

DCGI

KATEDRA POČÍTAČOVÉ GRAFIKY A INTERAKCE

Photorealism

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Outline

- Introduction
- Photorealistic rendering

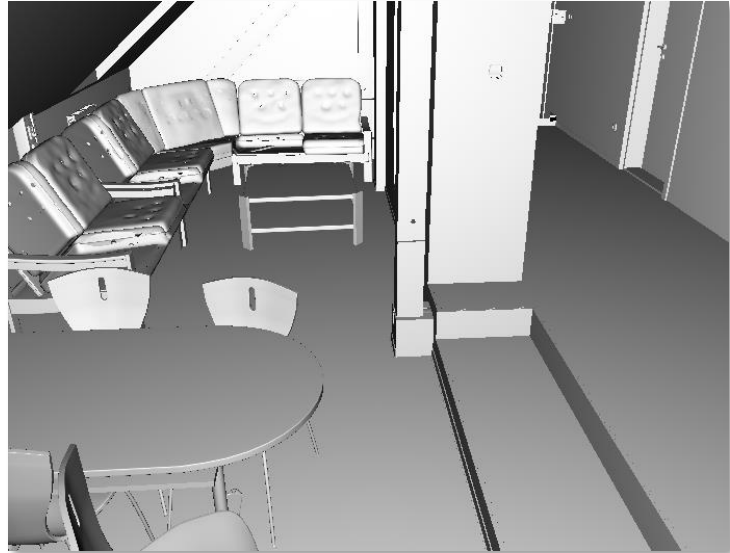
MPG 15.1-15.7

Rendering - Introduction

- Compute image



... from scene description



Photorealistic Rendering



(images from master thesis of R. Hub, ČVUT FEL 2014)

<https://area.autodesk.com/fakeorfoto/>

Scene Description (Review)

- Geometry
 - Objects & positions
 - Commonly a B-rep
- Surface materials
 - Color, reflectivity, ...
- Light sources
 - Position, direction, size
 - Directional and spatial distribution, color
- Camera
 - Perspective, parallel, spherical ...

