Global Illumination Across Industries

Course
SIGGRAPH 2010

Jaroslav Křivánek
Cornell University &
Charles University, Prague

Marcos Fajardo
Solid Angle SL

Per Christensen
Pixar Animation Studios

Eric Tabellion
PDI/DreamWorks

David Larsson
Illuminate Labs
*(*now *Autodesk)*

Michael Bunnell
Fantasy Lab, Inc.

Anton Kaplanyan
Crytek GmbH

Global Illumination Across Industries

Introduction

Jaroslav Křivánek

Cornell University &

Charles University, Prague

Global illumination?

- Light bouncing around in a scene

www.photos-of-the-year.com

Diffuse inter-reflection

- May go unnoticed, but looks odd if missing

Slide credit: Michael Bunnell

GI across industries? Which ones?

- Architectural visualization
- Interior design
- Product design
- Animated movies, special effects
- Games

What will I get if I stay?

- Representative sampling of GI techniques in film & games
- Focus on specifics & differences
- Little theory
- Delivered by the most qualified speakers…

Marcos Fajardo (*Solid angle SL*)

Ray Tracing in Film Production Rendering
(2:15 pm)

- Conceived Arnold renderer
- Unbiased path-tracer
- Adopted by Sony Pictures Imageworks for *Monster House*, now their standard renderer

Per Christensen (*Pixar*)

Point-based Global Illumination for Films
(2:40pm)

- Won Oscar for developing PBGI for film rendering
- PBGI responsible for wide acceptance of GI in film production
- PBGI first used on Pirates o.t. C.: Dead Man's Chest, dozens of films followed

Eric Tabellion (*PDI/DreamWorks*)

Ray Tracing vs. Point-based GI for Animated Films (3:05 pm)

- Pioneered the use of GI in 3D animation: Shrek 2
- First irradiance caching (ray tracing) later PBGI
- Compare their experience with the two techniques

Michael Bunnell (*FantasyLab*)

Adding Real-Time Point-based GI to a Video Game – Lessons Learned (3:45 pm)

- Originated the PBGI technique
- Won Oscar for PBGI
- Integrated PBGI in several game engines

David Larsson (*Illuminate Labs*)

Pre-computing Lighting in Games (4:15 pm)

- Lead engineer at Illuminate Labs
- Pre-lighting tools for games
- Widely used in practice

Anton Kaplanyan (*Crytek GmbH*)

Dynamic Global Illumination for Games: From Idea to Production (4:45 pm)

