Announcements

Final project presentations on **Wednesday**

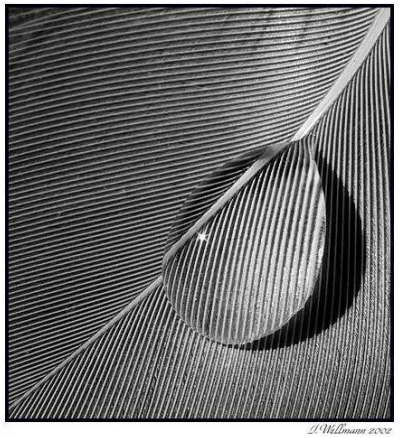
- Each group has **10 minutes**
- Place .ppt talk in artifact directory

Final reports due on Friday at 11:59pm

- Web page (see project4 web page)
- Does not have to be long, but should be sufficient to describe what you did, related work, results, and discussion

Evals at the end of class today

Matting and Transparency



Slides adapted from Alexei Efros, Yung-Yu Chuang, and Shree Nayar

How does Superman fly?

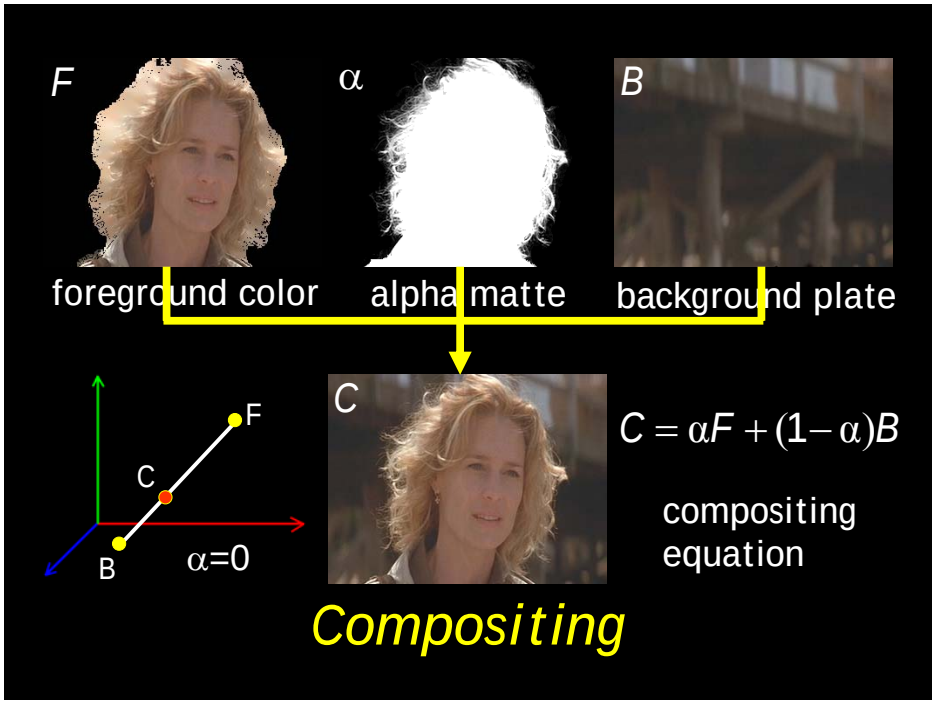
Super-human powers?