Different Approaches to Rendering

- *Non-photorealistic rendering*

- Mimic artistic styles
- Technical drawings
- Emphasizing selected information



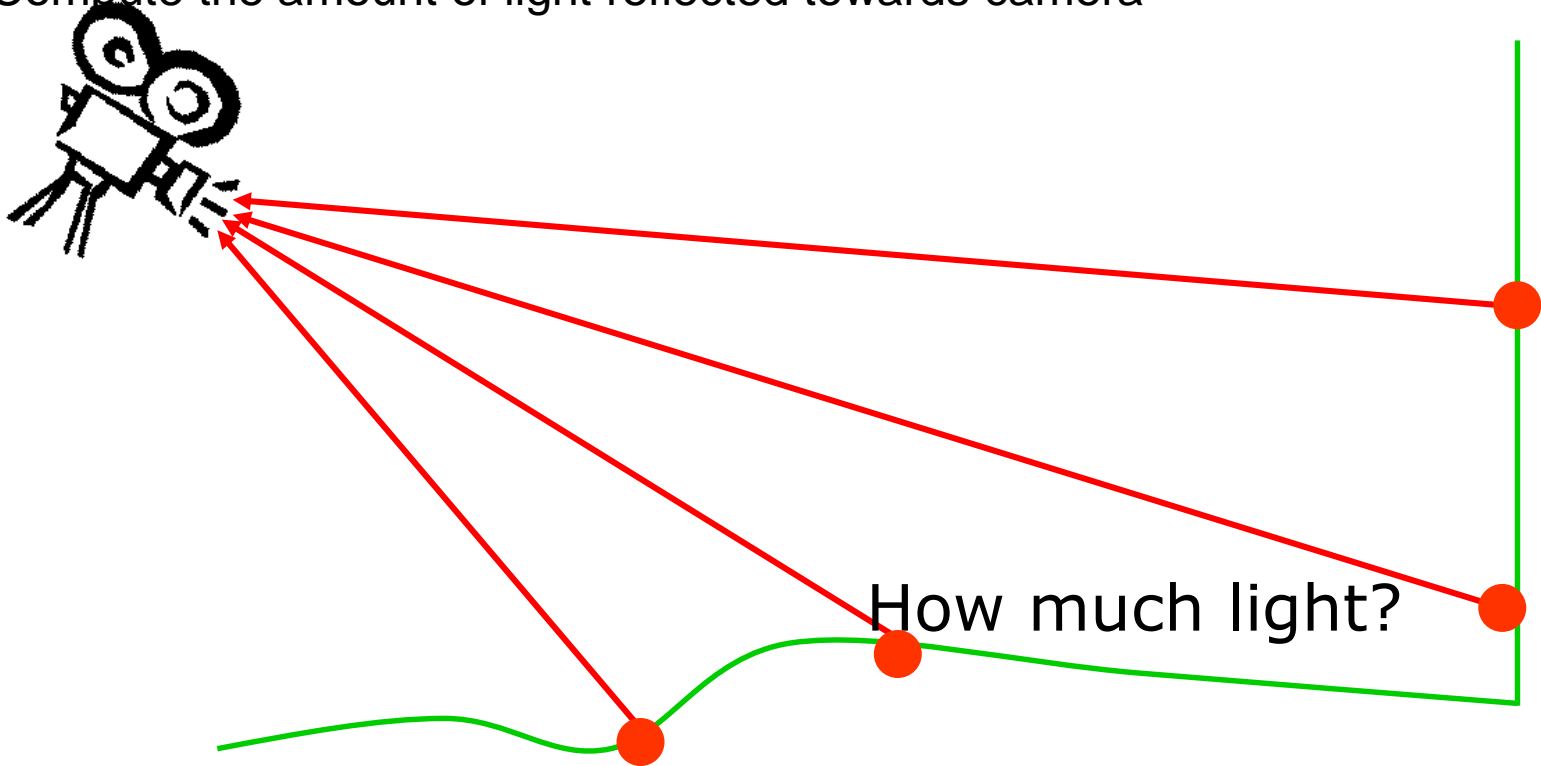
- *Photorealistic rendering*

- *Goals: images match reality*
- Simulation of light transport
- **Our topic**



