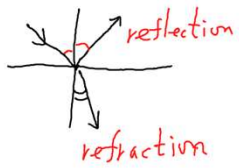
3. Translucent Surfaces : allow some lights to penetrate.



(refraction of lights)

eg. glass, water

* 4 Types of Light Sources

- Describe a light source with a 3-component intensity function.

$$I = \begin{bmatrix} I_r \\ I_g \\ I_b \end{bmatrix}$$

I_r, I_g, I_b: intensity of independent red, green, blue components.

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1. Ambient Light : uniform lighting (eg. classroom background lighting)

$$I_a = \begin{bmatrix} I_{ar} \\ I_{ag} \\ I_{ab} \end{bmatrix}$$

I_a is identical at every point in the scene.

2. Distant Light Source : light source is far away from the surface.

parallel light rays from the light source.

Specify the parallel ray vector v.

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3. Point Source : emits light rays equally in all directions

Let P_0 be the location of the point source.

$I(P_0) = \begin{bmatrix} I_r(P_0) \\ I_g(P_0) \\ I_b(P_0) \end{bmatrix}$

Intensity at point P : $I(P, P_0) = \frac{1}{|P-P_0|^2} I(P_0)$

Intensity $\propto \frac{\#\text{ rays}}{\text{area}}$

$\frac{k \text{ rays}}{4\pi d^2}$ (fixed k)

$\propto \frac{1}{d^2}$

Total: emitting k rays in all directions.

Total sphere area $= 4\pi d^2$.

* Define : $|P - P_0| = d$.

$I(P, P_0) = \frac{1}{d^2} I(P_0)$

* $\frac{1}{d^2}$ gives very high contrast. (bright or dark)

* In real world, sources are larger $\Rightarrow$ softer scenes.

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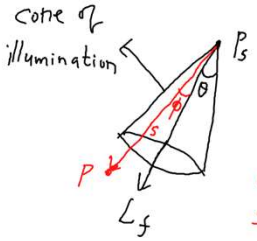
* In real world, light sources are larger $\Rightarrow$ softer scenes.

$\Rightarrow$ usually we replace $\frac{1}{d^2}$ by $\frac{1}{a+bd+cd^2}$ where a, b, c are constants.

We can adjust a, b, c to get more realistic effect.

($\frac{1}{d^2}$ is a special case with $a=b=0$, $c=1$)

4. Spotlights : The light has a narrow range of angles thru which the light is emitted.



P_s: spotlight position

L_s: focus direction

θ: cutoff angle $\in [0, 90^\circ]$

P: position of pt p being lit.

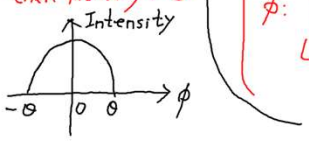
$S = P - P_s$: vector from P_s to P.

Intensity is attenuated by $(\cos\phi)^e$ $(e>1)$ when $\phi \le \theta$

e: spotlight exponent. describes how quickly the intensity drops off

ϕ: if $|L_s| = |S| = 1$, $L_s \cdot S = \cos\phi$.

If $\phi > \theta$ then intesity = 0



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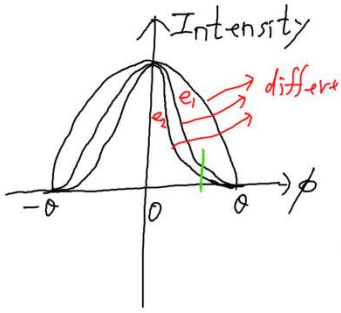

different e values. denoting different spotlight sources.

e_1 ? e_2 ($e_1 < e_2$ or $e_1 > e_2$?)

when $\phi \neq 0$ $\cos\phi < 1$. $e \uparrow$ $(\cos\phi)^e$ ↓

(eg. $\cos\phi = \frac{1}{2}$. $(\frac{1}{2})^1 = \frac{1}{2}$ $(\frac{1}{2})^2 = \frac{1}{4} < \frac{1}{2}$.)

$\Rightarrow e_2 > e_1$ $(e > 1)$

Phong Reflection Model: describes material-light interactions.

3 types of { material-light interactions / reflections } }
1. ambient reflection
2. diffuse =
3. specular =

3 components of the model (to be added together)

(Next class)

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