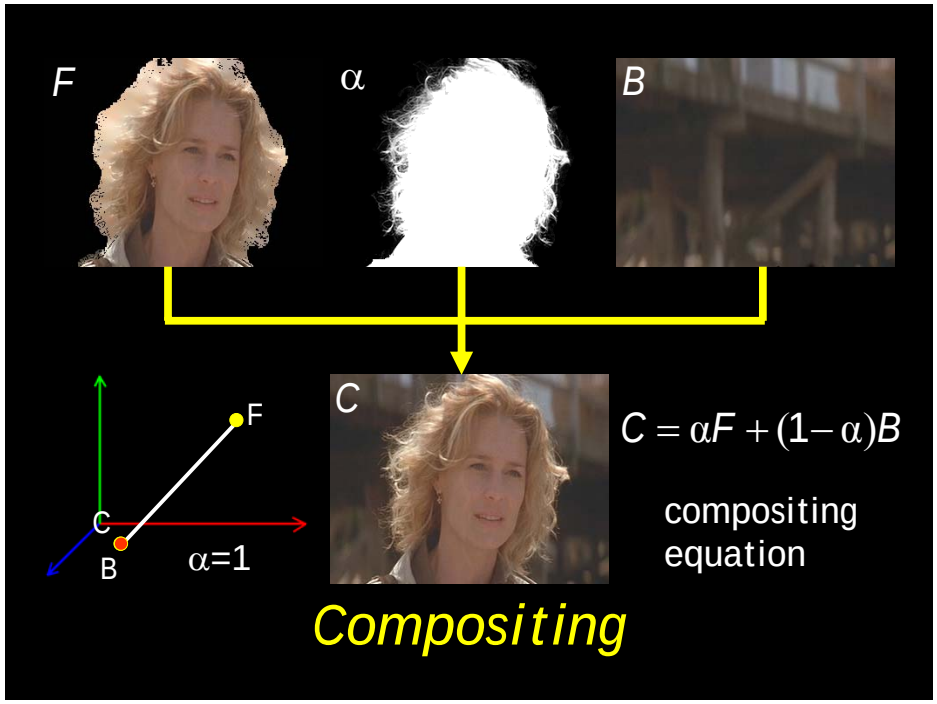
OR

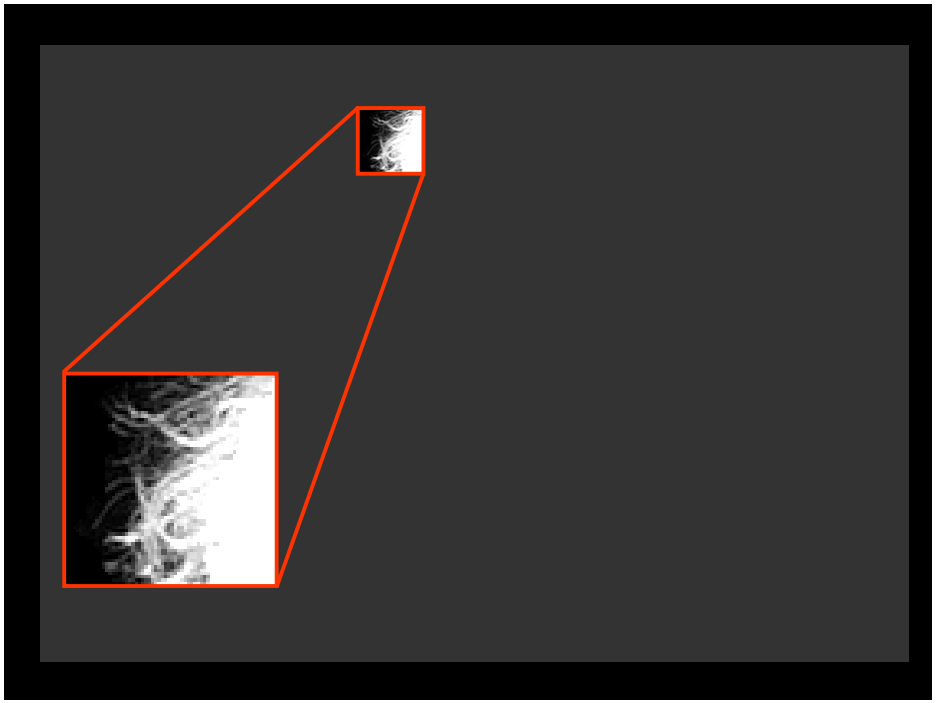
Image Matting?

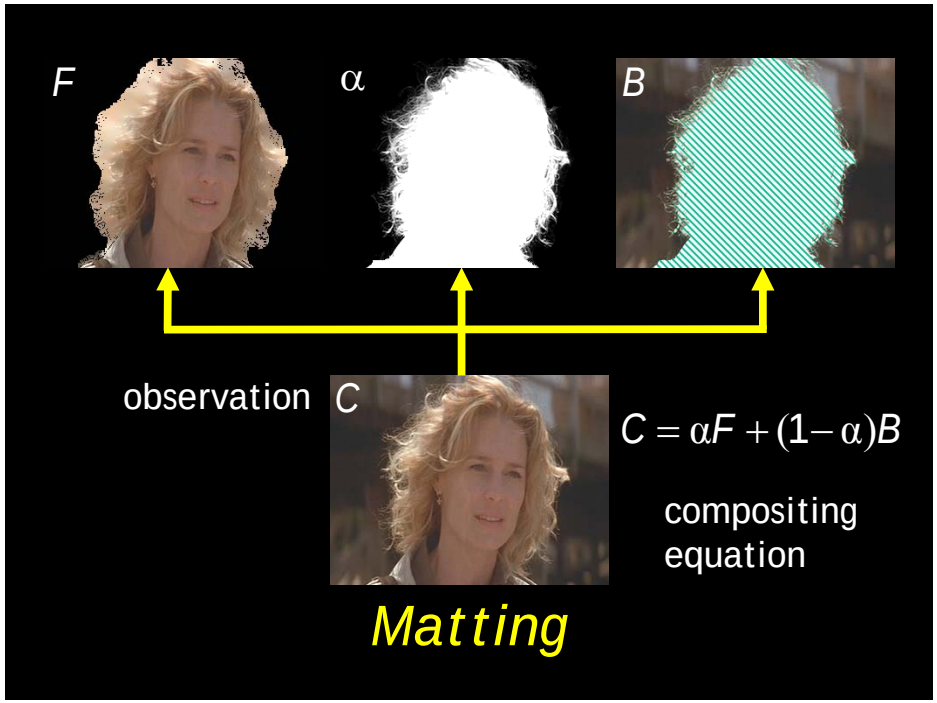
Digital matting

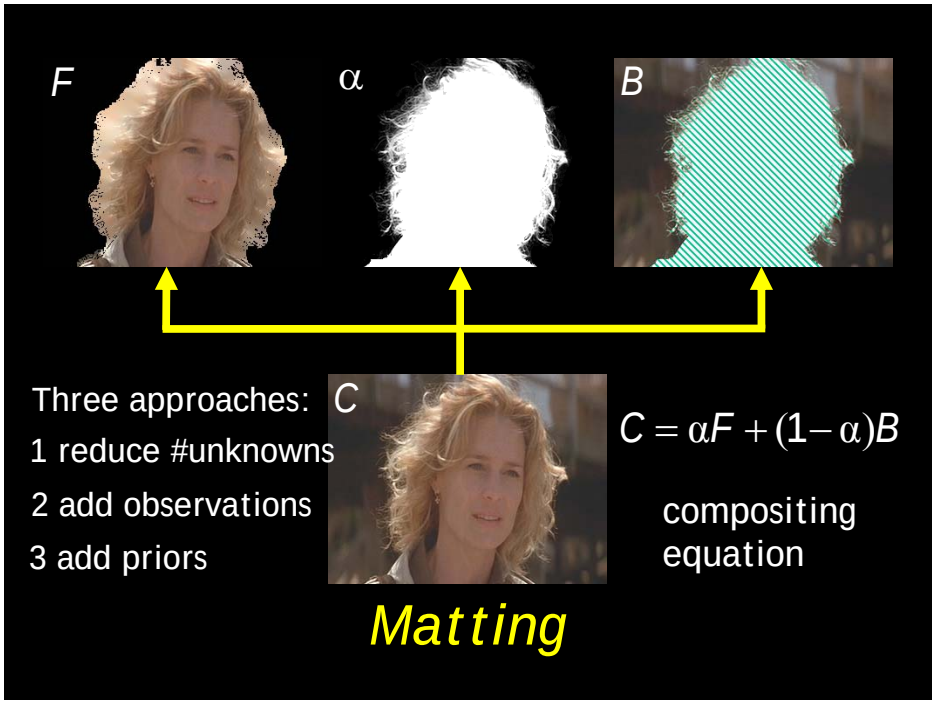
Forrest Gump (1994)