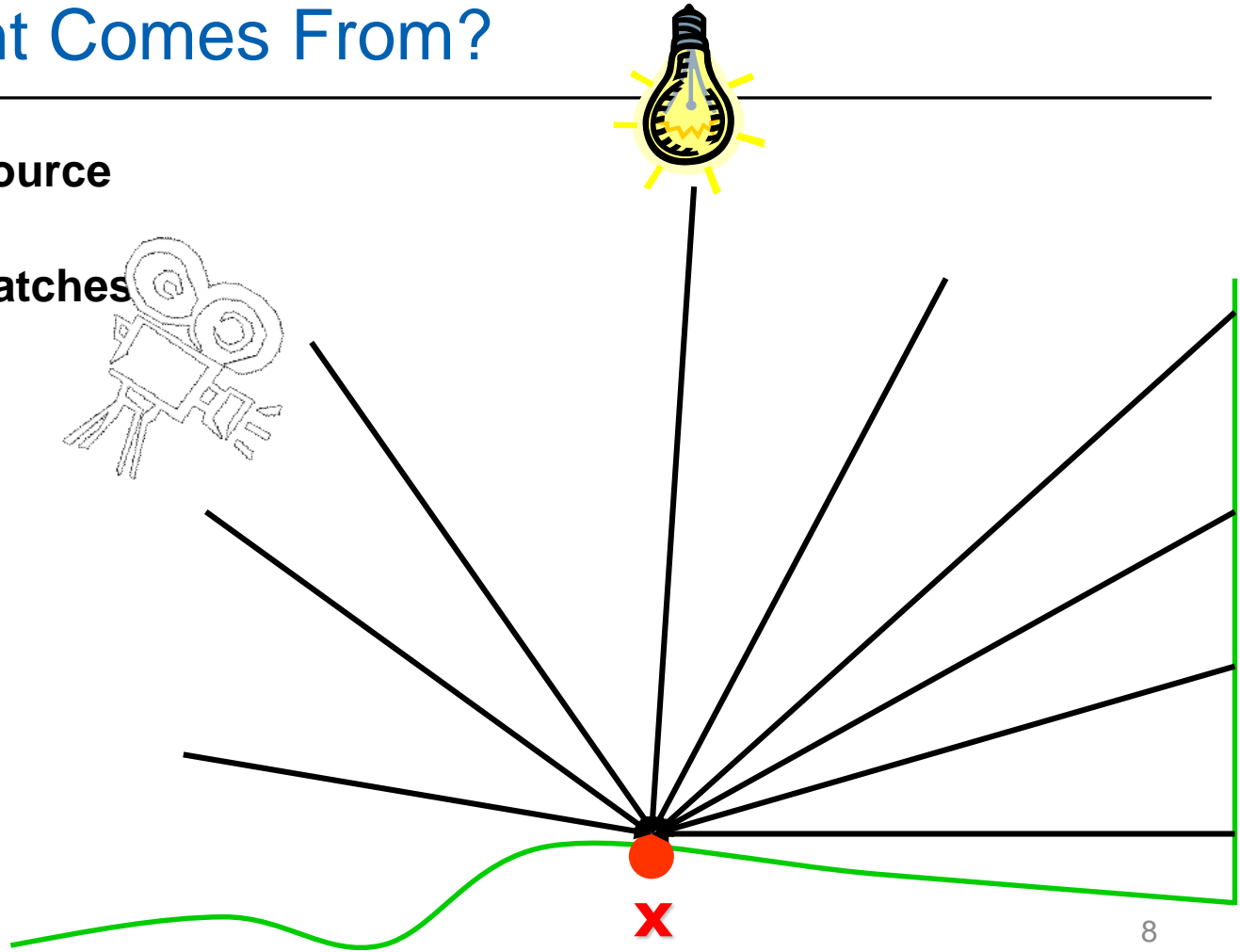
Photorealistic Rendering

- For every visible point \mathbf{p} in the scene
 - Compute the amount of light reflected towards camera



Where the Light Comes From?

- Directly from **light source**
(direct illumination)
- From other **scene patches**
(indirect illumination)

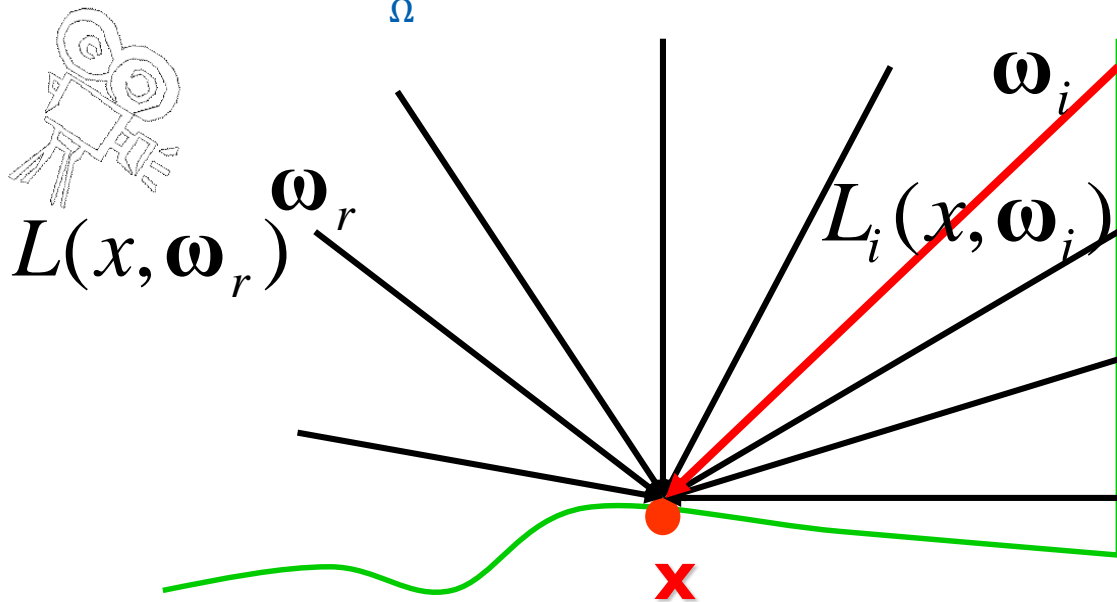


Rendering Equation

[Kajiya 86]

Hemispherical formulation

$$L_r(x, \omega_r) = L_e(x, \omega_r) + \int_{\Omega} f_r(x, \omega_i, \omega_r) L_i(x, \omega_i) \cos \theta_i d\omega_i$$

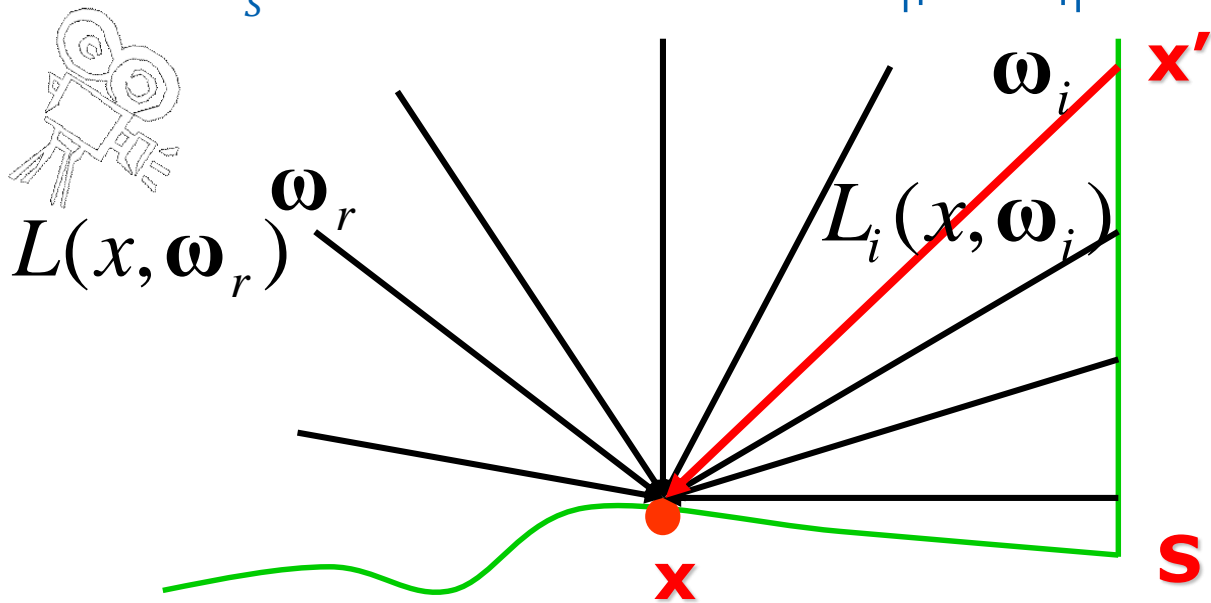


Rendering Equation

[Kajiya 86]

Area formulation

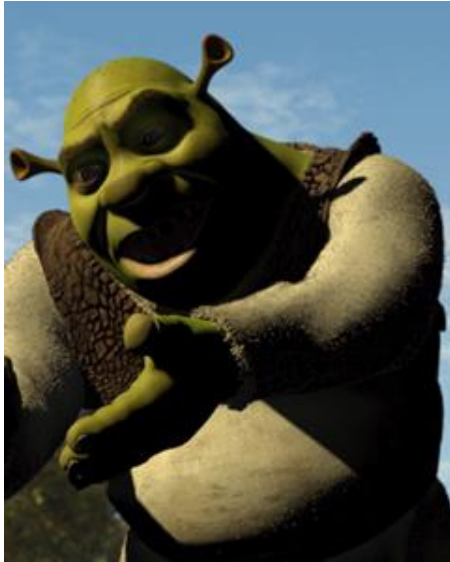
$$L_r(x, \omega_r) = L_e(x, \omega_r) + \int_S f_r(x, \omega_i, \omega_r) L_i(x, x' \rightarrow x) \frac{V(x, x') \cos \theta_i \cos \theta'}{\|x - x'\|^2} dA'$$



Global Illumination – GI

- **Only direct illumination**

- Light bounces ONCE on path from light source to camera



Images © PDI/Dreamworks



- **Global illumination**

- Global = Direct + Indirect
- Light transport among scene patches
- Many light bounces

Global Illumination Effects

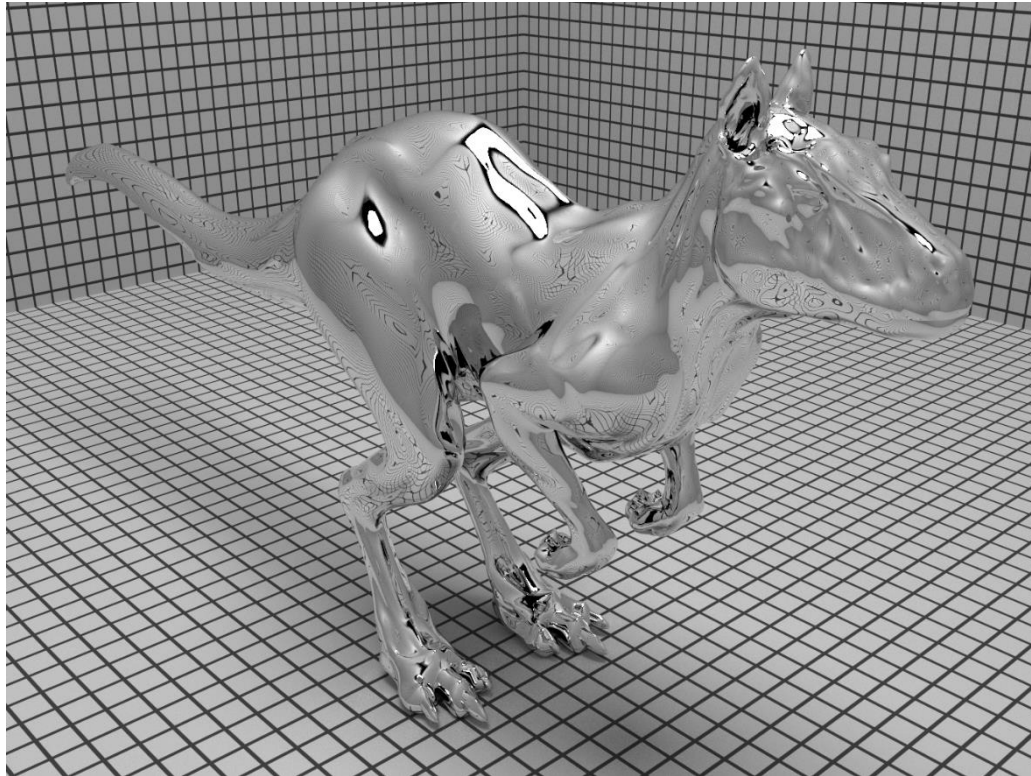
- Ideal reflection/refraction
- Color bleeding
- Caustics



