…with a lot of slides
donated by Paul Debevec

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Image-Based Lighting II

15-463: Computational Photography
Alexei Efros, CMU, Fall 2006
We can now illuminate synthetic objects with real light.

How do we add synthetic objects to a real scene?
Real Scene Example

Goal: place synthetic objects on table
Modeling the Scene

light-based model

real scene
The Light-Based Room Model
Modeling the Scene

light-based model

synthetic objects

local scene

real scene
The Lighting Computation

distant scene (light-based, unknown BRDF)

synthetic objects (known BRDF)

local scene (estimated BRDF)
Rendering into the Scene

Background Plate
Rendering into the Scene

Objects and Local Scene matched to Scene
Differential Rendering

Local scene w/o objects, illuminated by model
Differential Rendering (2)
Difference in local scene
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
HDR Image Series

2 sec  1/4 sec  1/30 sec
1/250 sec  1/2000 sec  1/8000 sec
Stp1 Panorama
Assembled Panorama
Light Probe Images
Capturing a Spatially-Varying Lighting Environment
The Movie
Simulating the Glare in the Human Eye

- Greg Spencer, Peter Shirley, Kurt Zimmerman, and Donald Greenberg. Physically-based glare effects for digital images. SIGGRAPH 95.
Scattering in the eye

What’s the scattering model?
Gaussian Blur, LDR information Only
Full HDR Disc Blur
Frame Postprocessing in Rendering with Natural Light
Real objects under new lighting
Rendering Light Probes as Light Sources
A Lighting Reproduction Approach
Composited Results
Environment Map from Single Image?
Eye as Light Probe! (Nayar et al)
Cornea is an ellipsoid

Figure 2: (a) An external view of the human eye. (b) A normal adult cornea can be modeled as an ellipsoid whose outer limit corresponds to the limbus. The eccentricity and radius of curvature at the apex can be assumed to be known.
Ellipsoid fitting
Putting it all together!
Reach for the sky

- How can we capture the whole sky as an environment map?
- What happens with the sun?
Direct HDR Capture of the Sun and Sky

- Use Sigma 8mm fisheye lens and Canon EOS 1Ds to cover entire sky
- Use 3.0 ND filter on lens back to cover full range of light
  - Only 0.1% of light gets through!

Extreme HDR Image Series

1 sec f/4

1/4 sec f/4

1/30 sec f/4

1/30 sec f/16

1/250 sec f/16

1/1000 sec f/16

1/8000 sec f/16
Extreme HDR Image Series
- sun closeup

1 sec f/4

1/4 sec f/4

1/30 sec f/4

1/30 sec f/16

1/250 sec f/16

1/1000 sec f/16

1/8000 sec f/16 only image that does not saturate!
Spectral Calibration - ND filters are NOT Necessarily Neutral!

Before correction based on MacBeth ColorChecker chart appearance

After correction based on MacBeth ColorChecker chart appearance
Two Complete days of HDR Lighting
(see video)

(day averages at 1 min. intervals)

Feb 22, 2004
Feb 23, 2004
Lit by sun and sky
9 samples per pixel, 17 min.
16 samples per pixel, 46 min.
100 samples per pixel, 189 min.
A sunlit sample point
A shadowed sample point
HDRI Sky Probe
Clipped Sky + Sun Source
Lit by sky only, 17 min.
Lit by sun only, 21 min.
Lit by sun and sky, 25 min