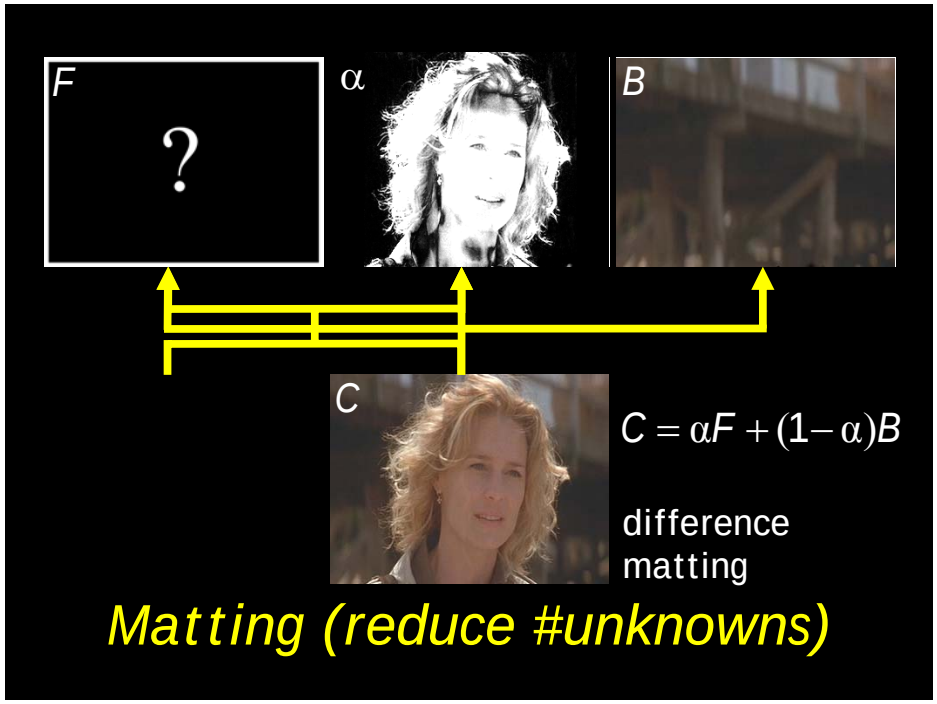

F
α
B
foreground color
alpha matte
background plate
C
F
C
B
α=0
$C = \alpha F + (1-\alpha)B$
compositing equation
Compositing

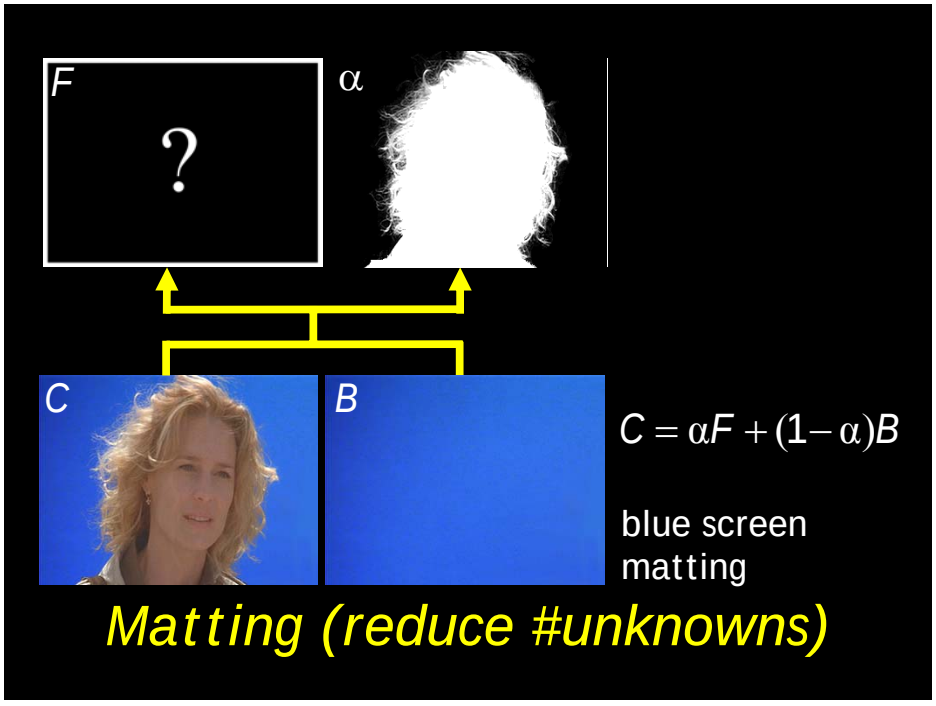

F
α
B
C
F
C
B
α=1
$C = \alpha F + (1-\alpha)B$
compositing equation
Compositing



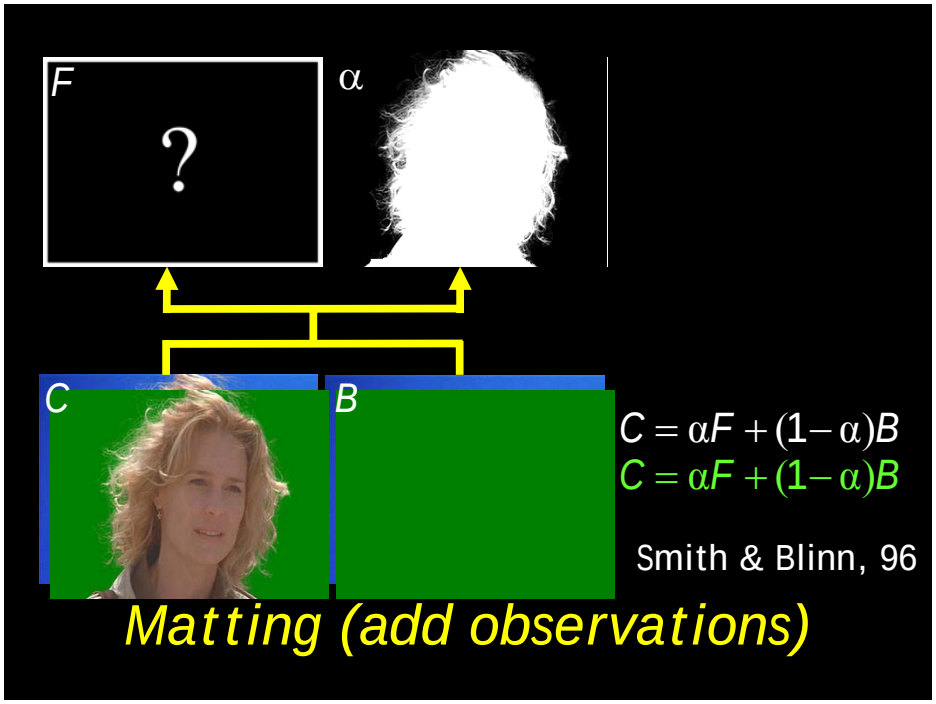

F
α
B
observation
C
$C = \alpha F + (1-\alpha)B$
compositing equation
Matting

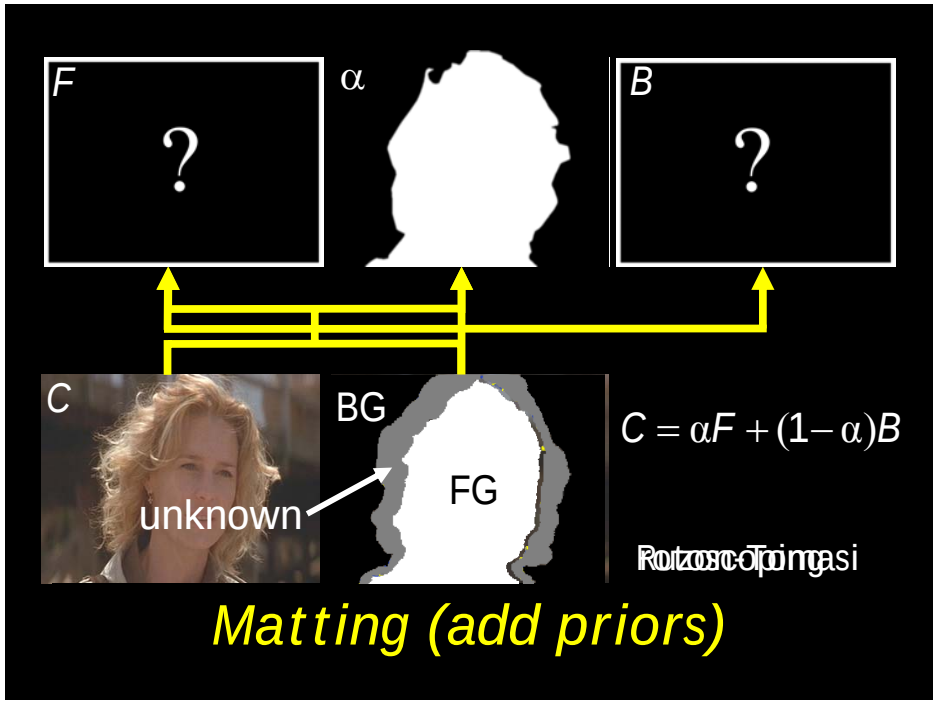

F
α
B
C
Three approaches:
1 reduce #unknowns
2 add observations
3 add priors
$C = \alpha F + (1-\alpha)B$
compositing equation
Matting


F
?
α
B
C
$C = \alpha F + (1-\alpha)B$
difference matting
Matting (reduce #unknowns)

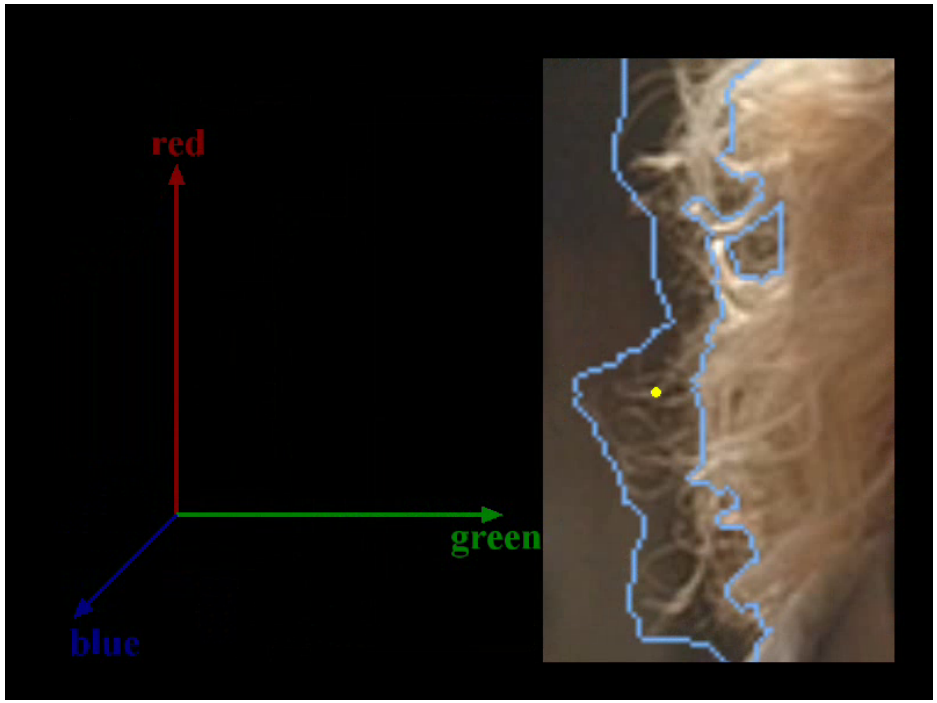

F
?
α
C
B
$C = \alpha F + (1-\alpha)B$
blue screen matting
Matting (reduce #unknowns)

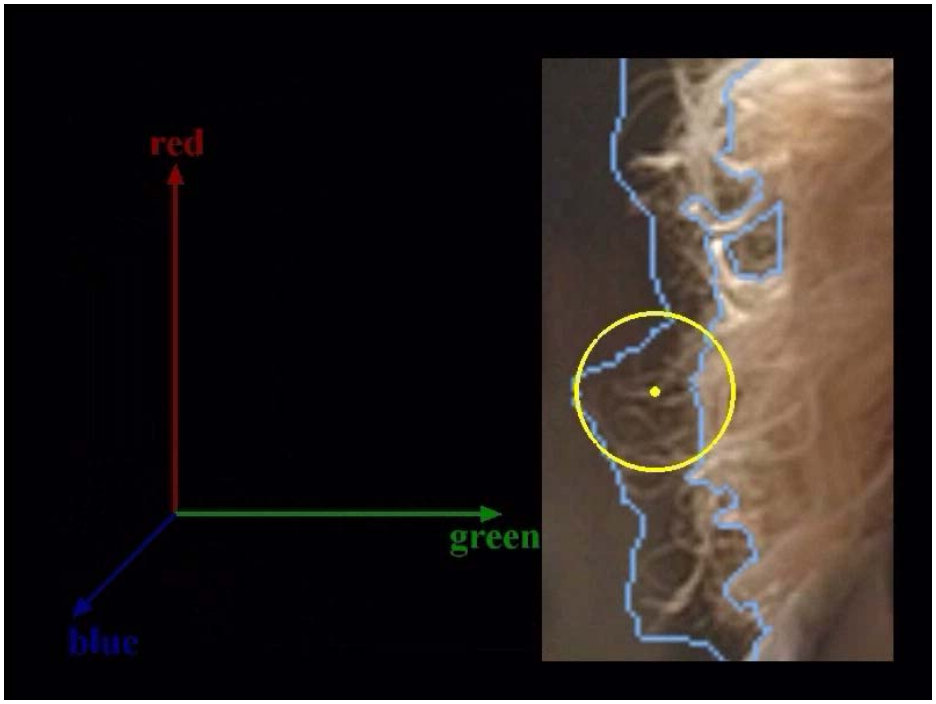
Problems with color difference
Background color is usually not perfect! (lighting, shadowing…)

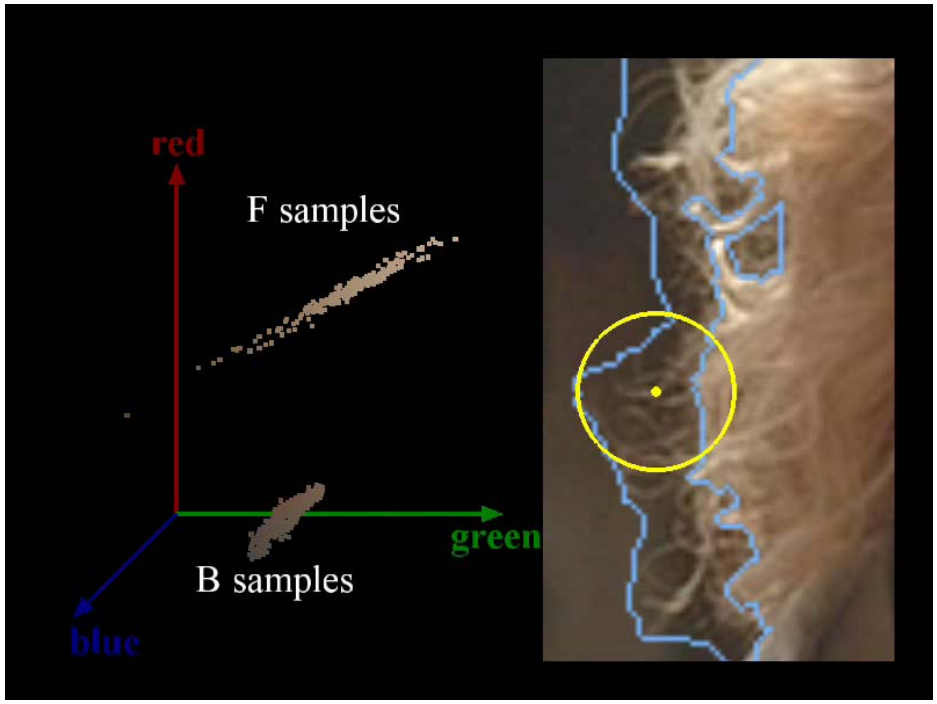

F
?
α
C
B
$C = \alpha F + (1-\alpha)B$
$C = \alpha F + (1-\alpha)B$
Smith & Blinn, 96
Matting (add observations)

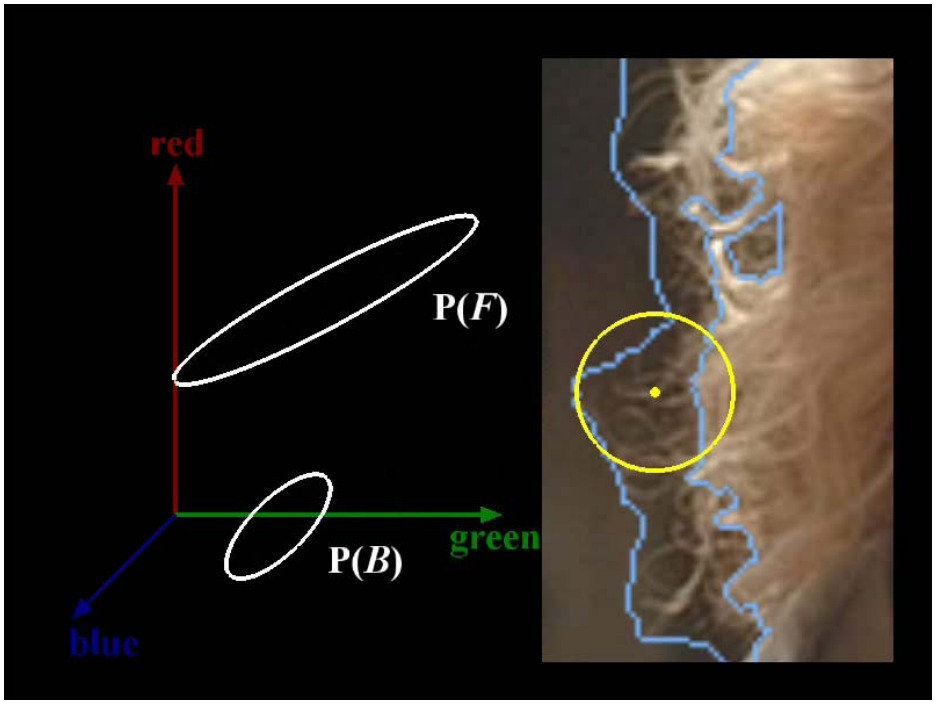

F
?
α
B
?
C
BG
FG
unknown
$C = \alpha F + (1-\alpha)B$
Matting (add priors)

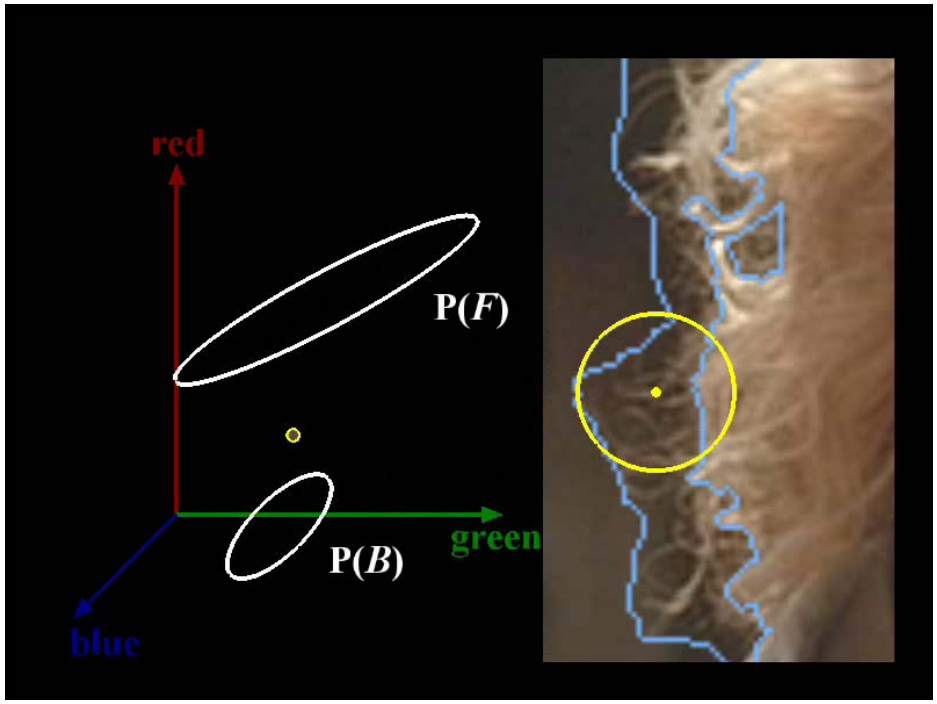
Bayesian image matting

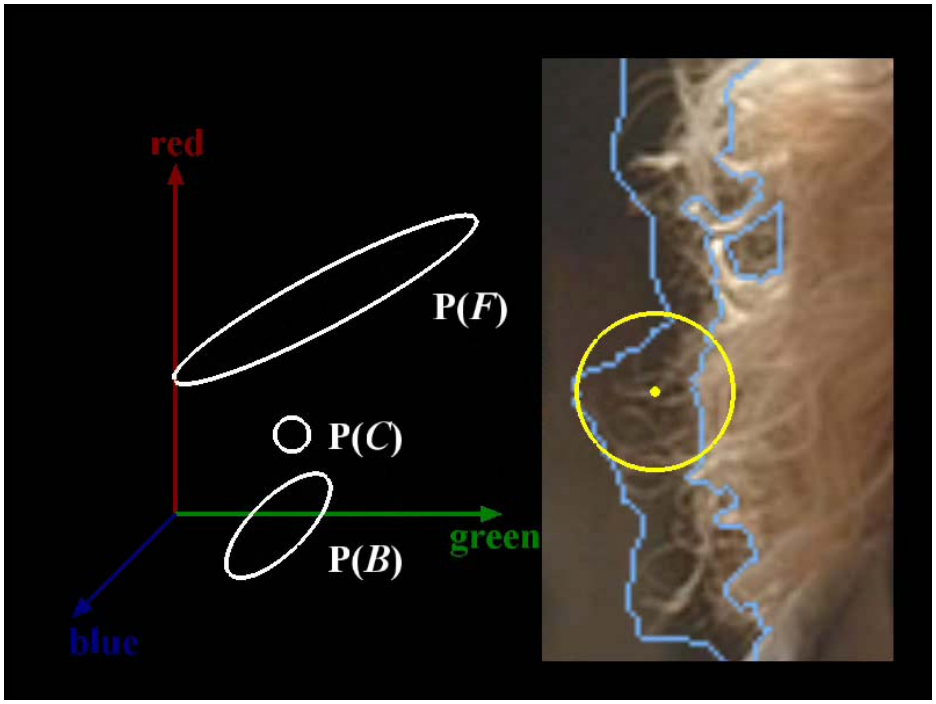

red
green
blue

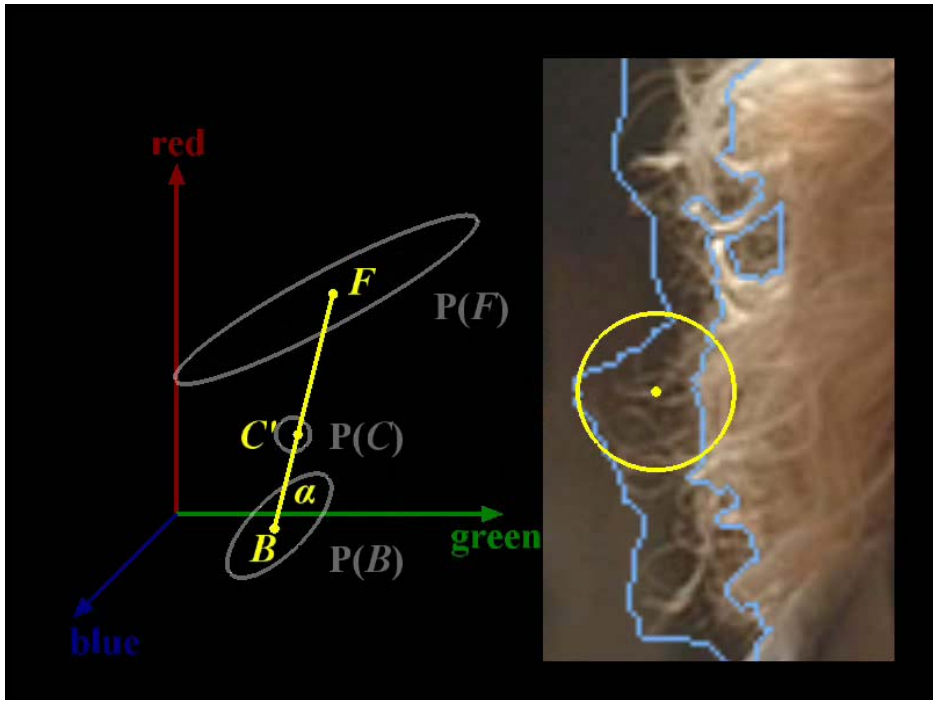

red
green
blue


red
F samples
green
B samples
blue


red
P(F)
P(B)
green
blue


red
P(F)
P(B)
green
blue





alpha

input

composite

Environment Matting and Compositing

Video

Douglas E. Zongker ~ Dawn M. Werner ~ Brian Curless ~ David H. Salesin

Fast Separation of Direct and Global Images Using High Frequency Illumination

Shree K. Nayar

Gurunandan G. Krishnan

Columbia University

Michael D. Grossberg

City College of New York

Ramesh Raskar

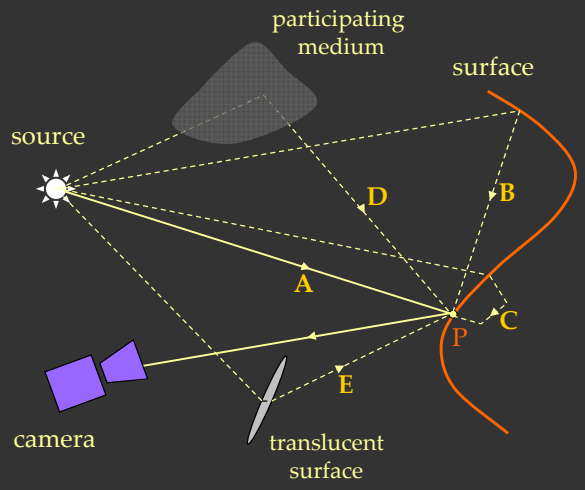
MERL

SIGGRAPH Conference

Boston, July 2006

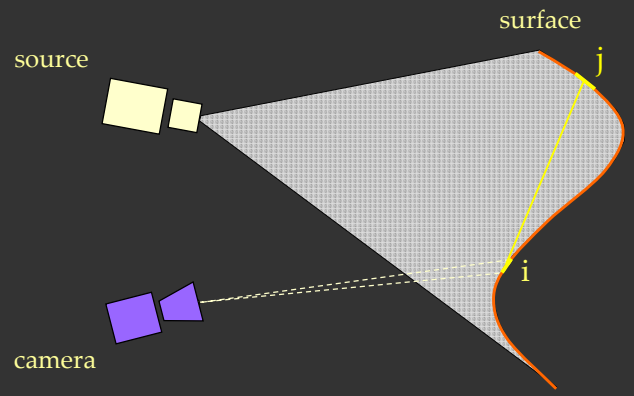
Support: ONR, NSF, MERL

Direct and Global Illumination



