PATH INTEGRAL METHODS FOR LIGHT TRANSPORT SIMULATION

THEORY & PRACTICE

Jaroslav Křivánek
Charles University Prague

Iliyan Georgiev
Light Transporttion, Ltd.

Anton Kaplanyan
KIT

Juan Cañada
Next Limit Technologies

INTRODUCTION

Jaroslav Křivánek

Charles University in Prague

Origin of this tutorial

- SIGGRAPH 2013 course:

"Recent advances in light transport simulation:
Theory & Practice"

Light transport – Global illumination

Archviz

Movies

Image courtesy of Columbia Pictures.
© 2006 Columbia Pictures Industries, Inc.

Light transport – Global illumination

Movies

- **2002, Shrek 2** (PDI/Dreamworks)
  - 1 bounce indirect

- **2006, Monster House** (Sony Imageworks)
  - **Full light transport** (path traced)
  - Arnold renderer

Image courtesy of Columbia Pictures.

Light transport – Global illumination

Movies

- **2006, Monster House** (Sony Imageworks)
  - **Full light transport** (path traced)
  - Arnold renderer

Image courtesy of Columbia Pictures.
© 2006 Columbia Pictures Industries, Inc.

- **Full light transport simulation**
  - Accuracy
  - Ease of use
  - **Visual consistency**

Light transport – Global illumination

- **More information**
  - "The State of Rendering"

- **Full light transport simulation**
  - Accuracy
  - Ease of use
  - **Visual consistency**

Issues in light transport simulation

- **Robustness**
  - None of the existing algorithms works for all scenes

Take-home message

Light transport simulation
is **not** a solved problem

(robustness, efficiency)

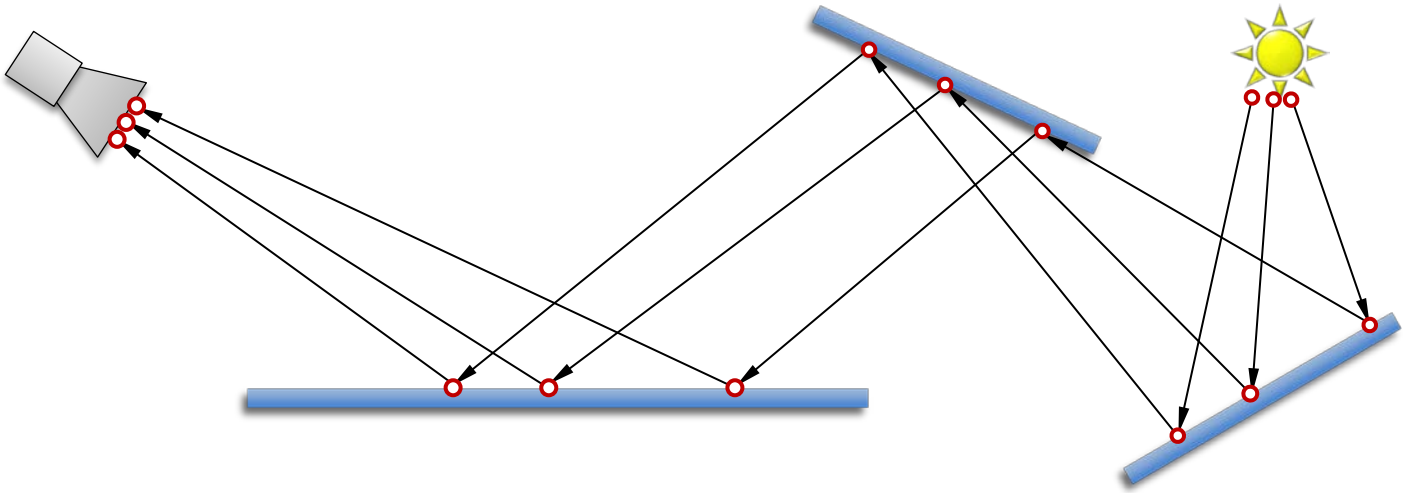
Some recent advances

- Vertex Connection and Merging (VCM) = BPT + PPM
  [Georgiev et al. 12], [Hachisuka et al. 12]

- Improvements on Metropolis Light Transport
  [Jakob and Marchner 12], [Lehtinen et al. 13]

Common denominator

- **Path integral formulation** of light transport
  [Veach and Guibas 1995], [Veach 1997]



Why is the path integral view so useful?

