Image-Based Lighting II

15-463: Rendering and Image Processing
Alexei Efros

…with a lot of slides donated by Paul Debevec

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

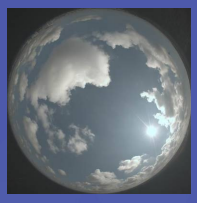
SIGGRAPH2004

- 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!

Stumpfel, Jones, Wenger, Tchou, Hawkins, and Debevec. "Direct HDR Capture of the Sun and Sky". To appear in Afrigraph 2004.

Extreme HDR Image Series

SIGGRAPH2004



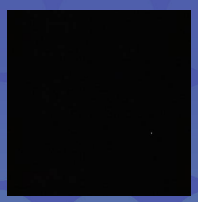
1 sec
f/4

1/4 sec
f/4

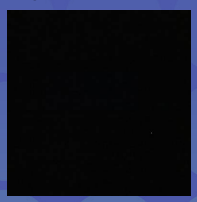
1/30 sec
f/4

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

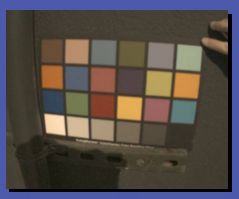

1/30 sec
f/16

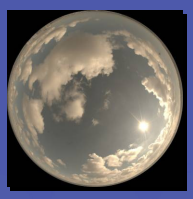

1/250 sec
f/16


1/1000 sec
f/16

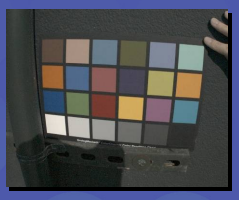

1/8000 sec f/16
only image that does not saturate!

Spectral Calibration - ND filters are NOT Necessarily Neutral!





Before correction

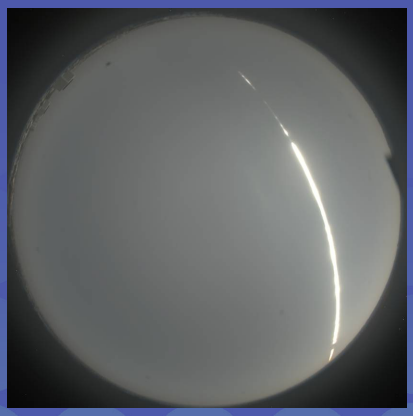


After correction based on MacBeth ColorChecker chart appearance

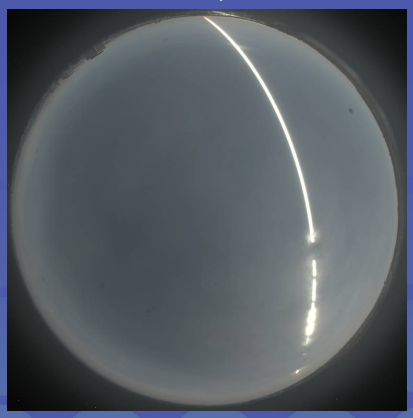
Two Complete days of HDR Lighting

SIGGRAPH2004

(day averages at 1 min. intervals)



