



Eurographics 2015

The 36th Annual Conference of the
European Association for Computer Graphics

Recent Advances in Adaptive Sampling and Reconstruction for Monte Carlo Rendering

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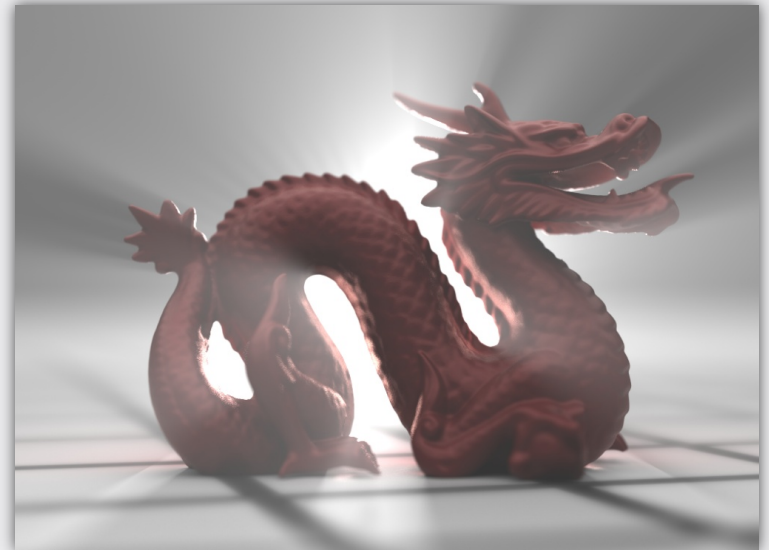
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Introduction

- Monte Carlo path tracing
 - Physically based
 - Very general
 - Guaranteed convergence (except pathological cases)
- Disadvantages
 - Noise, slow convergence

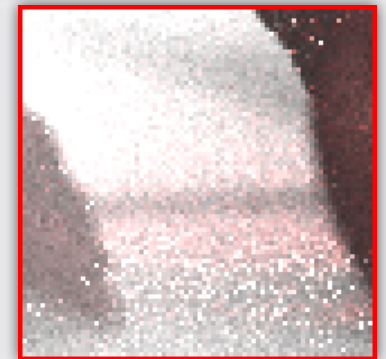
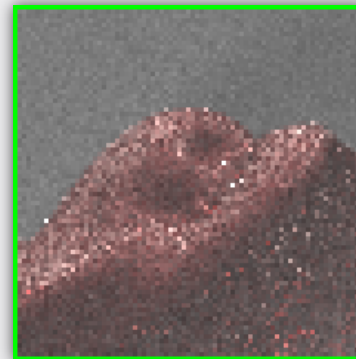
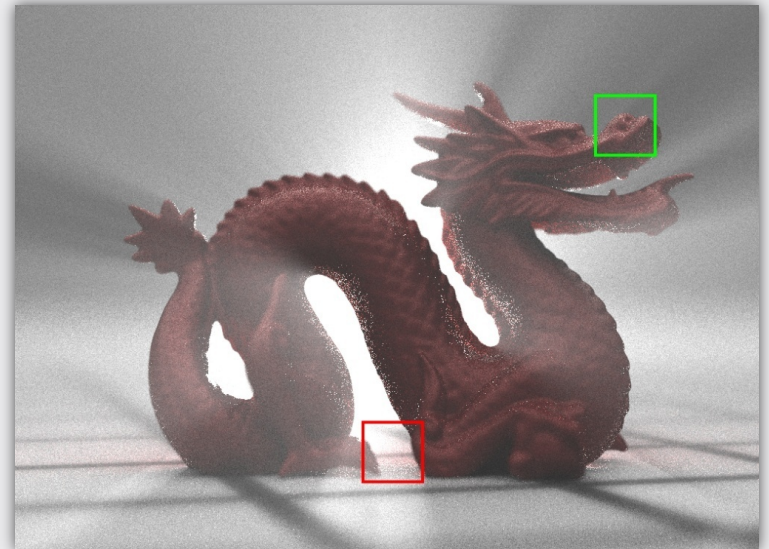
32000 samples per pixel, 12h