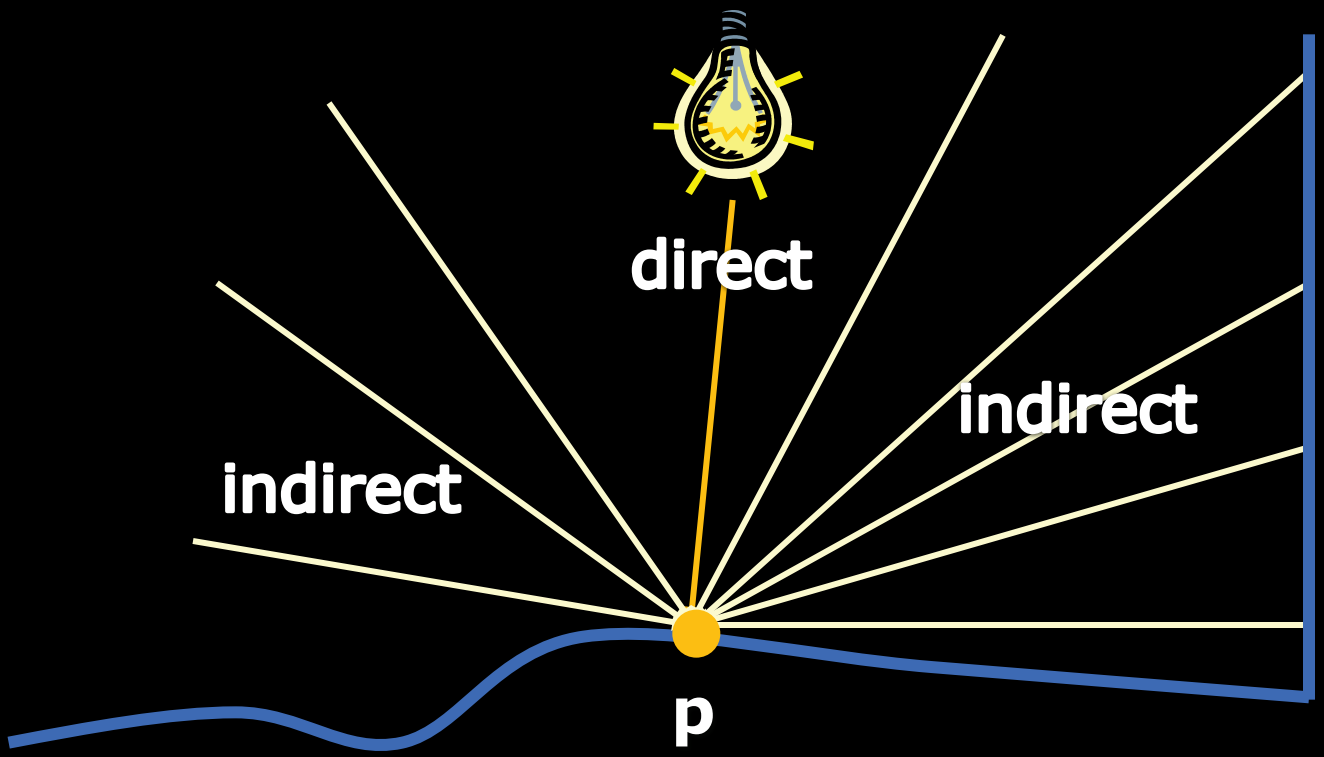
- Lead researcher at Crytek GmbH
- Developed the real-time GI technique for CryEngine

Realistic rendering

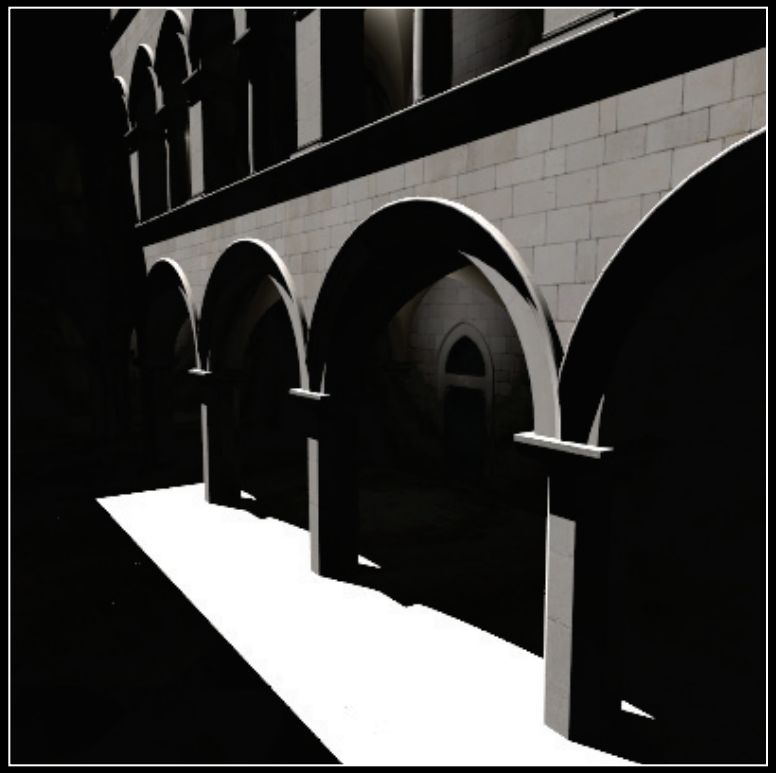
- For each visible point **p** in the scene
  - How much light is reflected towards the camera

Where does the light come from?

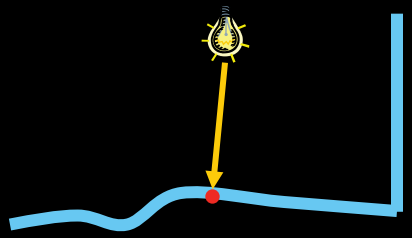
- From light sources (*direct illumination*)
- From scene surfaces (*indirect illumination*)

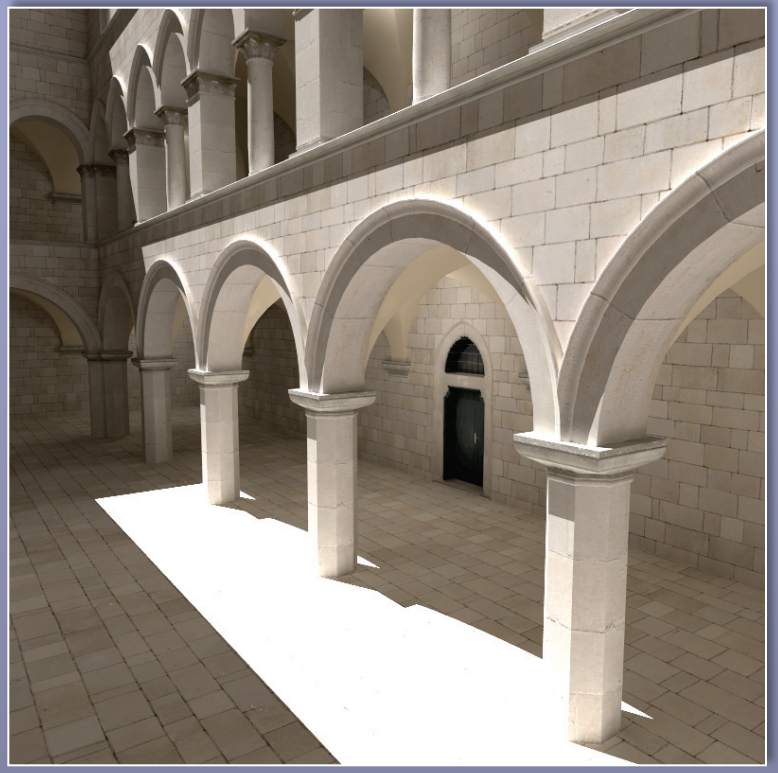


Direct and global illumination

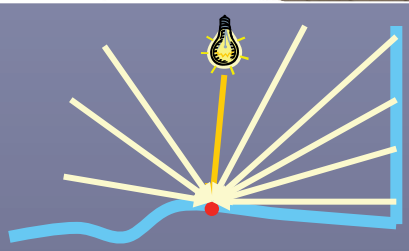


Direct-only



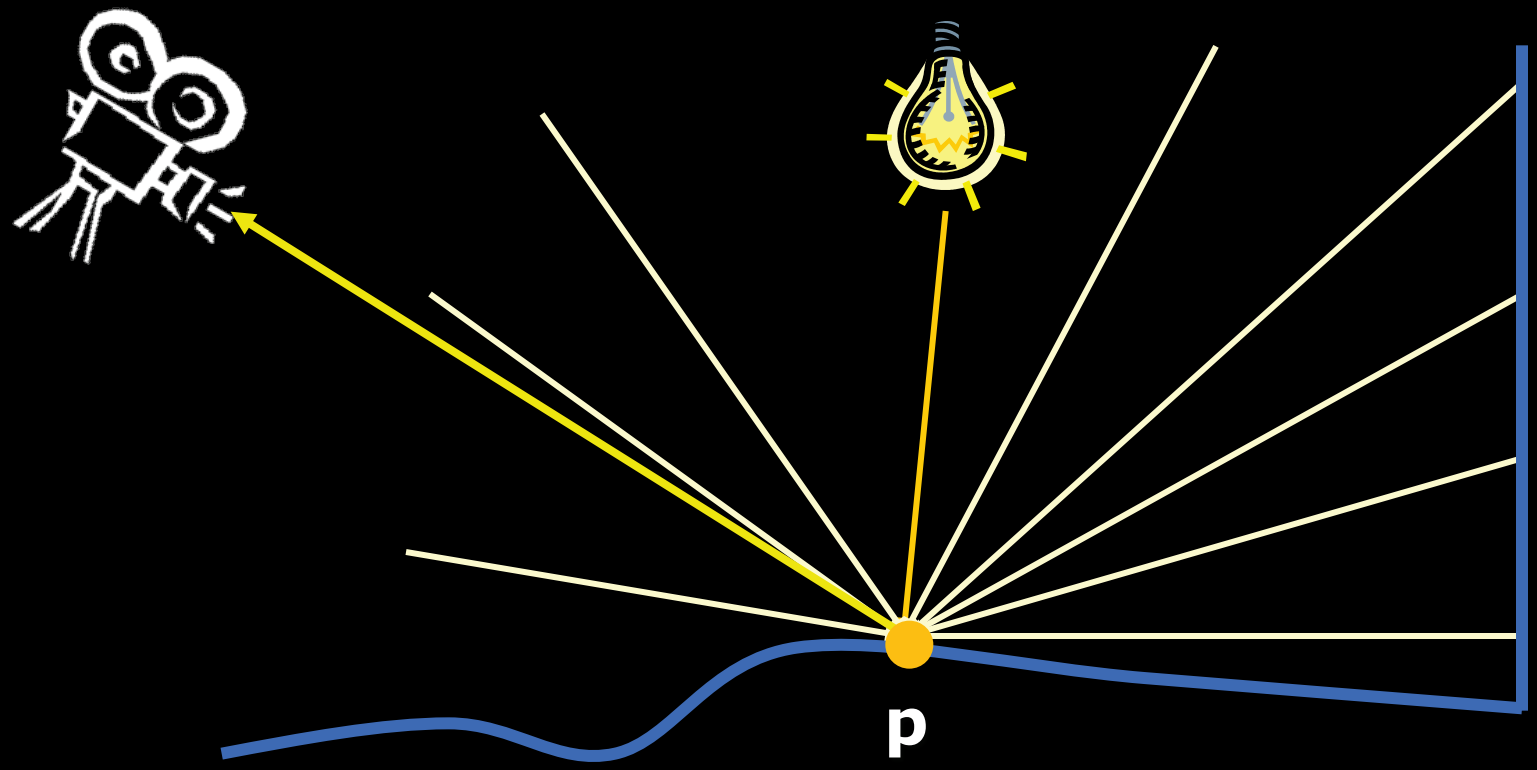


global =
direct +
indirect



Where does the light go then?

- Light reflection – material reflectance



Light reflection

- BRDF
- Shader

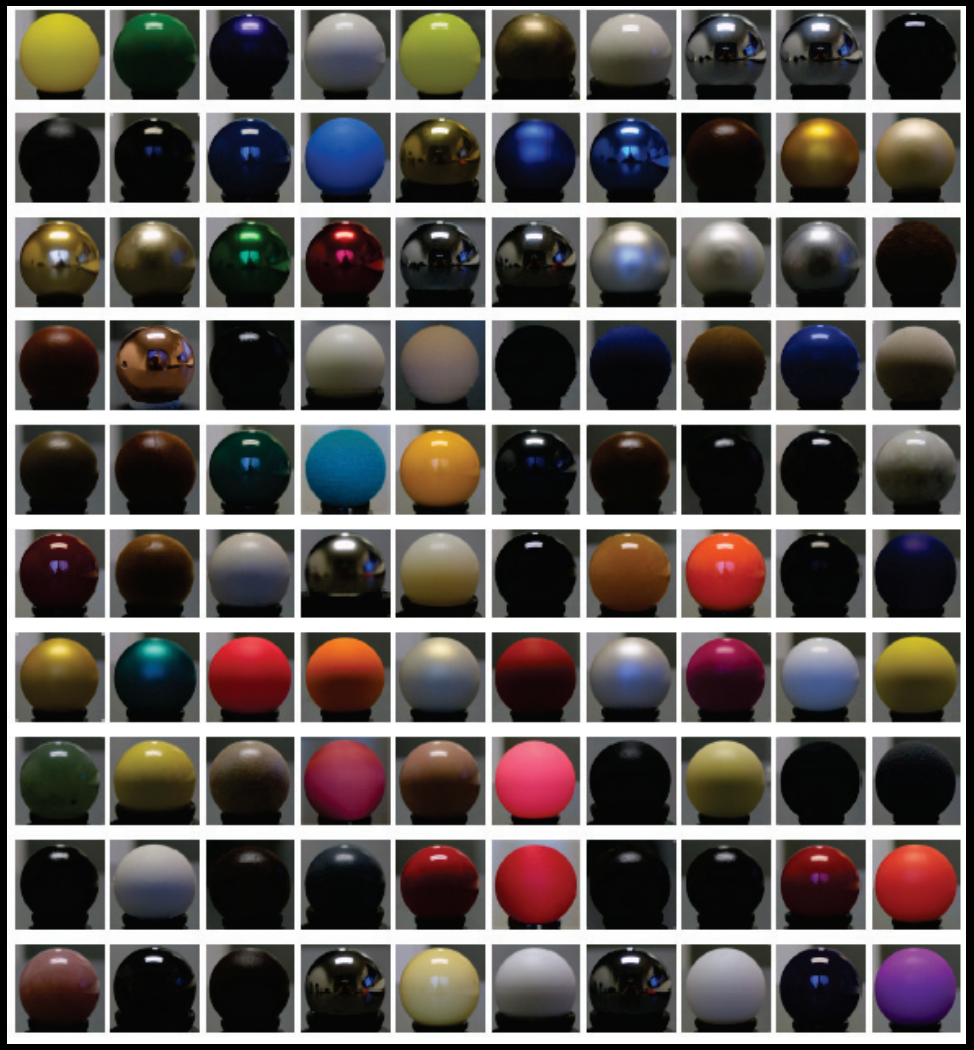
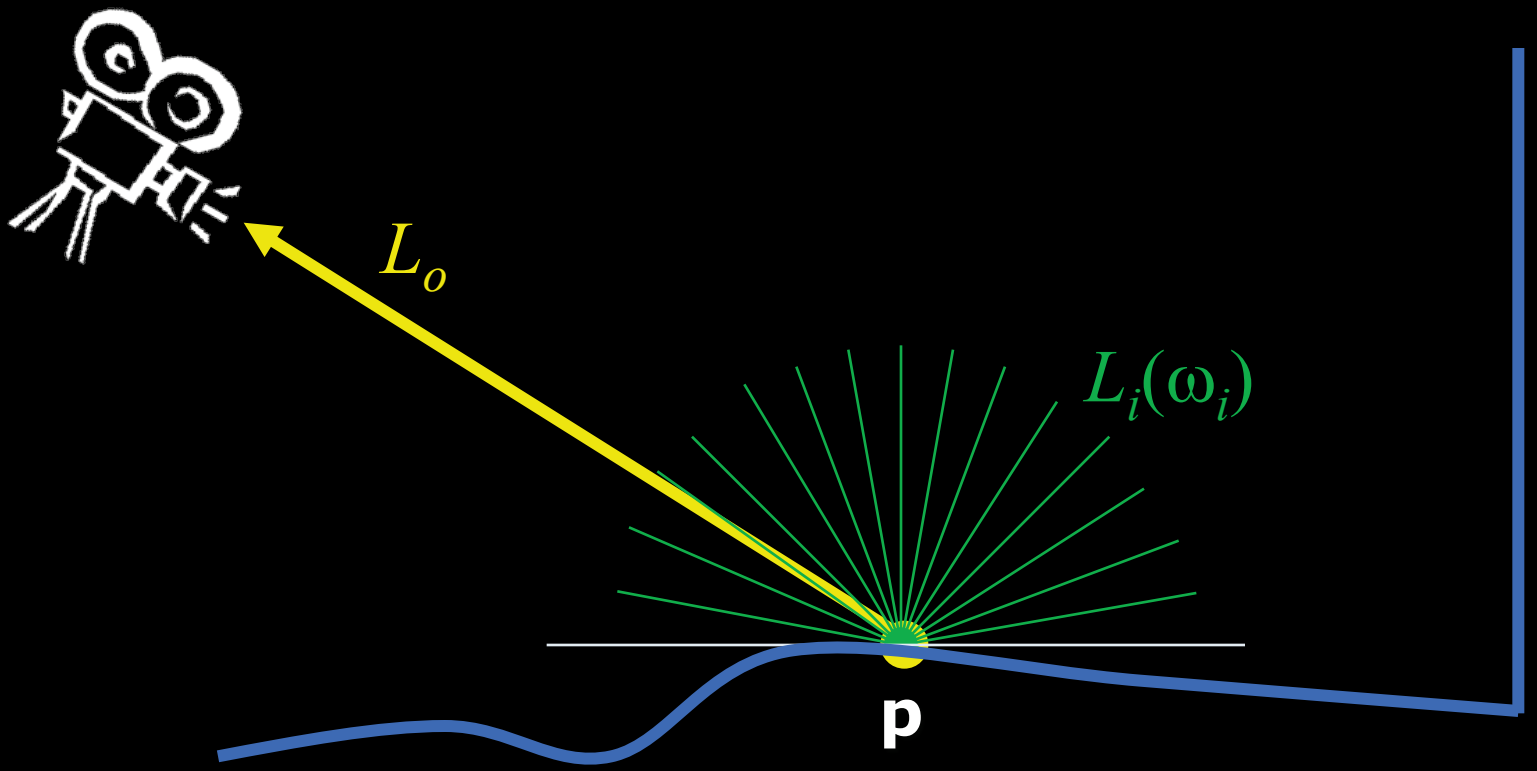


