Yet More Lighting Models

CS116B

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Outline

- RGB and other color schemes
- Luminance
- Transparent surfaces
- Atmospheric effects

RGB Color Considerations

- How do we set the properties of a material?
- In our lighting model we have coefficients k_a, k_d, and k_s in front of the ambient, diffusive, and specular components of the lighting model.
- Last day, we indicated these are really vectors of coefficients for the RGB components. That is, $\mathbf{k_d} = (k_{dR}, k_{dG}, k_{dB})$.
- If a light source has blue intensity I_B, then we calculate the diffusive blue intensity due to that light source, given the properties of our material as $k_{dB} * I_B * (\mathbf{N} . \mathbf{L})$. Where $\mathbf{L}$ is the vector of the light source.
- Sometimes people keep a global scalar k_a, k_d, and k_s and multiply these by so-called surface color vectors $S_{\mathbf{d}} = (S_{dR}, S_{dG}, S_{dB})$.

Other color representations

- So far we have been only considering intensity components $<I^{red}, I^{blue}, I^{green}>$.
- Could also imagine working in cyan, magenta, yellow or hue saturation and brightness.
- So now the surface color vector and light intensity must be converted to these schemes.
- Might have components like: $k_d * S_{dMag} * I_{Mag}(\mathbf{N.L})$.

Luminance

- Luminance provides information about the lightness or darkness of a color.
- It is a psychological measure of our perception of brightness.

  luminance = $\sum_{\text{visible frequencies } f} p(f)I(f)$
- Here f is the frequency I(f) is its intensity and p(f) is a proportionality function which depends on human vision.
- For RBG sources we have roughly:

  luminance = .299R + .587G +.114B
- For some lighting effect it is better to increase the G component.

Transparent Surfaces

- An object is **transparent** if we can see objects behind it. (Ex. window)
- If we cannot see things behind it through the object it is called **opaque**.
- If light passing through the object is transmitted but scattered in all directions, the object is called **translucent**.

Translucent Materials

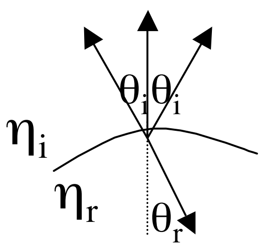
- Both diffuse and specular transimission can take place at the surface of a transparent object.
- We can simulate diffuse transmissions by distributing intensity contributions from background objects over a finite area to give a blurring effect.
- Ray tracing techniques can also be used.
- For basic illumination models, only usually consider specular-transparency effects.

Light Refraction

- Want to calculate refraction path of a ray of light through a material.
- Snell's Law gives us:

$\sin \theta_r = (\eta_i/\eta_r)*\sin \theta_i$.

Might need offset vectors when go through some materials like glass



θ_i = angle of incidence

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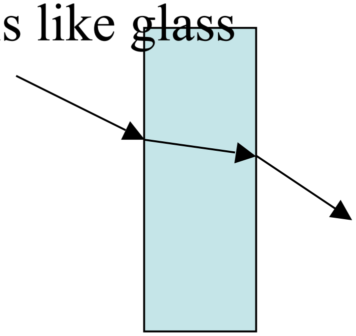
η_i = incident material index of refraction

η_r= refracting material index of refraction



Transmission vector $T= ((\eta_i/\eta_r)*\cos \theta_i - \cos \theta_r)\mathbf{N} -(\eta_i/\eta_r)\mathbf{L}$

Basic Transparency Model

- Path shifts due to refraction can be time consuming to calculate. So in simple model ignore.
- We can combine transmitted and reflected intensity using the simpler equation:

  $I=(1-k_t)I_{refl}+k_tI_{trans}$
- Here $(1-k_t)$ is called the **opacity factor**. k_t closer to one makes the object more transparent.
- Might need to modify visible surface depth sorting to consider if nearer objects are transparent or not. Or could use A-buffer approach.

Atmospheric Effects

- Want to model effect of atmosphere on lighting.
- Example: fog, haze, martian coloring,etc.
- Can use an exponential attenuation factor:

  $f_{atmos}(d) = e^{-p*d}$ or $f_{atmos}(d) = e^{-(p*d)^2}$

  Here d is distance from object to viewing position and p is a constant. Intensity might be modeled as:

  $I = f_{atmos}(d)*I_{obj} + [1 - f_{atmos}(d)]*I_{atmos}$.