Announcements

- Dec 16, 7-11pm in Siebel 4240.
  Final project presentations and Open House for press!
This was $T = T_{vp} \cdot T_{can} \cdot T_{eye} \cdot T_{rb}$

Now, read ___________________________
Next problem:

Start with standard computer graphics techniques.

Two approaches

- Image-order rendering:

- Object-order rendering:
Rendering in VR vs Computer Graphics

\[ T = T_{vp} \cdot T_{can} \cdot T_{eye} \cdot T_{rb} \]

Visual vs audio rendering

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Ray tracing stages:

1. Ray generation
2. Ray intersection
3. Shading
Image-Order Rending: Shading

Ray tracing stages:

1. Ray generation
2. Ray intersection
3. Shading: Simplest: Lambertian model
Image-Order Rending: Shading

Handling highlights/shininess
Image-Order Rending: Shading

Handling highlights/shininess:
specular component.

\[ L = k_d \cdot I \cdot \max(0, n \cdot l) + \text{diffuse} \]

http://learnopengl.com/?_escaped_fragment_=Lighting/Basic-Lighting
Problem: What happens to the sides of objects turned away from the light source?
Image-Order Rendering: Shading

Ambient light component:

\[ L = k_d \cdot I \cdot \max(0, n \cdot l) + k_s \cdot I \cdot \max(0, n \cdot h) \]

diffuse

specular
Image-Order Rending: Shading

Multiple light sources:

\[ L = k_d \cdot I \cdot \max(0, n \cdot l) + k_s \cdot I \cdot \max(0, n \cdot h) + k_a \cdot I_a \]

diffuse

specular
Image-Order Rending: Shading

Alternative approach: global illumination
- Handling multiple reflections
- Very expensive

http://graphics.stanford.edu/~henrik/images/global.html
Image-Order Rending: Shading

BRDF: Bidirectional Reflectance Distribution Function
Image-Order Rendering: Shading in VR
Object-Order Rending