Mies Courtyard House with Curved Elements

Modeling: Stephen Duck; Rendering: Henrik Wann Jensen

Ideal Specular Reflection



Reflection on Water Surface

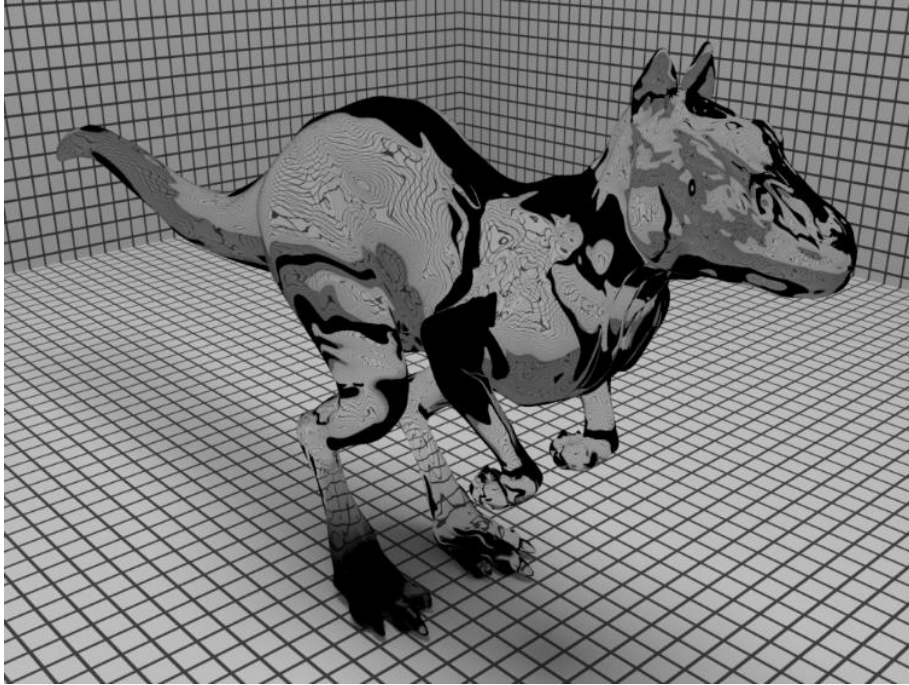


Smooth Water Surface

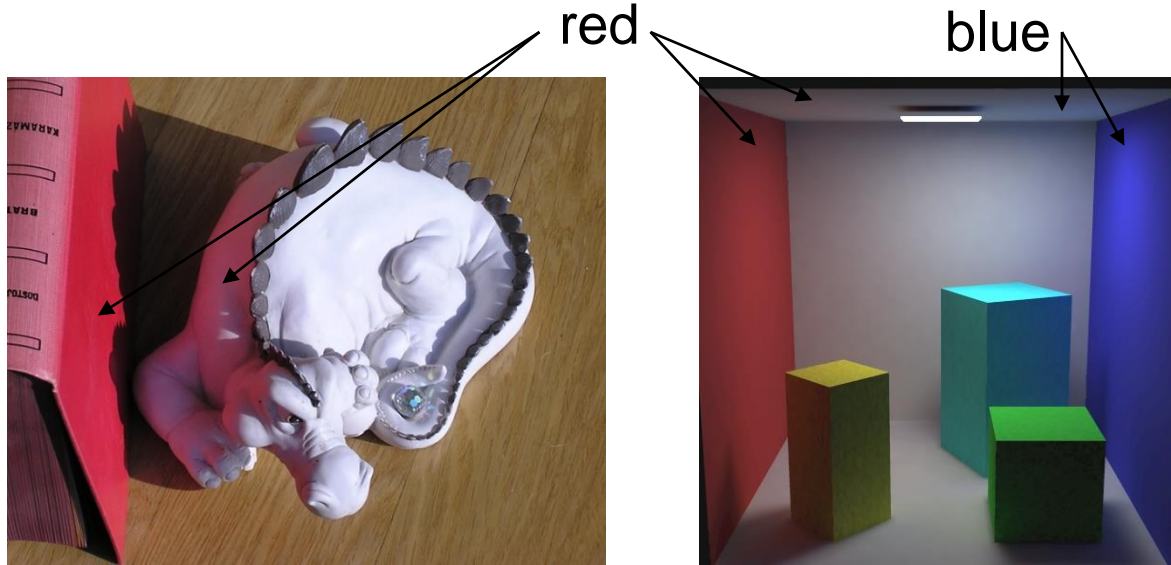


Wavy Water Surface

Ideal Specular Refraction



Color Bleeding



- From one diffuse surface to another
- Important in painting
 - subconscious understanding of spatial relationships