Feb 22, 2004

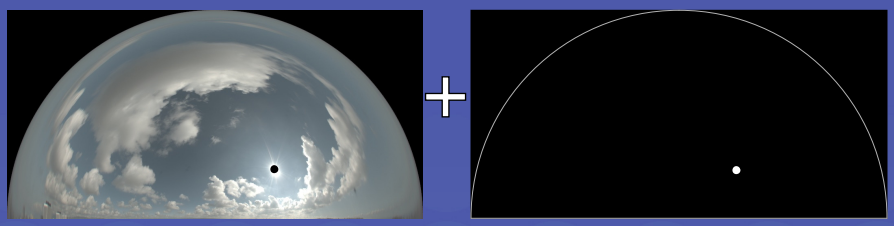


Feb 23, 2004

HDRI Sky Probe

SIGGRAPH2004

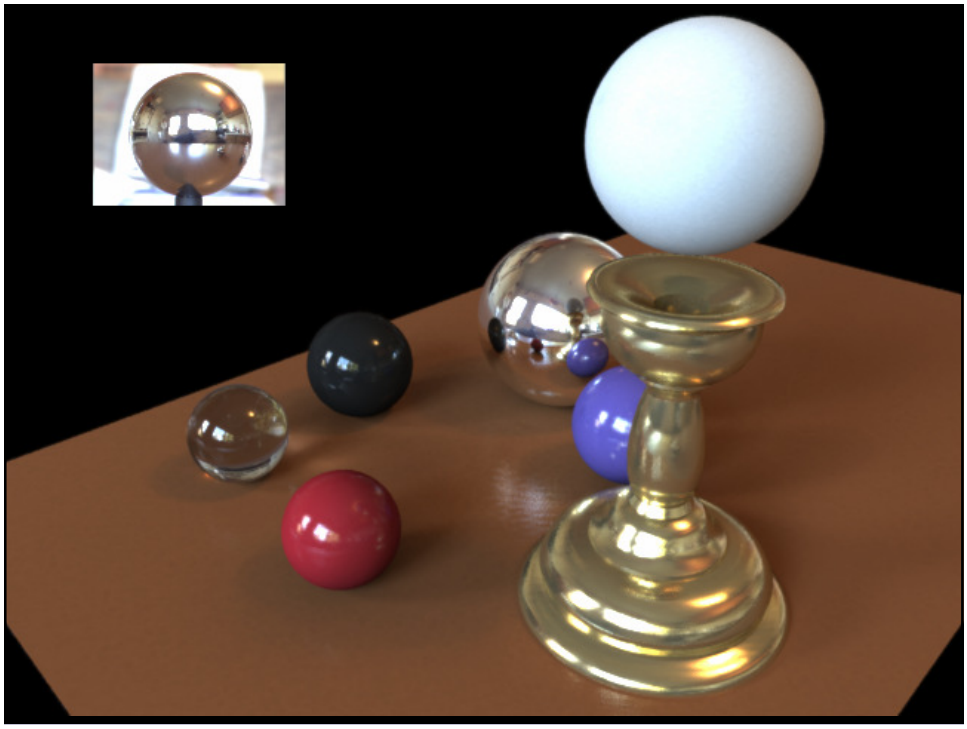
Clipped Sky + Sun Source

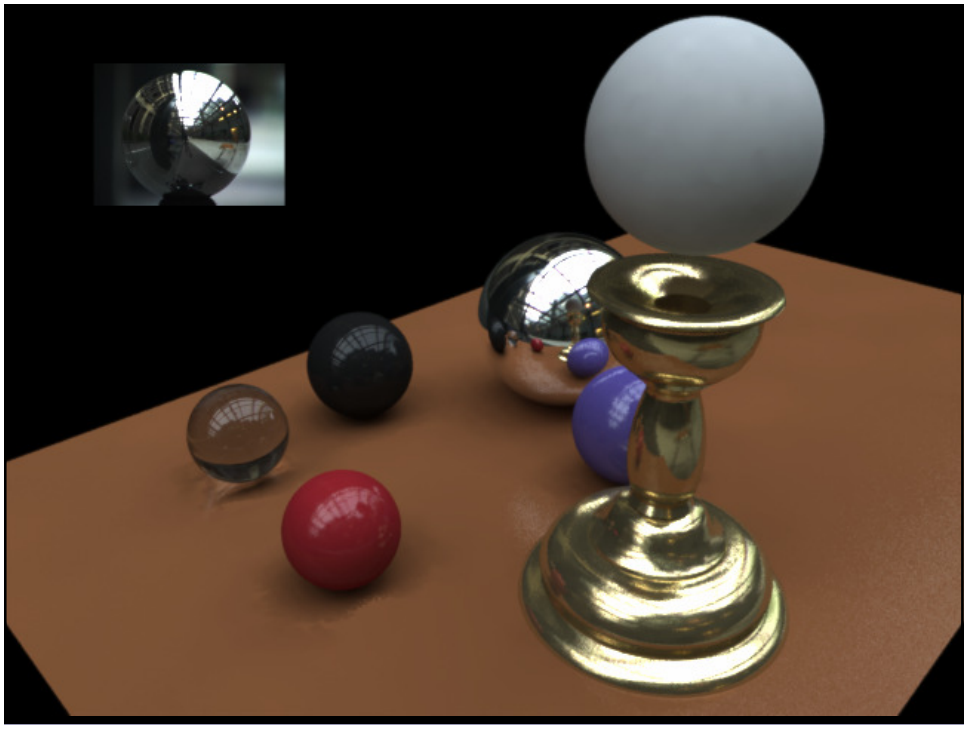


Lit by sky only

Lit by sun only

Lit by sun and sky





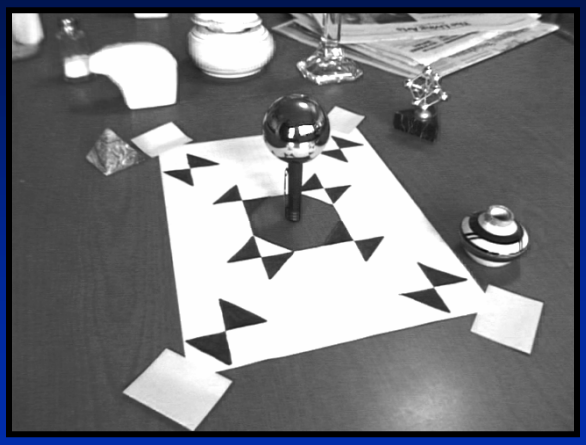
We can now illuminate
synthetic objects with real light.

How do we add synthetic objects to a
real scene?

