Image-Based Lighting Tutorial

Paul Debevec
Presented by Craig Hiller
Image Based Lighting

- Process of illuminating scenes and objects (real or synthetic) with images of light from the real world
- Based off of reflection-mapping technique
  - Panoramic images as texture maps on models to make shiny objects reflect their environments
Basic Steps

1. Capturing real-world illumination

2. Mapping the illumination onto a representation of the environment

3. Placing the 3D object inside the environment

4. Simulating the light from the environment illuminating the object
Capturing Light

• Need an omnidirectional and high dynamic range (HDR) image
  • Camera + Mirror Ball
  • Image Stitching
  • Scanning panoramic camera
Capturing Light

- Pixel values need to be proportionate to light levels
  - Accomplished via HDR photography
  - Normally non-linear due to displays
Light Probe -> Environment

- Convert from \((x, y, z)\) in scene to \((u, v)\) in probe
  - \(-z\) is forward (outer edge of sphere)
  - \(+z\) is backward (center of sphere)
  - \(+y\) is up (towards top of sphere)
Light Probe -> Environment

d = sqrt(x*x + y*y)

r = 1/(2*Pi) * acos(z) / d

u = 0.5 + x*r

v = 0.5 + y*r
Rendering

- Trace rays from the camera to the scene
- When a ray hits the environment, takes value from light probe
- If a ray hits an object, sends out new rays to determine irradiance
- Compute the light reflected toward camera based on object’s properties
Extensions

• Simulate light into large environments

• Use a simulated environment instead of light probe image

• Illuminate real-word objects

  • Need images illuminated under all lighting conditions
A computer model of the ruins of the Parthenon as illuminated just after sunset by a sky captured in Marina del Rey, California. Modeled by Brian Emerson and Yikuong Chen and rendered using the Arnold global illumination system.
Extensions

- Simulate light into large environments
- Use a simulated environment instead of light probe image
- Illuminate real-word objects
  - Need images illuminated under all lighting conditions