Introduction

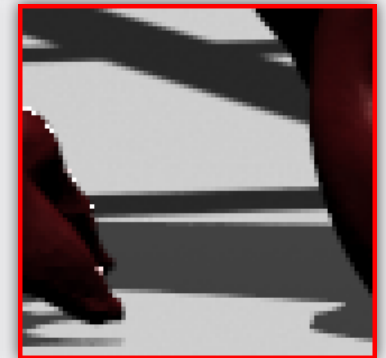
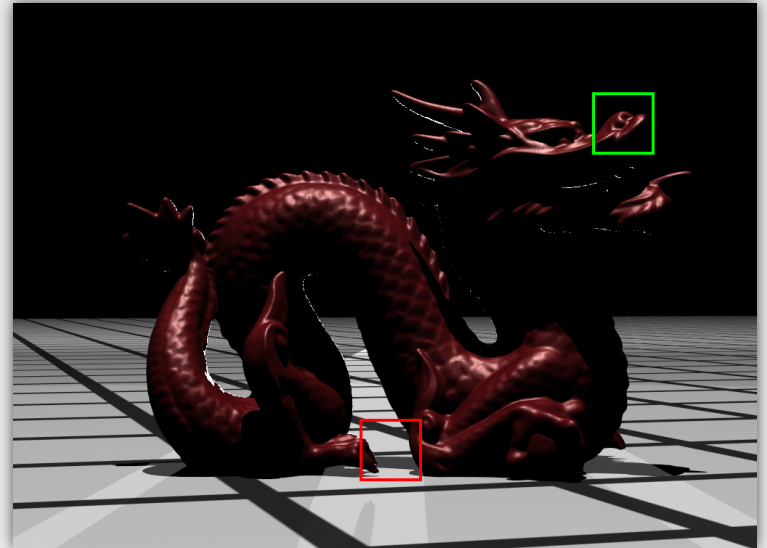
- Monte Carlo path tracing
 - Physically based
 - Very general
 - Guaranteed convergence (except pathological cases)
- Disadvantages
 - Noise, slow convergence

32 samples per pixel, 42s



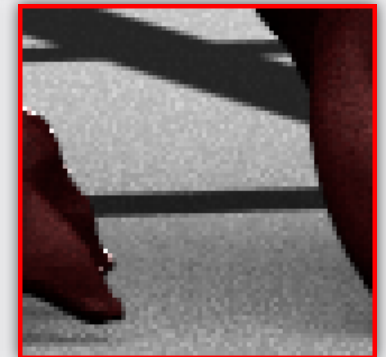
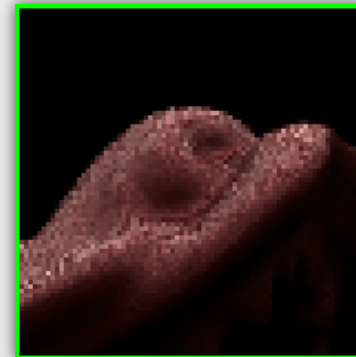
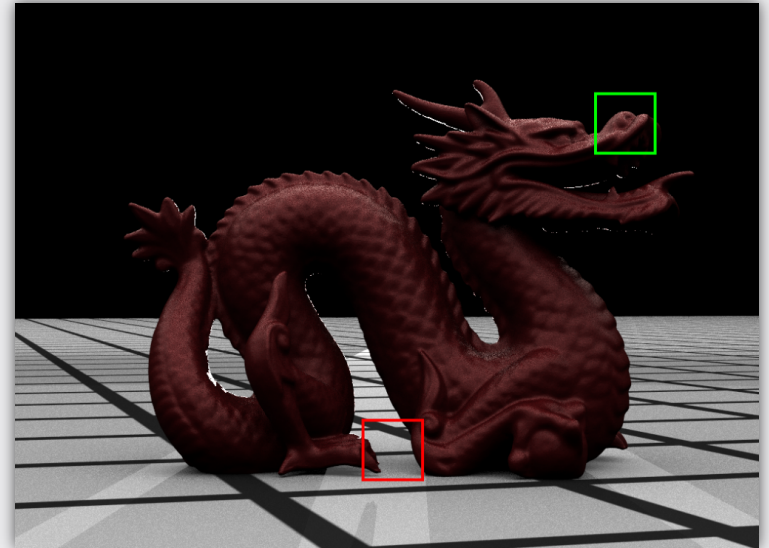
Introduction – curse of dimensionality