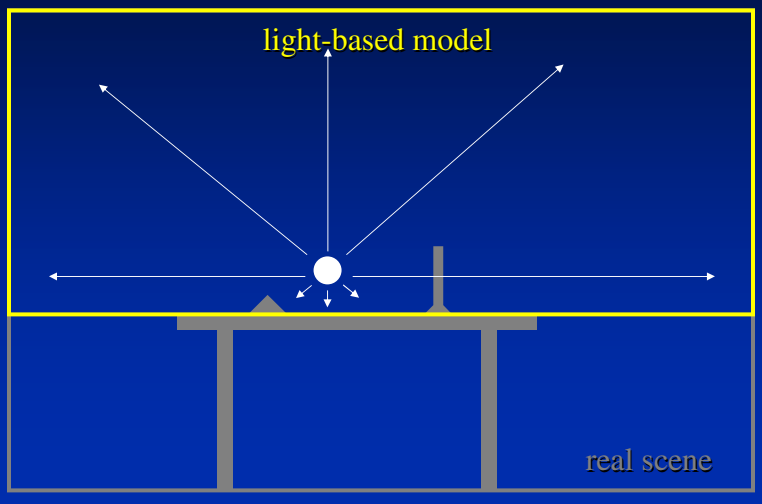
Real Scene Example

Goal: place synthetic objects on table

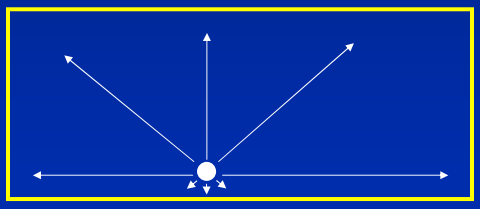
Light Probe / Calibration Grid



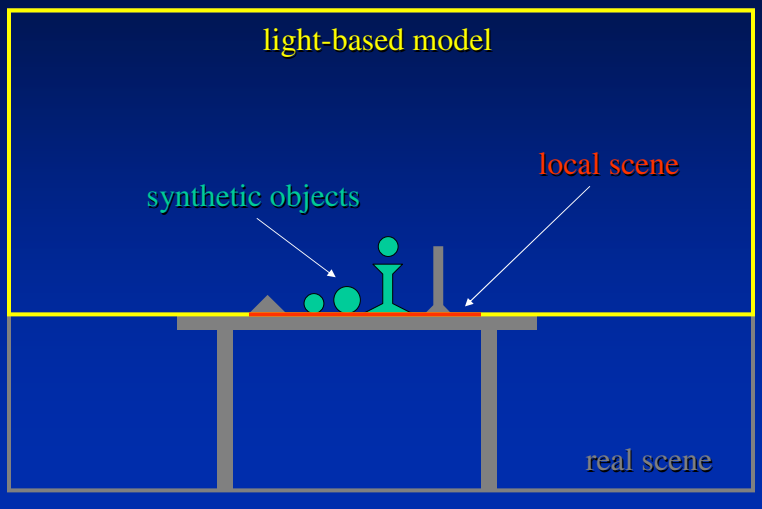
Modeling the Scene



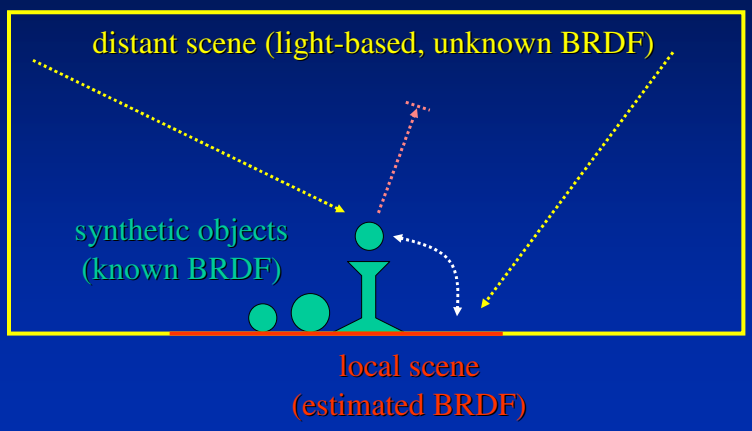
The *Light-Based* Room Model



Modeling the Scene



The Lighting Computation



Rendering into the Scene

Background Plate

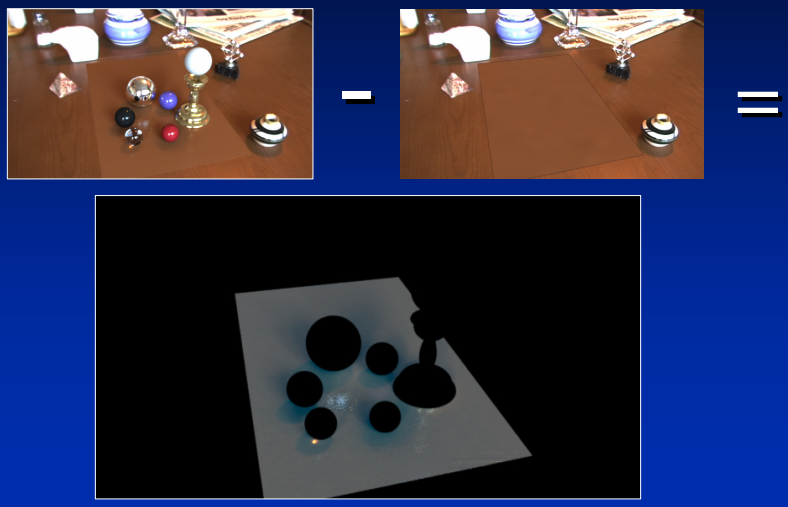
Rendering into the Scene

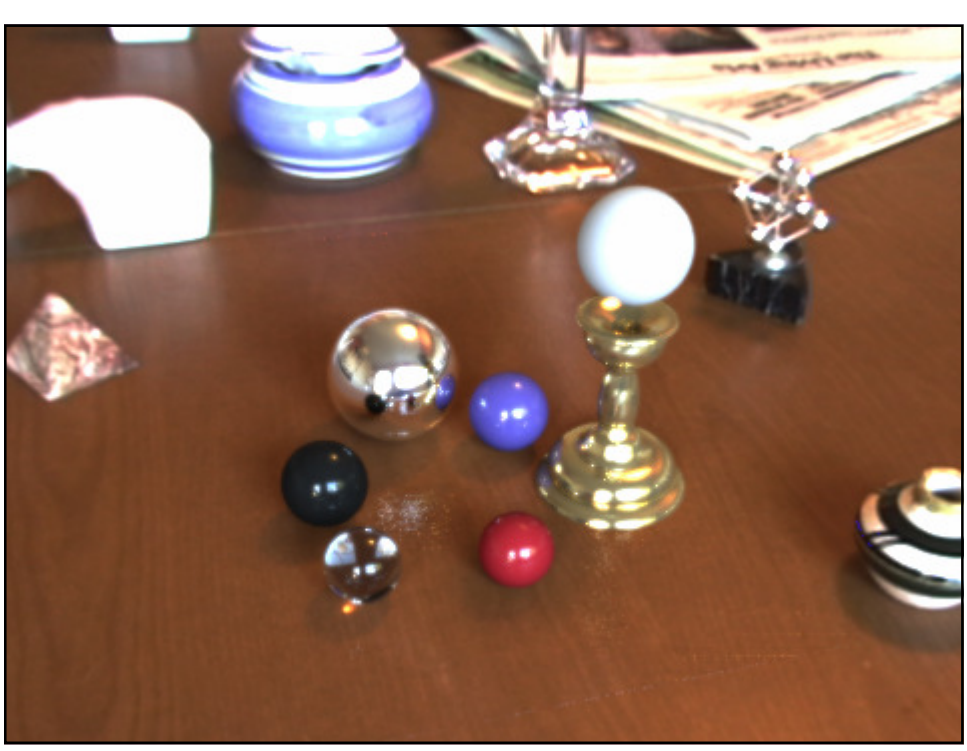
Objects and Local Scene matched to Scene