A : Direct
B : Interrelection
C : Subsurface
D : Volumetric
E : Diffusion

Direct and Global Components: Interreflections



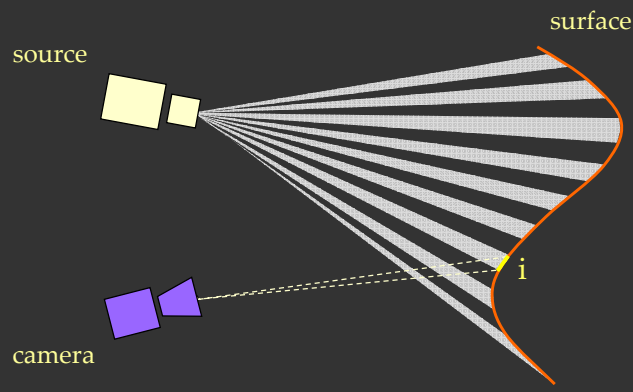
$$L[c,i] = L_d[c,i] + L_g[c,i]$$

radiance direct global

$$L_g[c,i] = \sum_P A[i,j]\, L[i,j]$$

BRDF and geometry

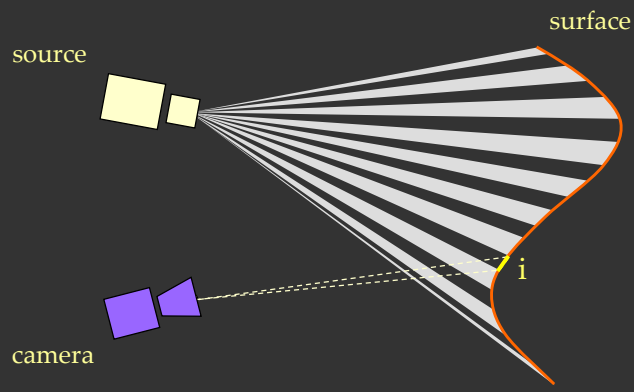
High Frequency Illumination Pattern



$$L^{+}[c,i] = L_d[c,i] + \alpha L_g[c,i]$$

fraction of activated source elements

High Frequency Illumination Pattern



$$L^{+}[c,i] = L_d[c,i] + \alpha L_g[c,i] \qquad L^{-}[c,i] = (1-\alpha) L_g[c,i]$$

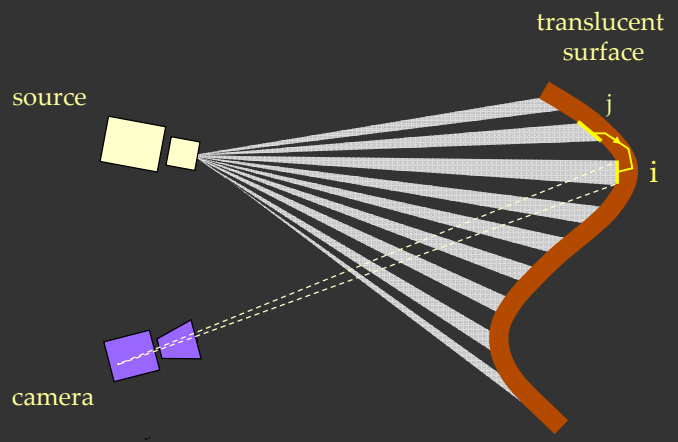
fraction of activated source elements

Separation from Two Images

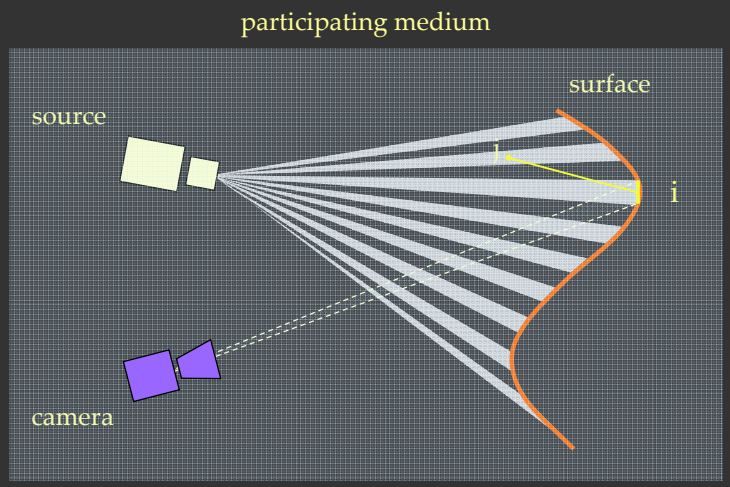
$$\alpha = \frac{1}{2}: \quad L_d = L_{\max} - L_{\min}, \quad L_g = 2L_{\min}$$