→ Anti-aliasing – 2D



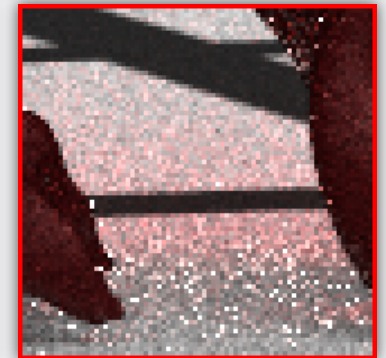
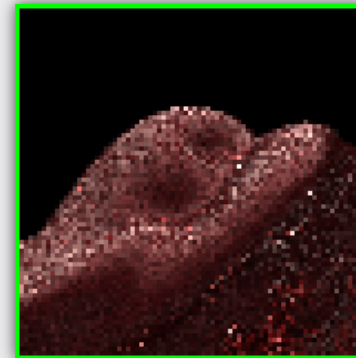
Introduction – curse of dimensionality

- Anti-aliasing – 2D
- Area-lighting – 2D



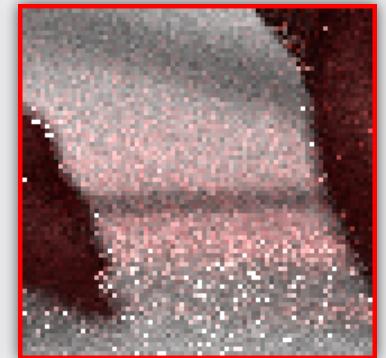
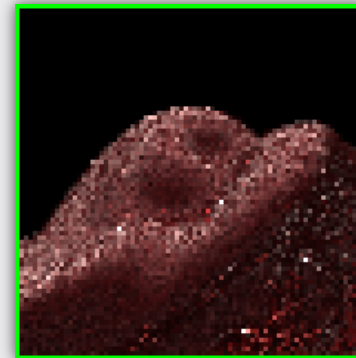
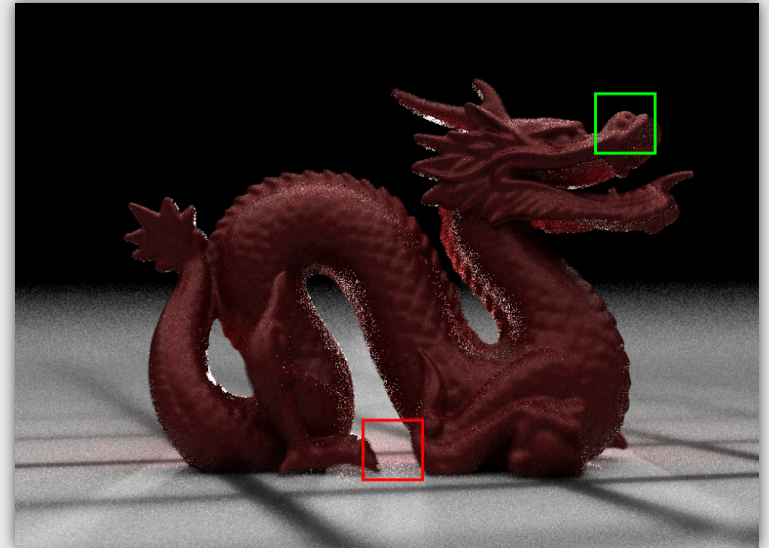
Introduction – curse of dimensionality