Differential Rendering

Local scene w/o objects, illuminated by model

Differential Rendering (2)
Difference in local scene





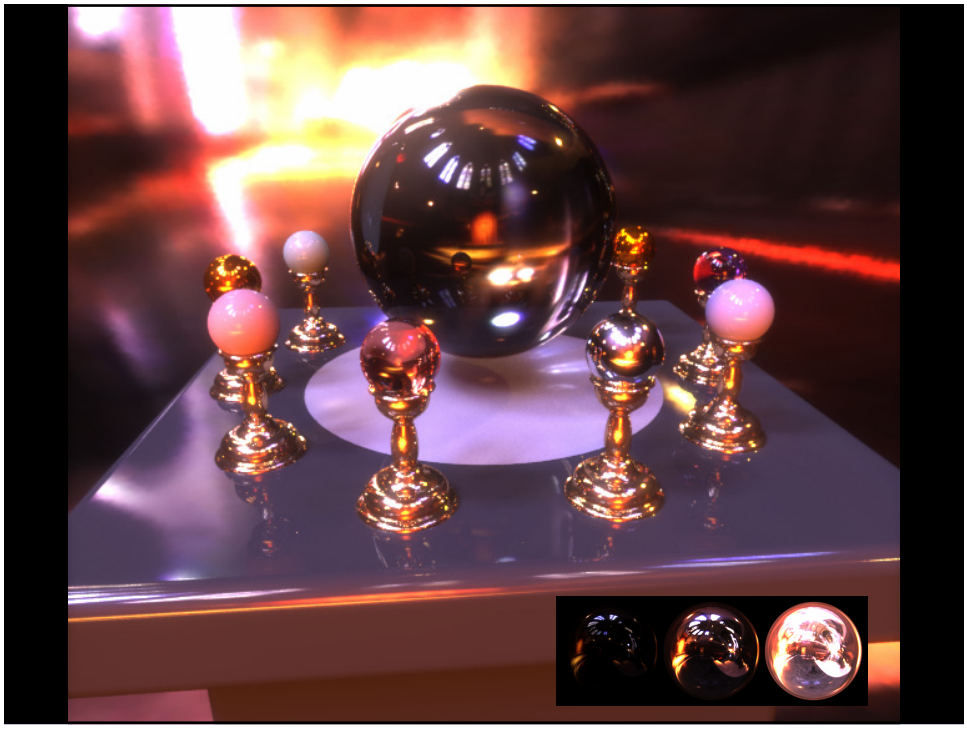
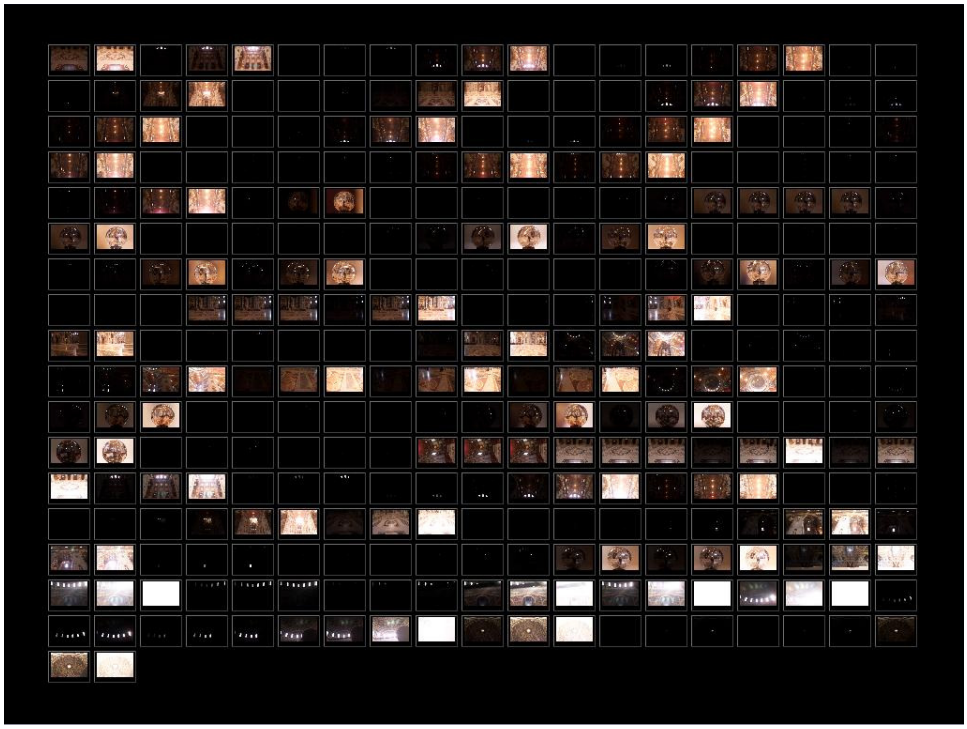


