Image-based Lighting

Many slides from Debevec, some from Efros, Kevin Karsch
From *Flight of the Navigator*
from Terminator 2
Mirror balls for image-based lighting
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Mirror balls for image-based lighting
Real environment maps

• We can use photographs to capture environment maps
  – Fisheye lens
  – Mirrored balls (light probes)
Mirrored Sphere
How much direction can it cover?
How to render an object inserted into an image?

Image-based lighting

• Capture incoming light with a “light probe”
• Model local scene
• Ray trace, but replace distant scene with info from light probe

Debevec SIGGRAPH 1998
Key ideas for Image-based Lighting

• Light probes: a way of capturing environment maps in real scenes
Mirror ball -> equirectangular
Mirror ball -> equirectangular

Mirror ball  
Normals  
Reflection vectors  
Phi/theta of reflection vecs

Equirectangular  
Phi/theta equirectangular domain
One small snag

• How do we deal with light sources? Sun, lights, etc?
  – They are much, much brighter than the rest of the environment

• Use High Dynamic Range photography!
Key ideas for Image-based Lighting

- Capturing HDR images: needed so that light probes capture full range of radiance
LDR->HDR by merging exposures

Exposure 1

Exposure 2 ...

Exposure n

Real world

0 to 255

High dynamic range

10^{-6} 10^6
Ways to vary exposure

- Shutter Speed (*)
- F/stop (aperture, iris)
- Neutral Density (ND) Filters
Acquiring the Light Probe
Assembling the Light Probe
Real-World HDR Lighting Environments

Lighting Environments from the Light Probe Image Gallery:
http://www.debevec.org/Probes/
Illumination Results

Rendered with Greg Larson's RADIANCE
Comparison: Radiance map versus single image

HDR

LDR
CG Objects Illuminated by a Traditional CG Light Source
Illuminating Objects using Measurements of Real Light

Environment assigned “glow” material property in Greg Ward’s RADIANCE system.

http://radsite.lbl.gov/radiance/
Rendering with Natural Light

SIGGRAPH 98 Electronic Theater
Movie

- http://www.youtube.com/watch?v=EHBgkeXH9lU
Capturing a Spatially-Varying Lighting Environment
HDR Image Series

2 sec  1/4 sec  1/30 sec

1/250 sec  1/2000 sec  1/8000 sec
Light Probe Images
IMAGE-BASED LIGHTING IN Fiat Lux

Paul Debevec, Tim Hawkins, Westley Sarokin, H. P. Duiker, Christine Cheng, Tal Garfinkel, Jenny Huang

SIGGRAPH 99 Electronic Theater
Fiat Lux

- http://ict.debevec.org/~debevec/FiatLux/movie/
- http://ict.debevec.org/~debevec/FiatLux/technology/
What if we don’t have a light probe?

Zoom in on eye

Insert Relit Face

Environment map from eye

Environment Map from an Eye
Can Tell What You are Looking At

Eye Image:

Computed Retinal Image: