Beyond Ray Tracing

COSC342

Lecture 22
23 May 2017

Beyond Ray Tracing

- Path Tracing
- Bidirectional Path Tracing
- Metropolis Light Transport
- Cone/Beam Tracing
- Radiosity
- Caustics

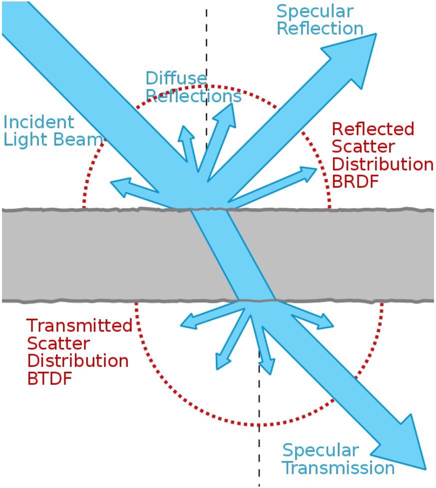
Path Tracing

Model scattering of light

- Diffuse rays
- Specular rays
- Reflection, rotation

BRDF

- Bidirectional reflection distribution function
- Determines rays to cast
- Depends on surface material



Bidirectional Path Tracing

We cast rays from the camera

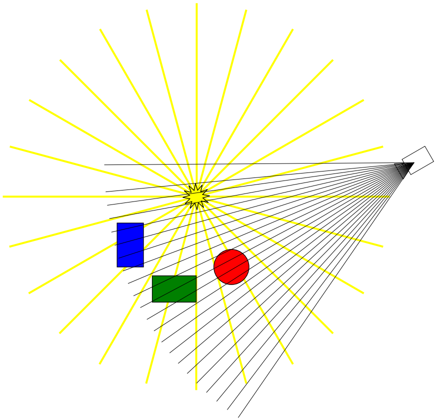
- Can cast rays from lights
- Most rays won't reach image
- But more realistic lighting

Compromise by doing both

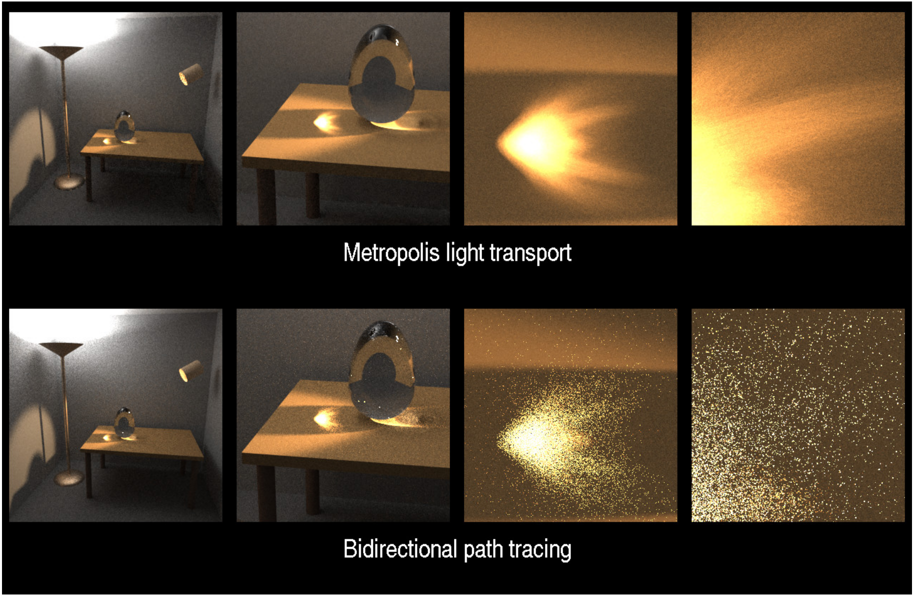
- Limited rays from lights
- Path tracing from camera
- Join up rays at each surface

Metropolis light transport

- Add samples near joined rays
- Monte-carlo approach



Metropolis Light Transport (Veach & Guibas, SIGGRAPH'97)



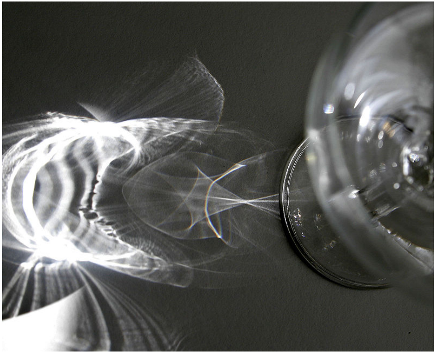
Benefits of Bidirectional Approach

Shadows of transparent objects

- Partial shading
- Accounting for refraction

Caustics

- Bright areas in shadows
- Caused by refraction
- Different paths add up



Light through glass 05, CC-BY-SA Fir0002/Flagstaffotos

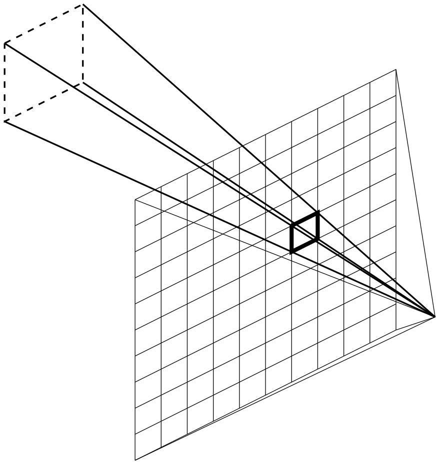
Cone/Beam Tracing

Rays have no thickness

- Pass through image at a point
- But pixels have an area
- Super-sampling one approach

Beam tracing uses solid ‘rays’

- Pyramids for square pixels
- Cones for circular patches
- Avoids many aliasing issues
- Intersections more complex



Radiosity

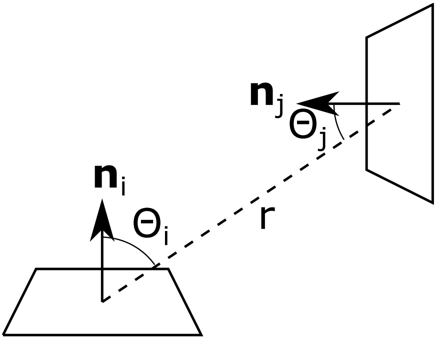
Divide scene into patches

- Each can reflect light
- Some emit light also

How much light at each patch?

- Sum light over all patches
- Weighted by *view factor*

$$F_{i,j} = \frac{1}{\pi r^2} \cos(\theta_i) \cos(\theta_j)$$



Radiosity Example (Kamil Dudka, Radiosity Renderer and Visualiser)