IMAGE-BASED LIGHTING IN *FIAT LUX*

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

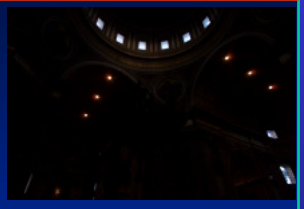
SIGGRAPH 99 Electronic Theater



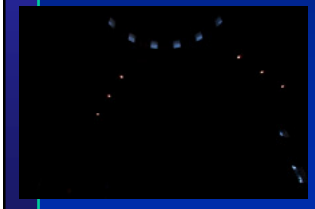
HDR Image Series

2 sec

1/4 sec



1/30 sec

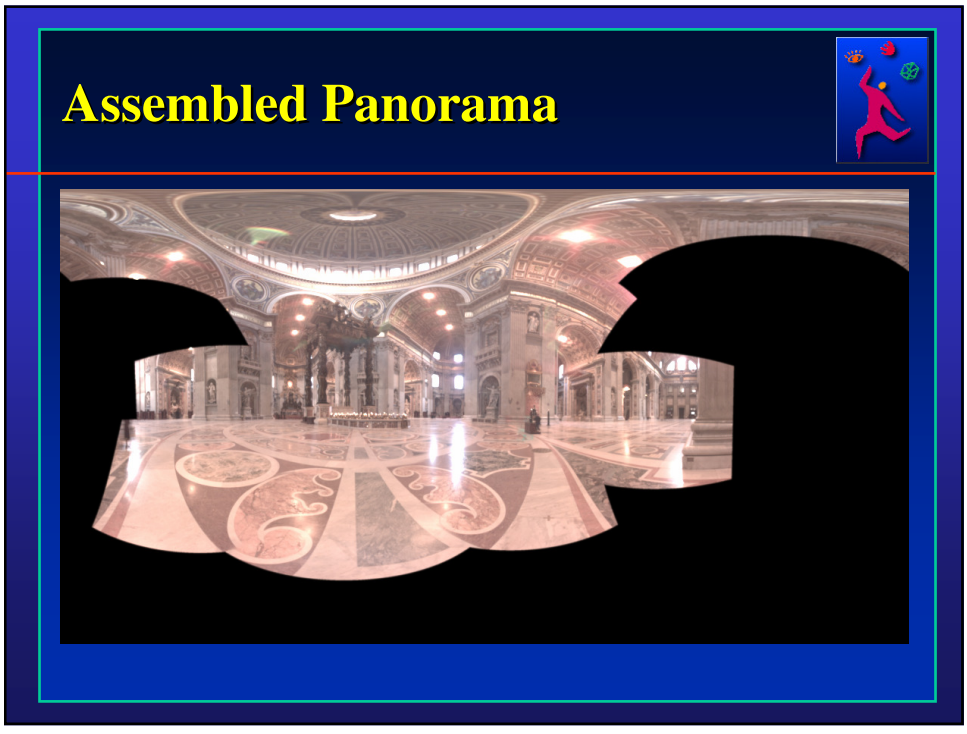


1/250 sec

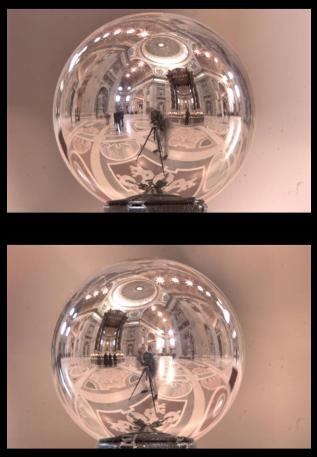
