Global Illumination Across Industries

Course
SIGGRAPH 2010

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Global Illumination Across Industries

Introduction

Jaroslav Křivánek
Cornell University &
Charles University, Prague
Global illumination?

- Light bouncing around in a scene

- diffuse inter-reflections
- glossy reflections
- caustics
- refractions

www.photos-of-the-year.com
Diffuse inter-reflection

- May go unnoticed, but looks odd if missing
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
Illumination integral

- Total amount of light reflected to $\omega_o$:

$$L_o = \int L_i(\omega_i) \text{ BRDF}(\omega_i) \cos \theta_i \, d\omega_i$$
Q: How much light is coming from $\omega_i$?

$$L_i(p, \omega_i) = L_o(p', -\omega_i)$$
Recursion

Q: How much light is reflected from \( p' \) ?

Illumination integral at \( p' \)

Recursive 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