Caustics

1. Light concentration due to reflection/refraction
2. Local increase of light intensity
3. Incidence with diffuse surface



reality



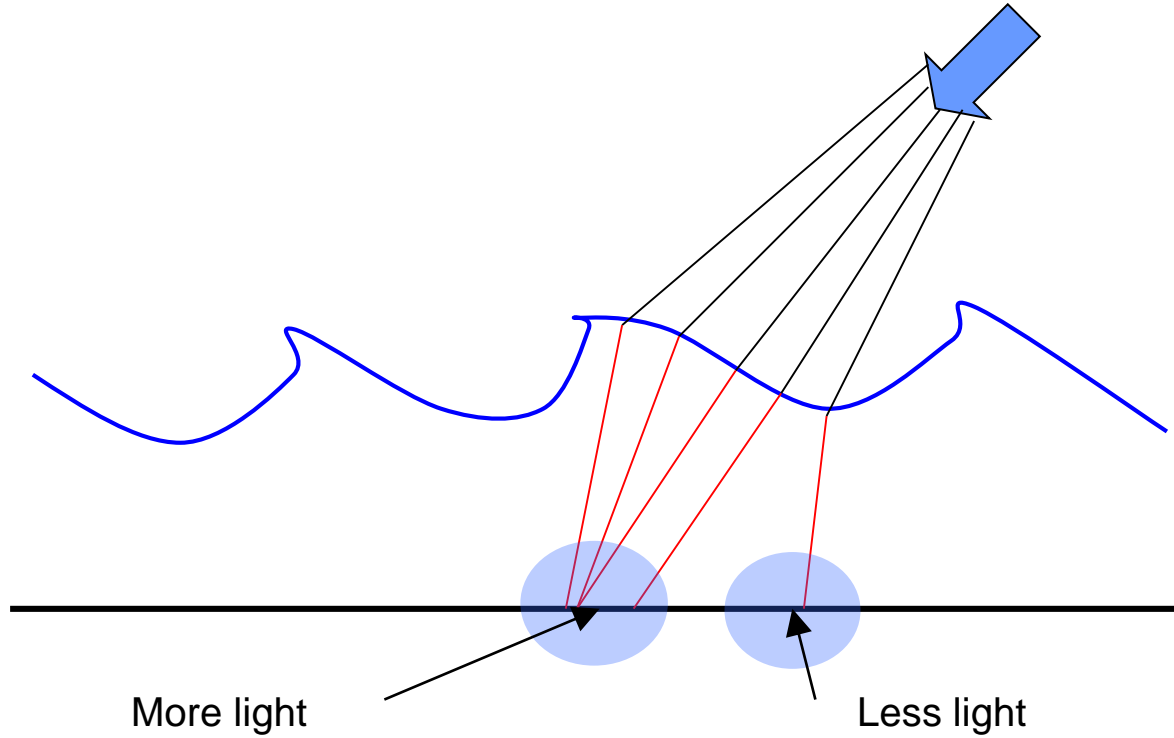
simulation

Rendering Water

- Reflection/refraction on water surface
- Caustics on the pool bottom

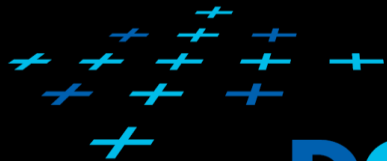


Underwater Caustics



Global Illumination Simulation

- We need
 - Description of “amount of light” in space – radiometry
 - Description of light reflection on surface – BRDF
 - Description of stationary light distribution – rendering equation
 - Efficient algorithms!
- Details in Realistic Image Synthesis (A4M39RSO)



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Questions?