1/2000 sec

1/8000 sec

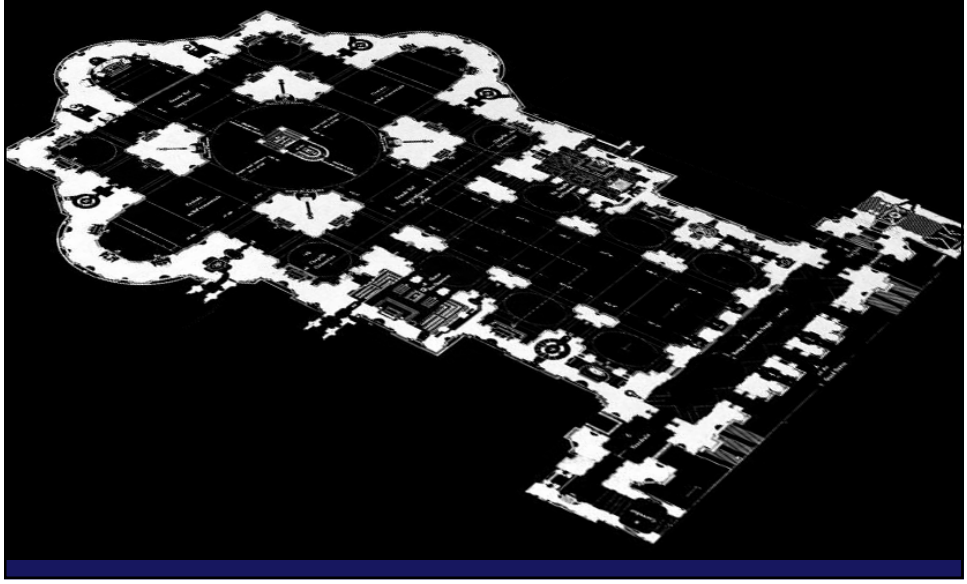

Stp1
Panorama


Assembled Panorama

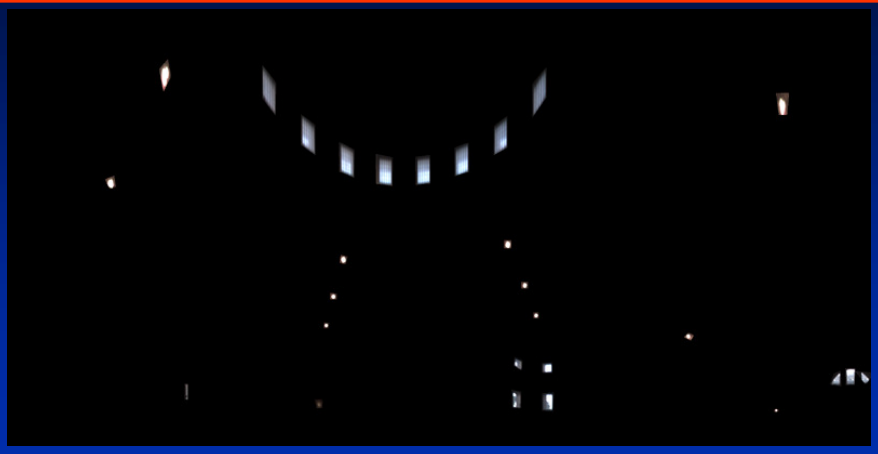
Light Probe Images



Capturing a Spatially-Varying Lighting Environment



Identified Light Sources



The Movie

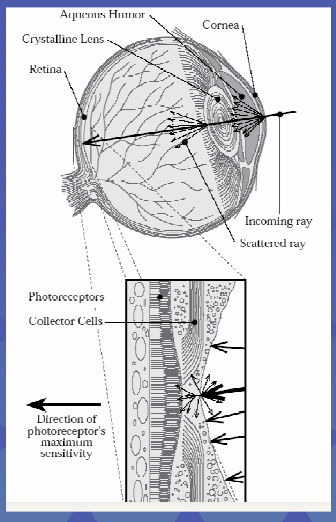