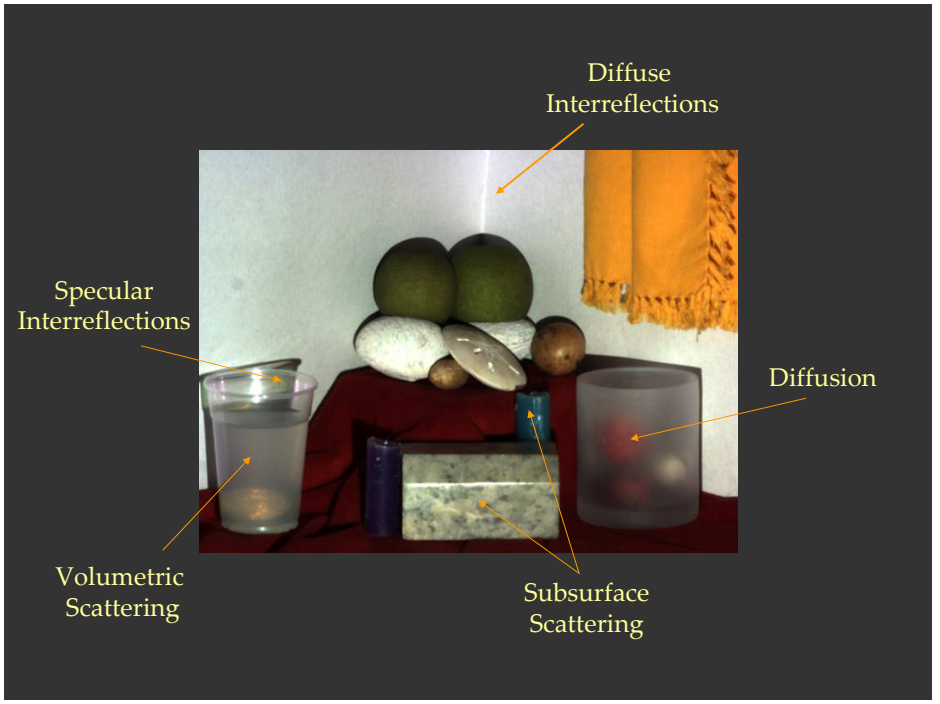
direct global

Other Global Effects: Subsurface Scattering



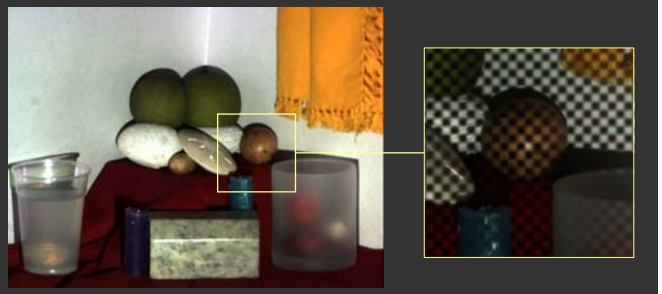
Other Global Effects: Volumetric Scattering



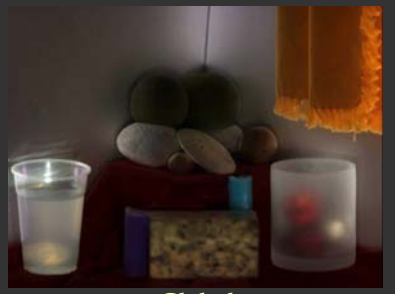


Scene

Scene



Direct



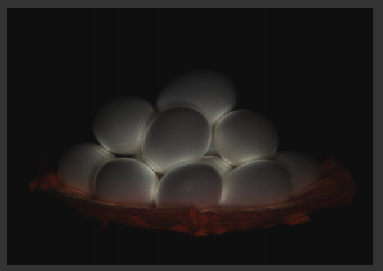
Global

Real World Examples:

Can You Guess the Images?

Eggs: Diffuse Interreflections

Direct



Global

Wooden Blocks: Specular Interreflections

Direct

Global

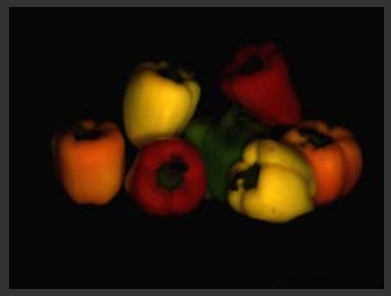
Kitchen Sink: Volumetric Scattering

Volumetric Scattering:
Chandrasekar 50, Ishimaru 78

Direct

Global

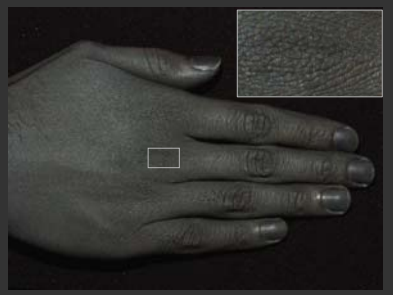
Peppers: Subsurface Scattering



Direct Global

Hand

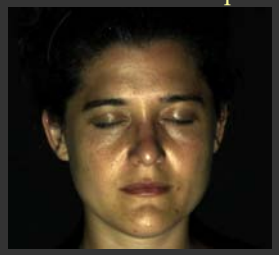
Skin: Hanrahan and Krueger 93, Uchida 96, Haro 01, Jensen et al. 01, Cula and Dana 02, Igarashi et al. 05, Weyrich et al. 05

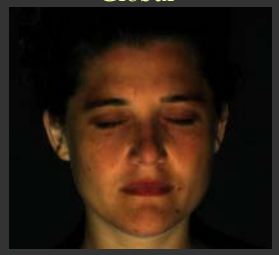


Direct Global

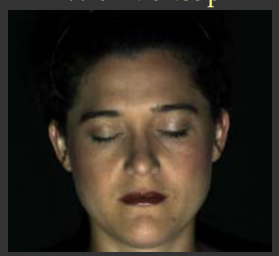
Face: Without and With Makeup

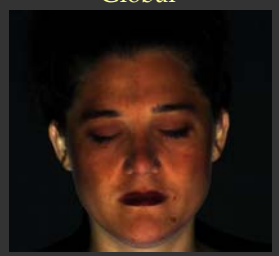
Without Makeup Direct Global





With Makeup Direct Global





Blonde Hair

Hair Scattering: Stamm et al. 77, Bustard and Smith 91, Lu et al. 00 Marschner et al. 03

Direct Global

www.cs.columbia.edu/CAVE