image courtesy Wojciech Matusik

Illumination integral

- Total amount of light reflected to ω_o:

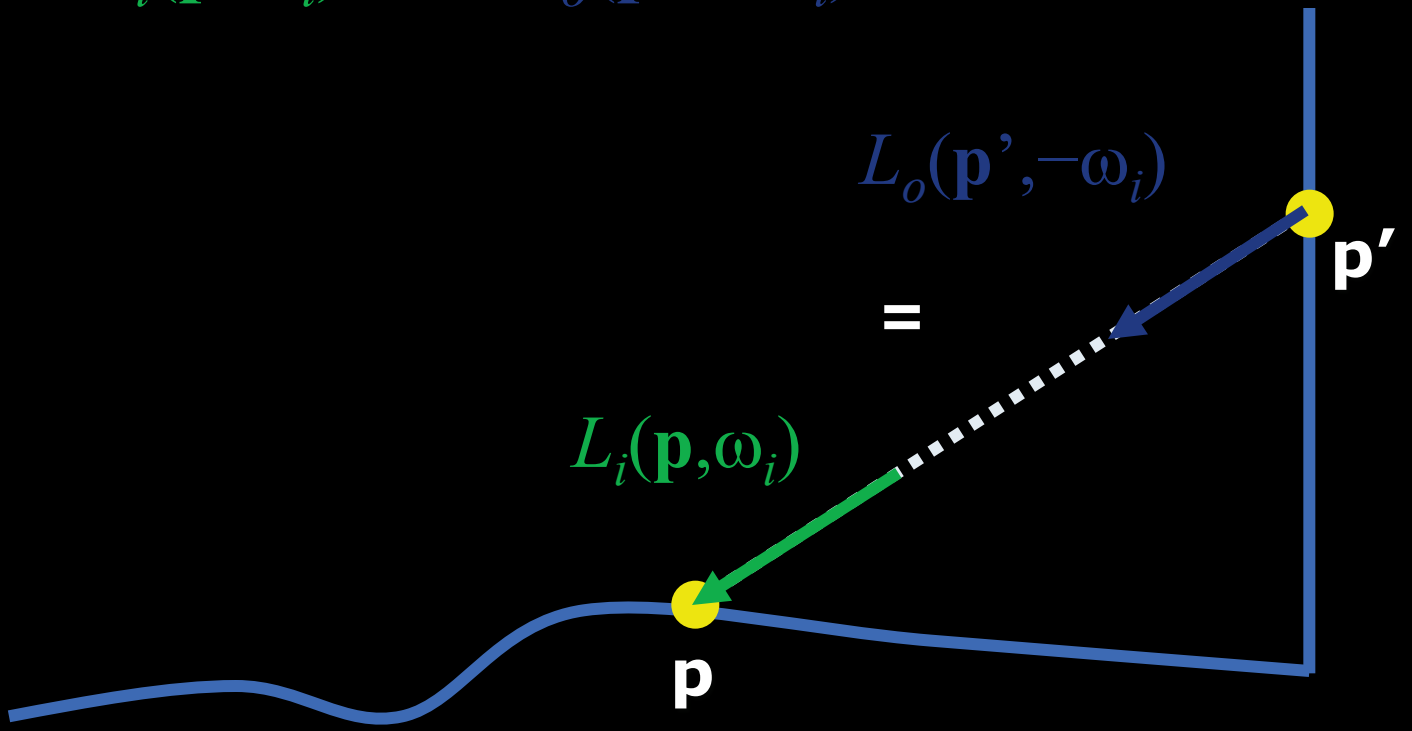
$$L_o = \int L_i(\omega_i)\ \mathrm{BRDF}\ (\omega_i)\ \cos\theta_i\ \mathrm{d}\omega_i$$



Light transport

- **Q**: How much light is coming from ω_i ?

$$L_i(\mathbf{p},\omega_i) = L_o(\mathbf{p}',-\omega_i)$$

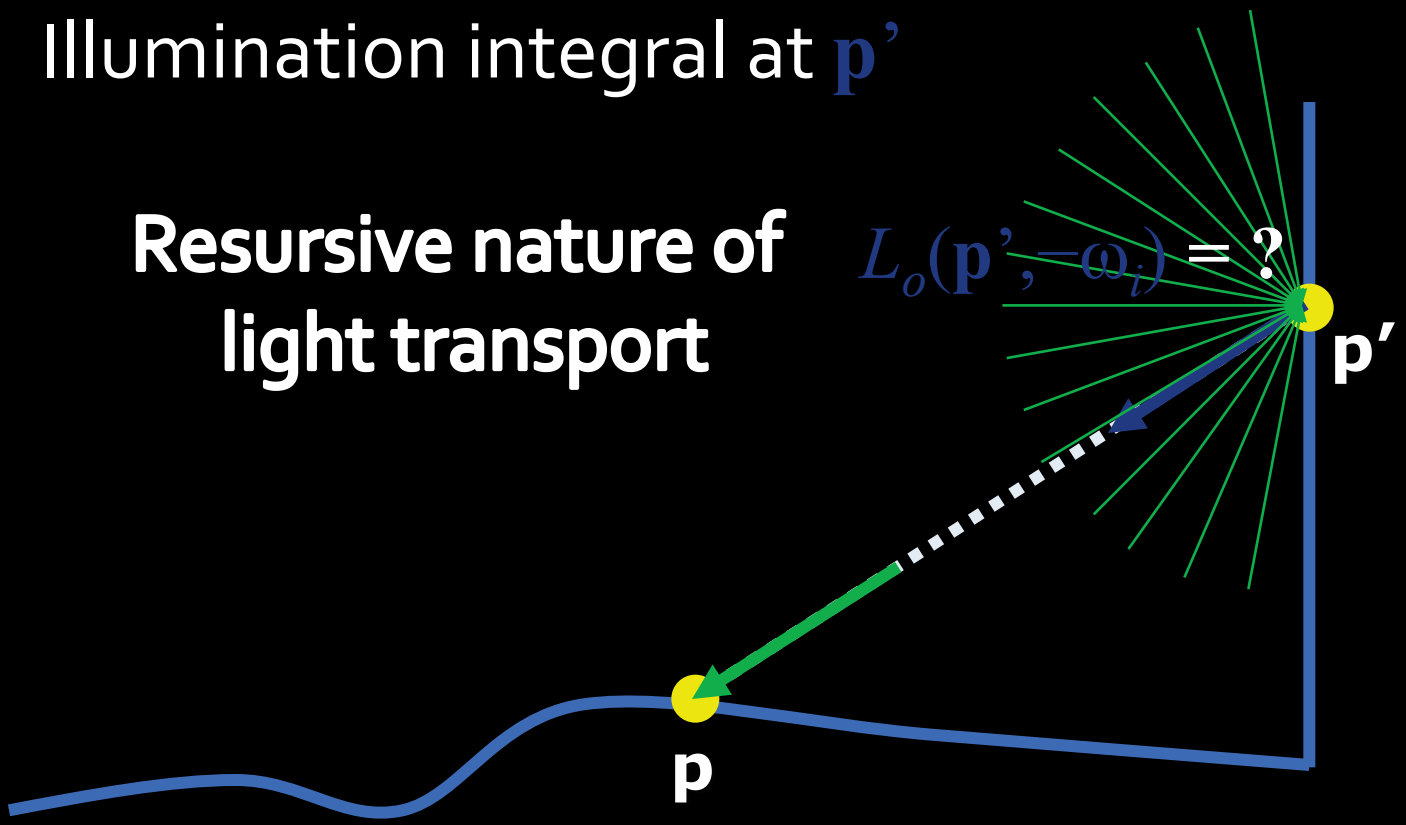


Recursion

- **Q**: How much light is reflected from **p'** ?

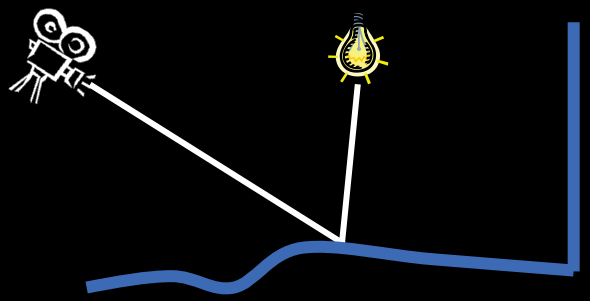
Illumination integral at **p'**

Resursive nature of light transport

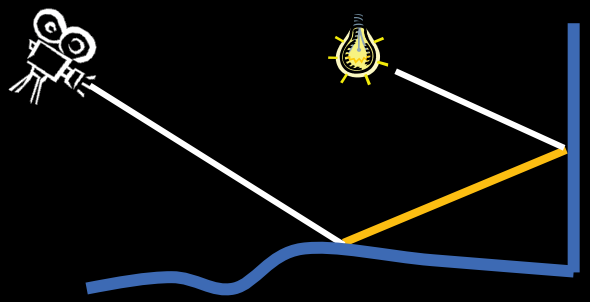


1-bounce indirect … ?

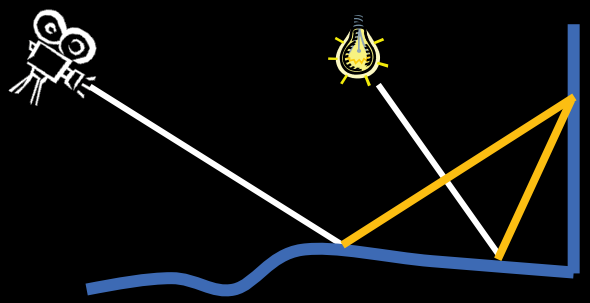
- Direct-only



- 1-bounce indirect



- 2-bounce indirect



GI computation

- Many techniques exist
- All of them transport light among surfaces
- Different practical consequences
- Our course will help you get oriented