Simulating the Glare in the Human Eye

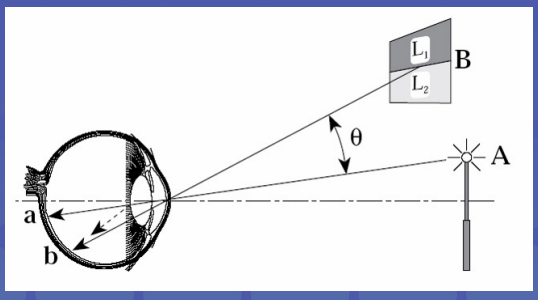
SIGGRAPH2004

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

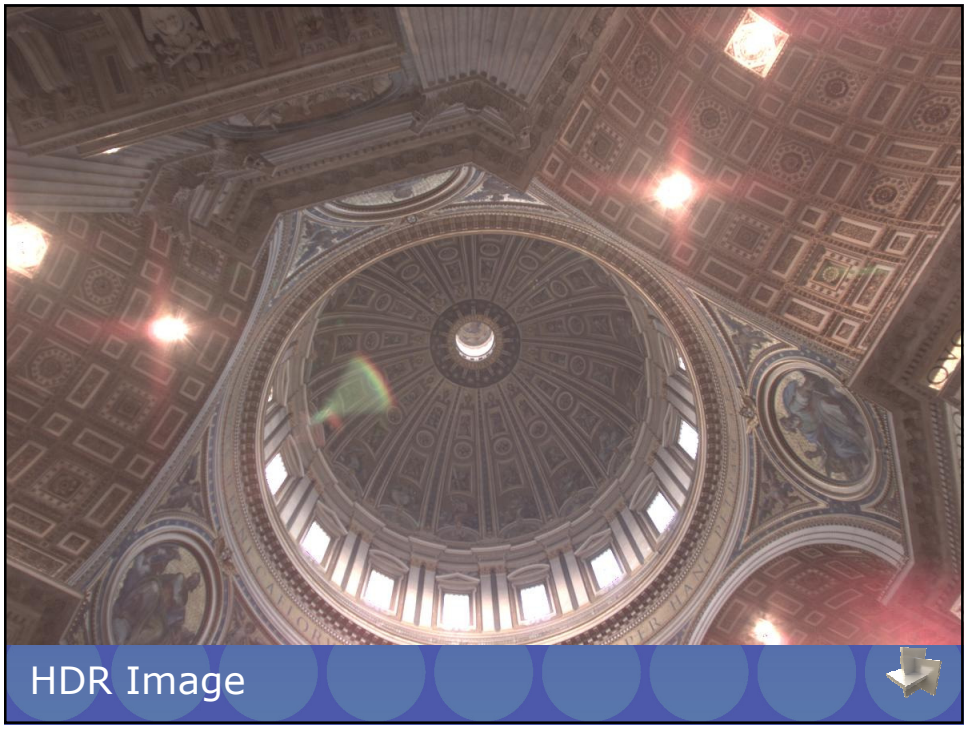
Scattering in the eye

SIGGRAPH2004

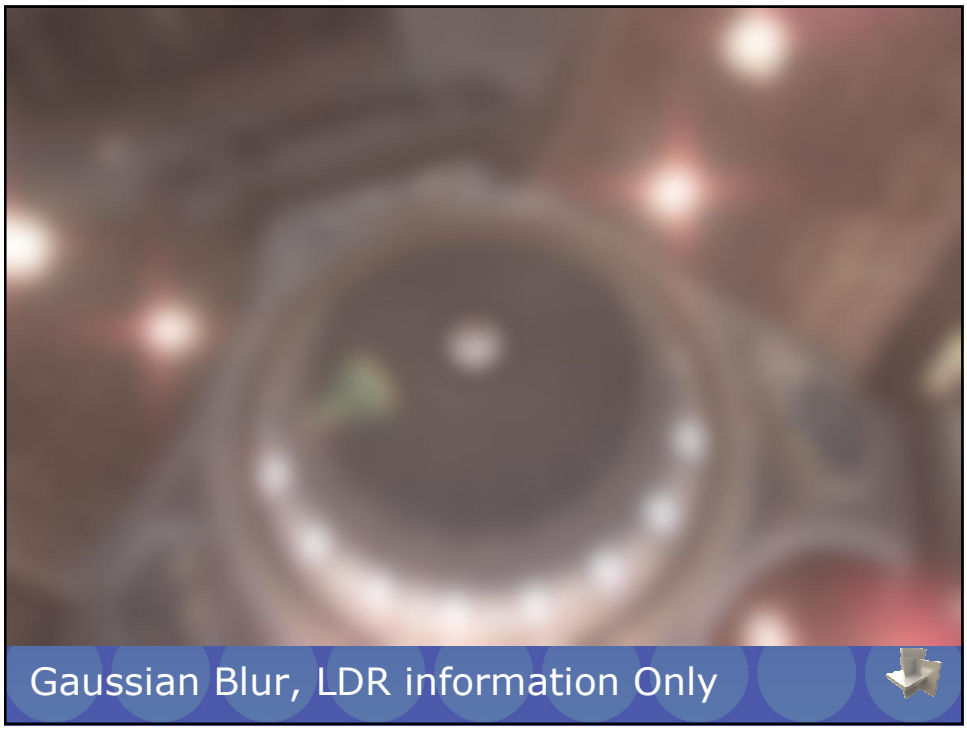




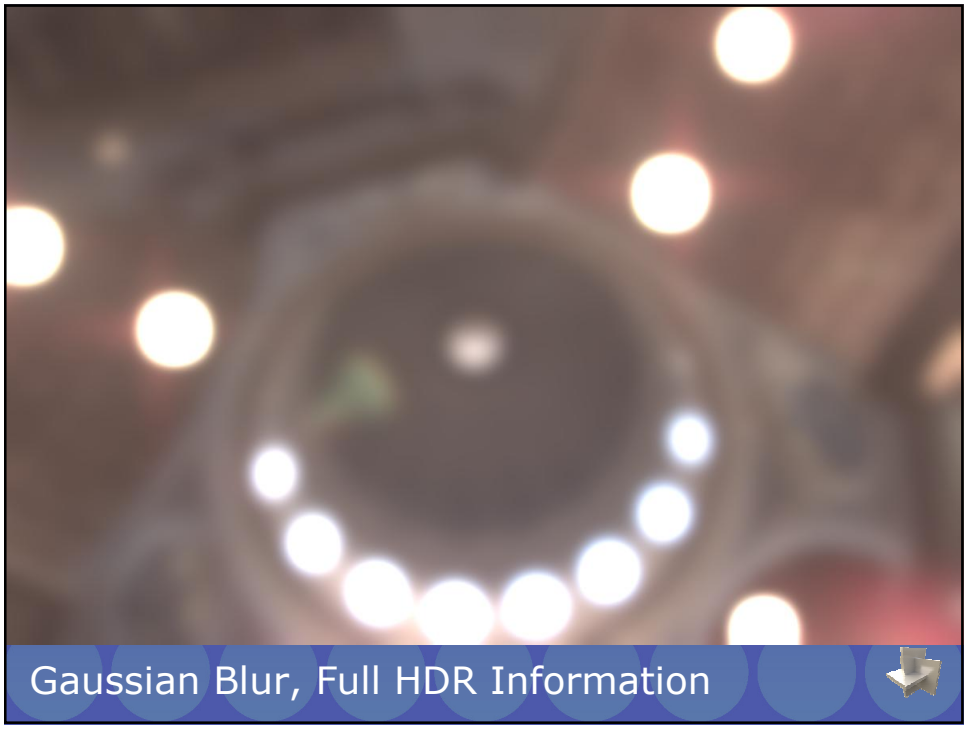
What's the scattering model?