- Anti-aliasing – 2D
- Area-lighting – 2D
- Single-bounce indirect illumination – 2D



Introduction – curse of dimensionality

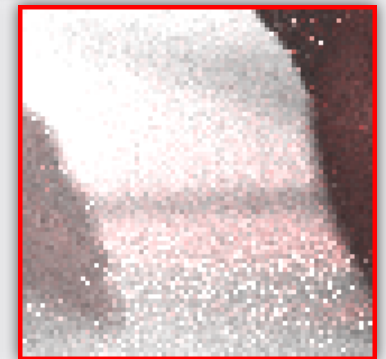
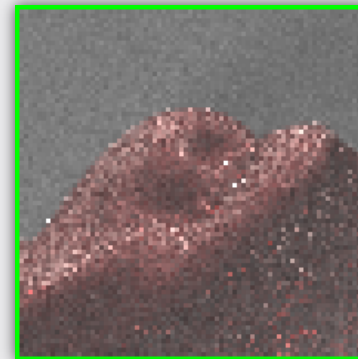
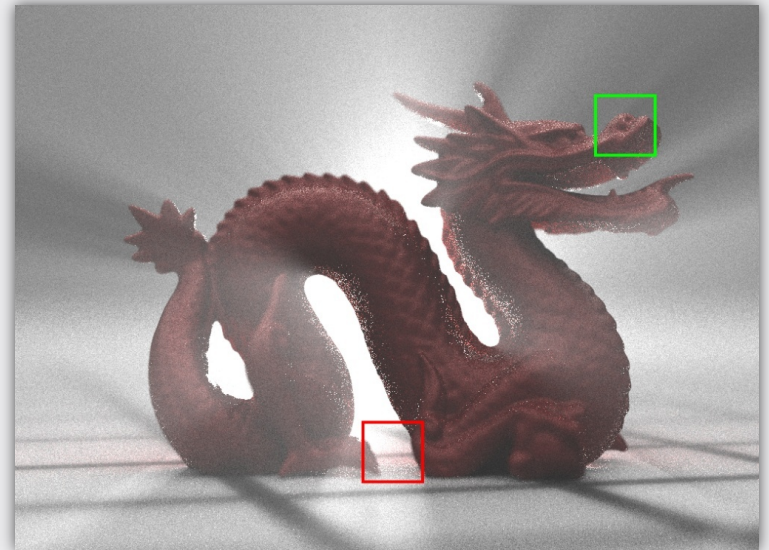
- Anti-aliasing – 2D
- Area-lighting – 2D
- Single-bounce indirect illumination – 2D
- Depth-of-field – 2D



Introduction – curse of dimensionality

- Anti-aliasing – 2D
- Area-lighting – 2D
- Single-bounce indirect illumination – 2D
- Depth-of-field – 2D
- Single-scattering participating media – 1D