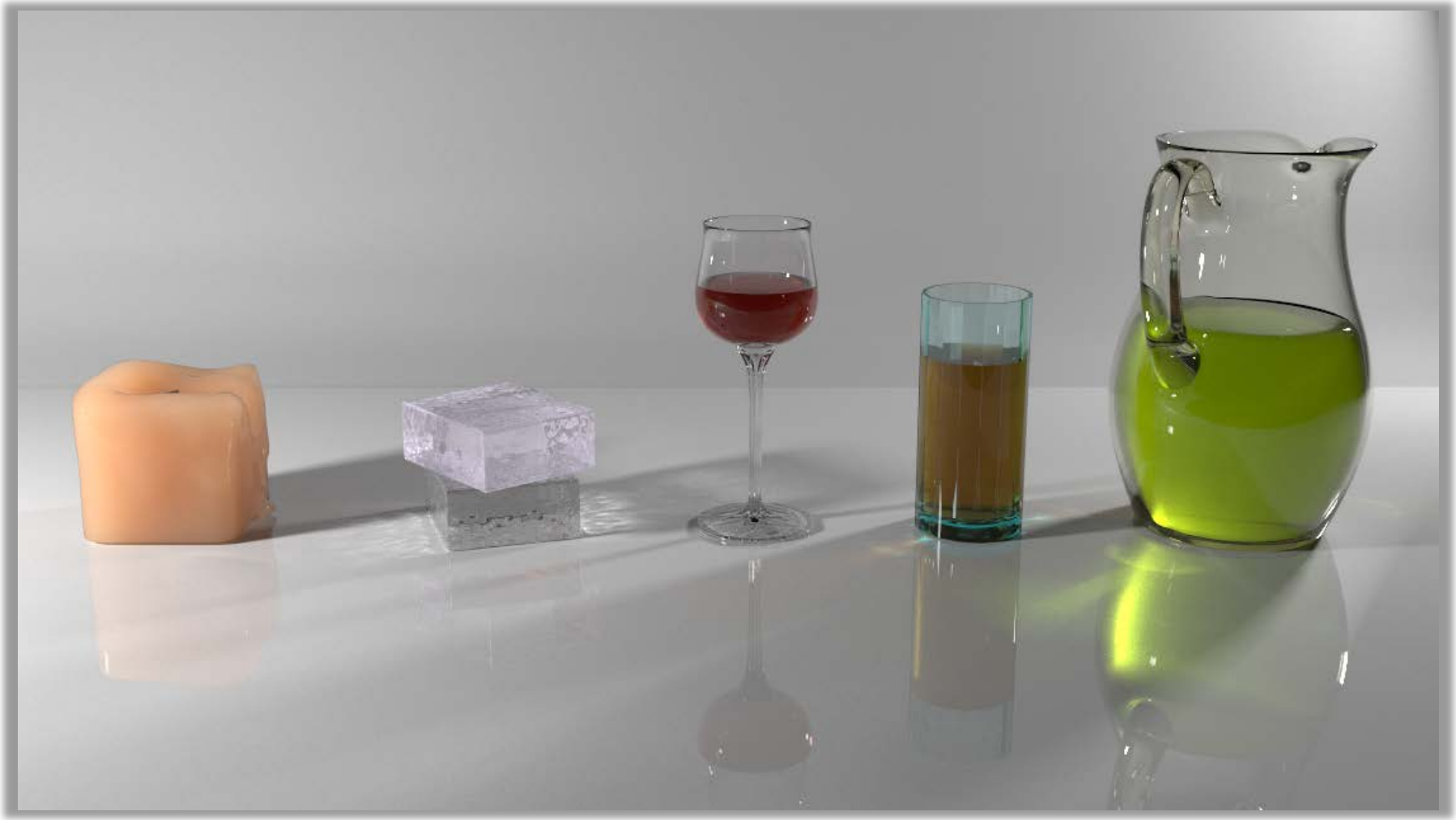
- Identify source of problems
  - **High contribution paths** sampled with **low probability**
- Develop solutions
  - Advanced, global **path sampling techniques**
  - **Combined** path sampling techniques (MIS)

Example:
Vertex Connection & Merging (VCM)