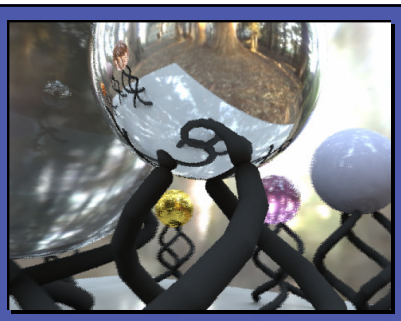
HDR Image



Gaussian Blur, LDR information Only


Gaussian Blur, Full HDR Information

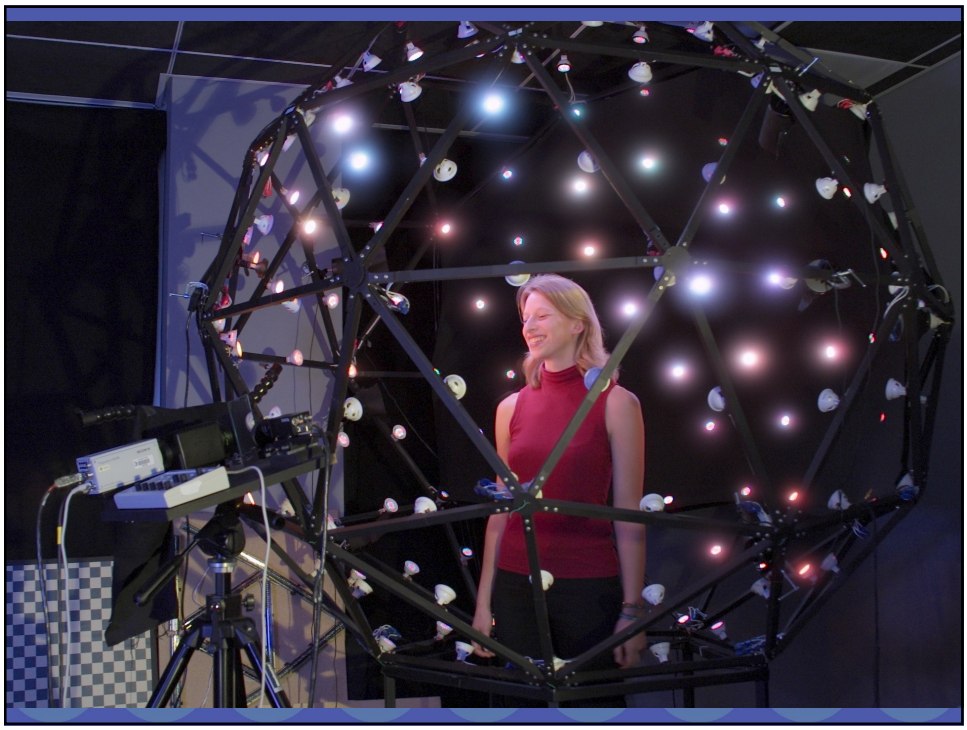

Full HDR Disc Blur



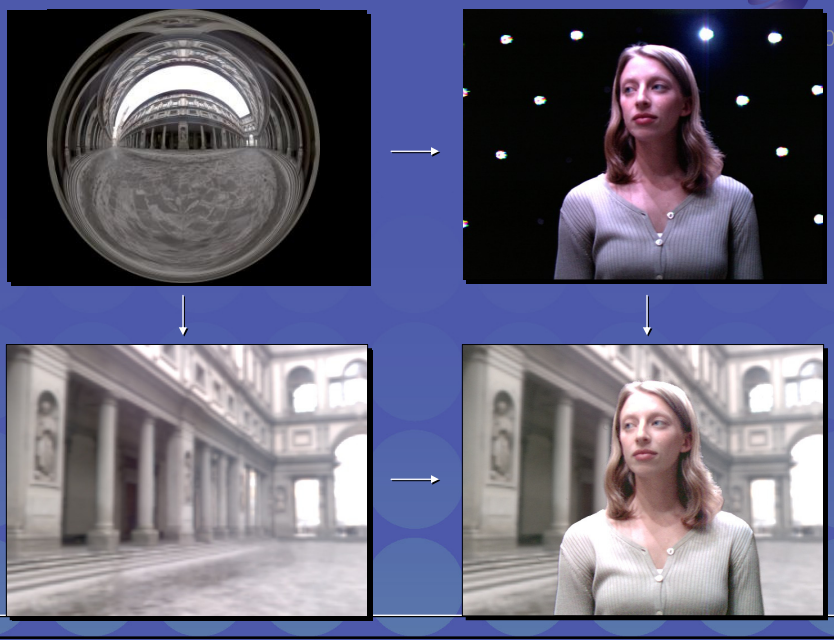

Frame Postprocessing in Rendering with

Compositing Complex Objects

Rendering Light Probes as Light Sources



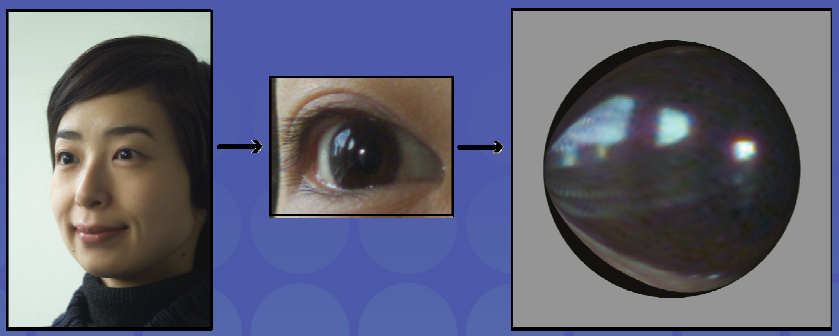
A Lighting Reproduction Approach



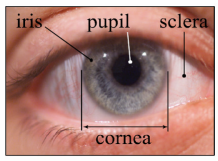
Composited Results

Environment Map from Single Image?

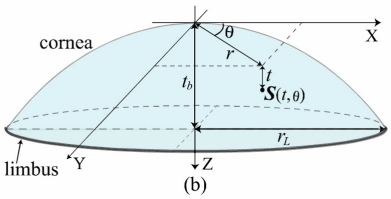
Eye as Light Probe! (Nayar et al)



Cornea is an ellipsoid



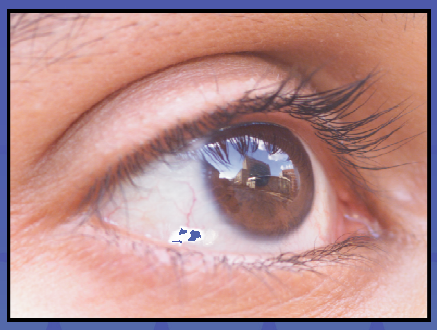
(a)

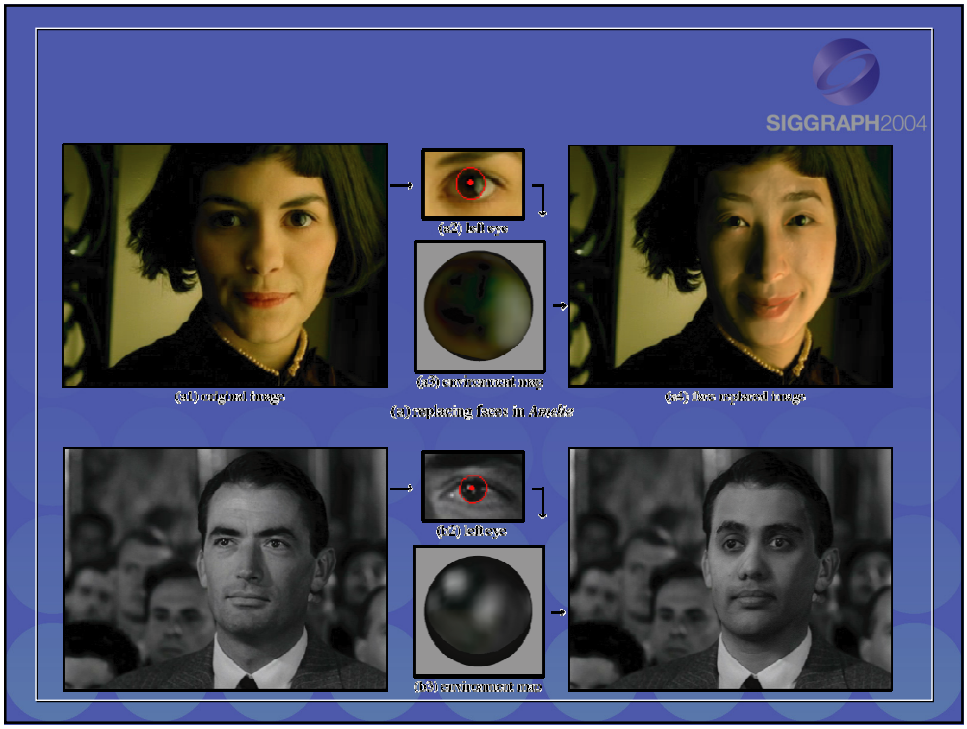


(b)

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




SIGGRAPH2004