Total: 9D

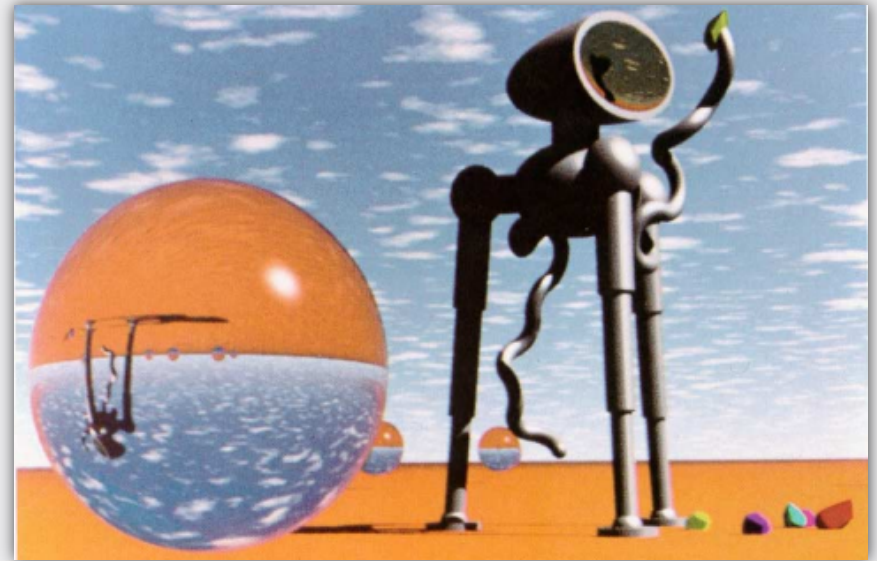


Early approaches

Sample map



Output image



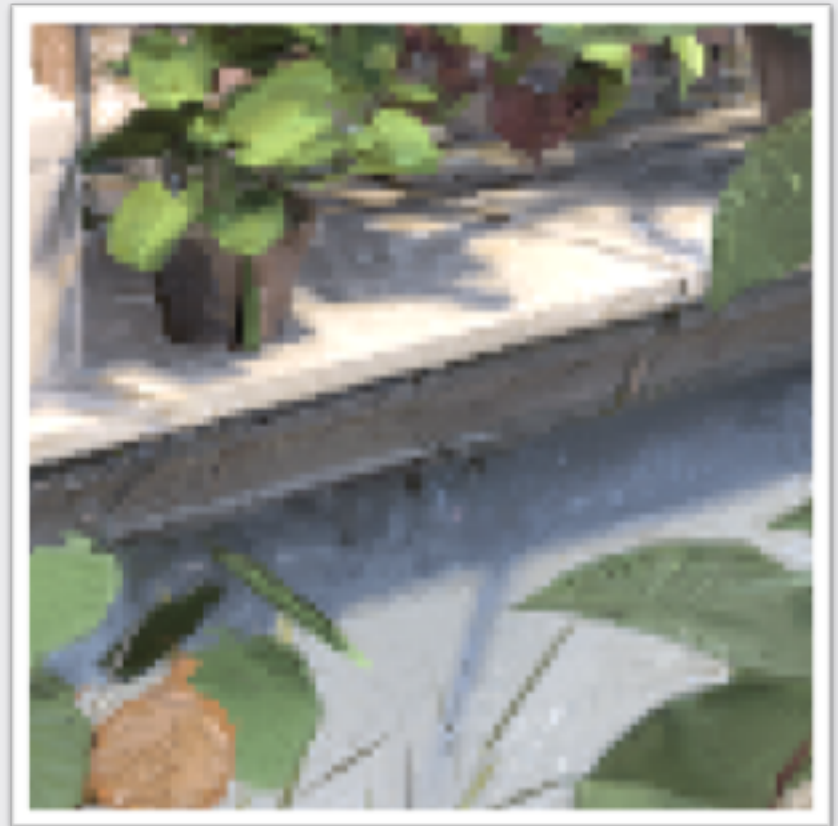
[Mitchell 1987]

Recent advances

Path tracing, 55s



Rousselle et al. 2013, 57s



Adaptive sampling and reconstruction

- Locally analyze error (variance)

1. Adapt sampling density to error
2. Reconstruct image by aggregating data over several pixels



Outline

A priori

- Analyze light transport equations around individual samples
- Estimate sampling rates, reconstruction filters **based on analysis**

A posteriori

- Ignorant of light transport effects
- Estimate sampling rates, reconstruction based on **empirical statistics from sets of acquired samples**



Outline

A priori

- Frequency analysis (Cyril)
- Light field structure (Matthias)
- Derivatives (Wojciech)

A posteriori

- Fabrice