SIGGRAPH Asia 2012

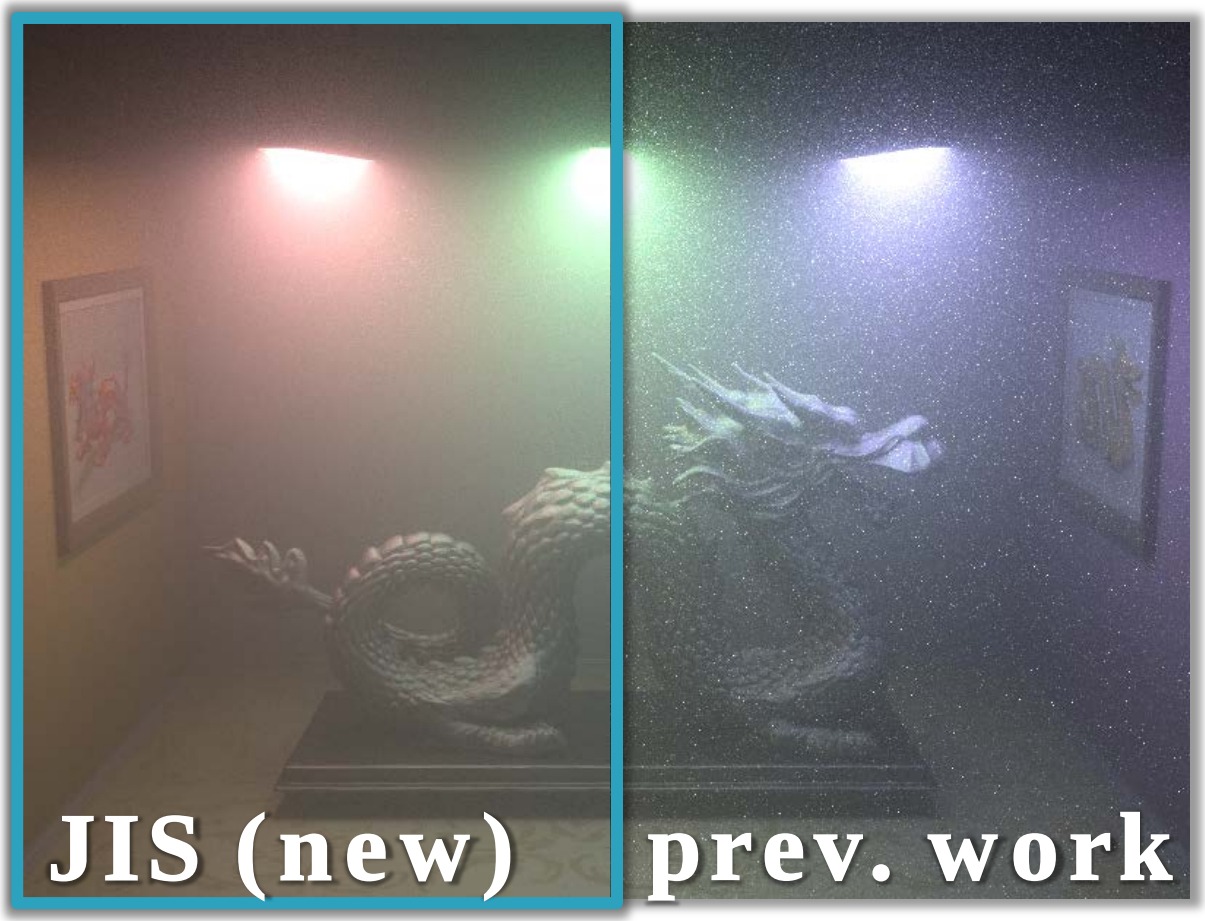
Example:
Unified Points, Beams & Paths

SIGGRAPH 2014 (to appear)



Example:
Joint Importance Sampling (JIS)

SIGGRAPH Asia 2013



Course outline

- **Path Integral Formulation of Light Transport** (*Jaroslav Křivánek*)
- **Bidirectional Path Sampling Techniques** (*Jaroslav Křivánek*)
- **Vertex Connection and Merging** (*Iliyan Georgiev*)

Course outline

- **Markov Chain and Sequential Monte Carlo Methods** (*Anton Kaplanyan)*
- **Comparison of Advanced Light Transport Methods** (*Anton Kaplanyan)*
- **Advanced Light Transport in the VFX/Archiviz industry** (Juan Cañada)