

Gradient-Domain path tracing

Presented by Khalil Chatoui

Review:

Real time rendering:

- Global illumination with radiance regression functions

- Image-based bidirectional scene reprojection

➔ Strengths, limitations, results

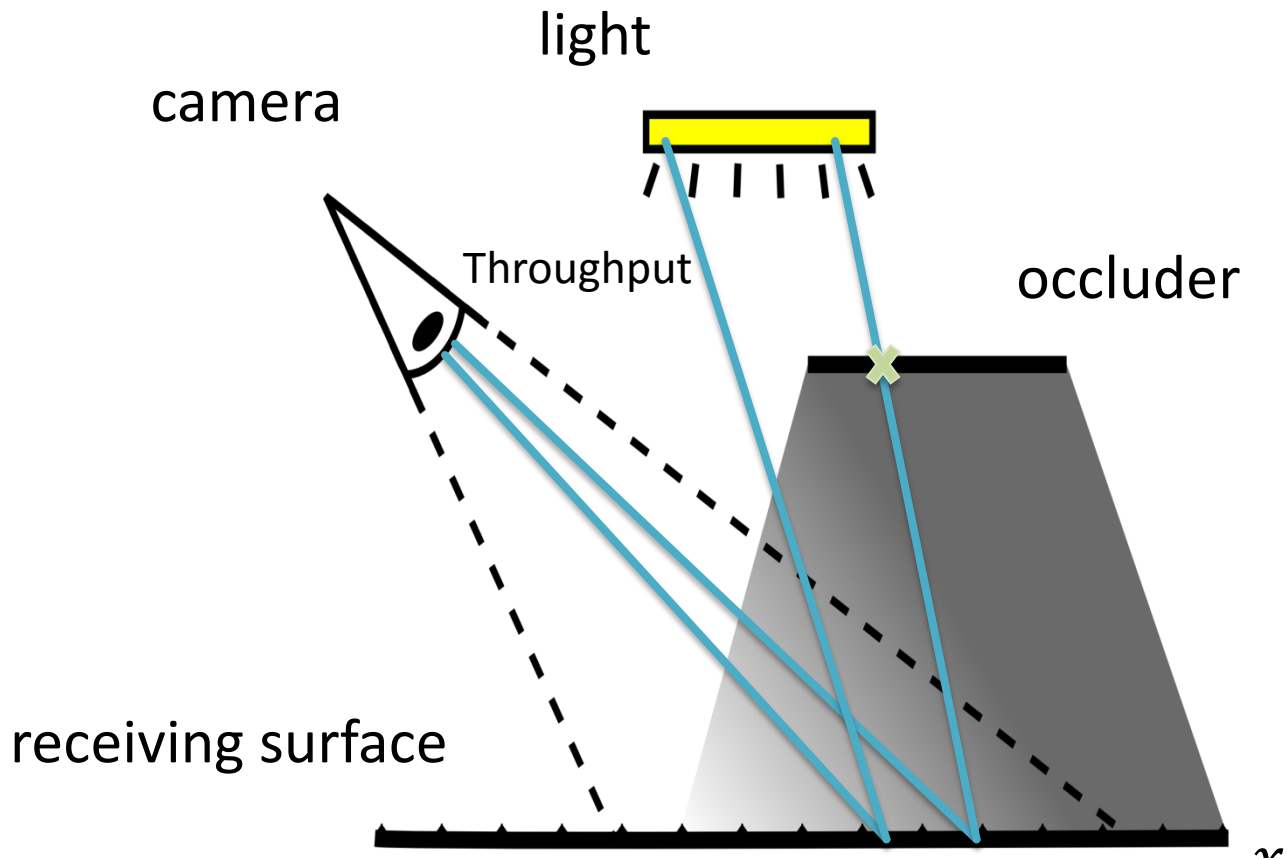
Papers:

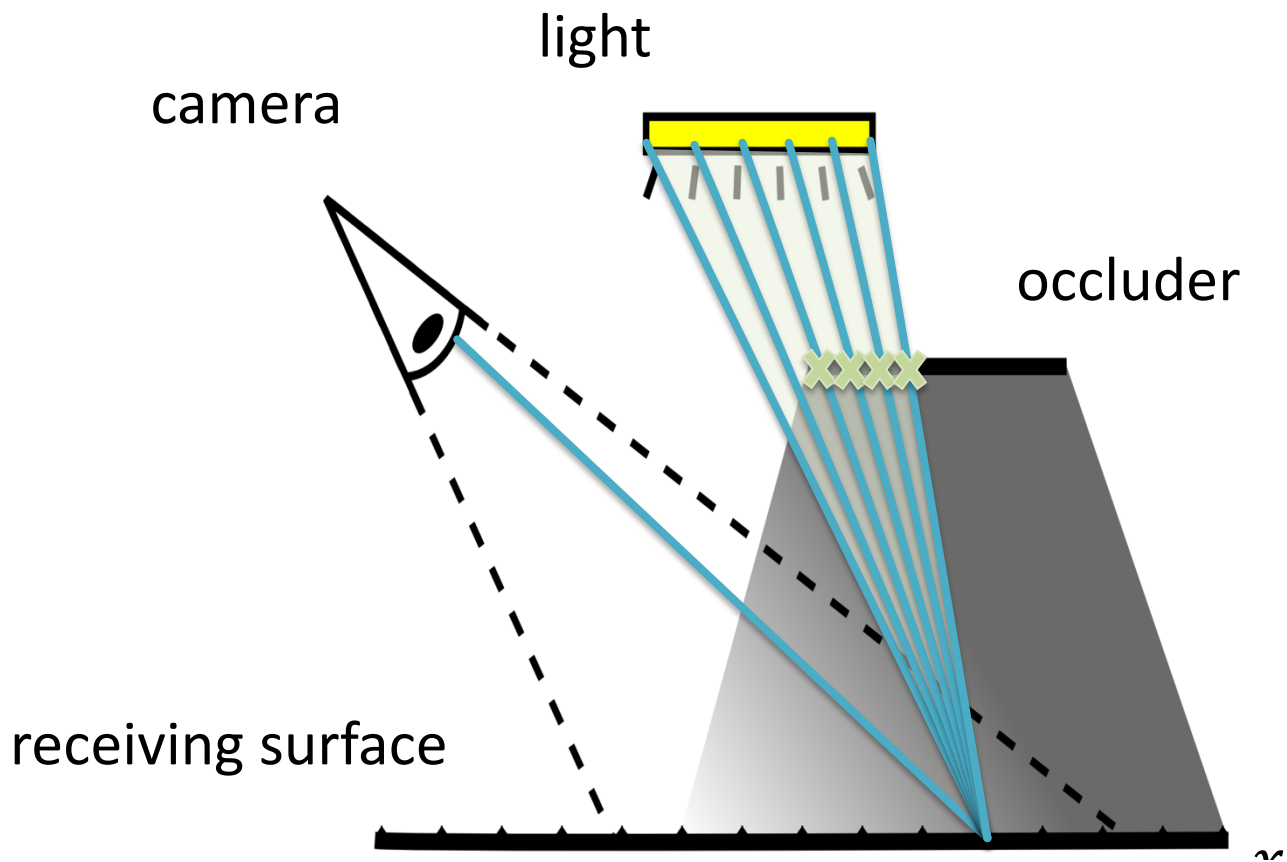
- **Gradient-Domain Path Tracing** (Proc. SIGGRAPH 2015)
- **Gradient-Domain Bidirectional Path Tracing** (Eurographics Symposium on Rendering, 2015)

Gradient-Domain Path Tracing

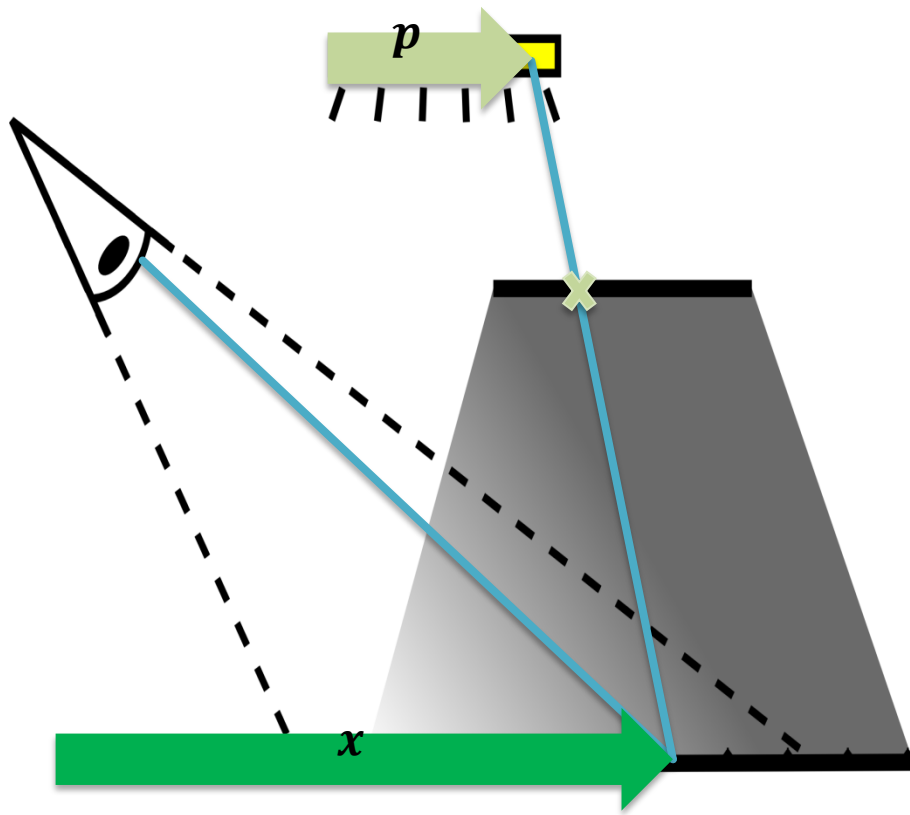
(Proc. SIGGRAPH 2015)

Marco Manzi Markus Kettunen Miika Aittala Jaakko Lehtinen
Frédo Durand Matthias Zwicker

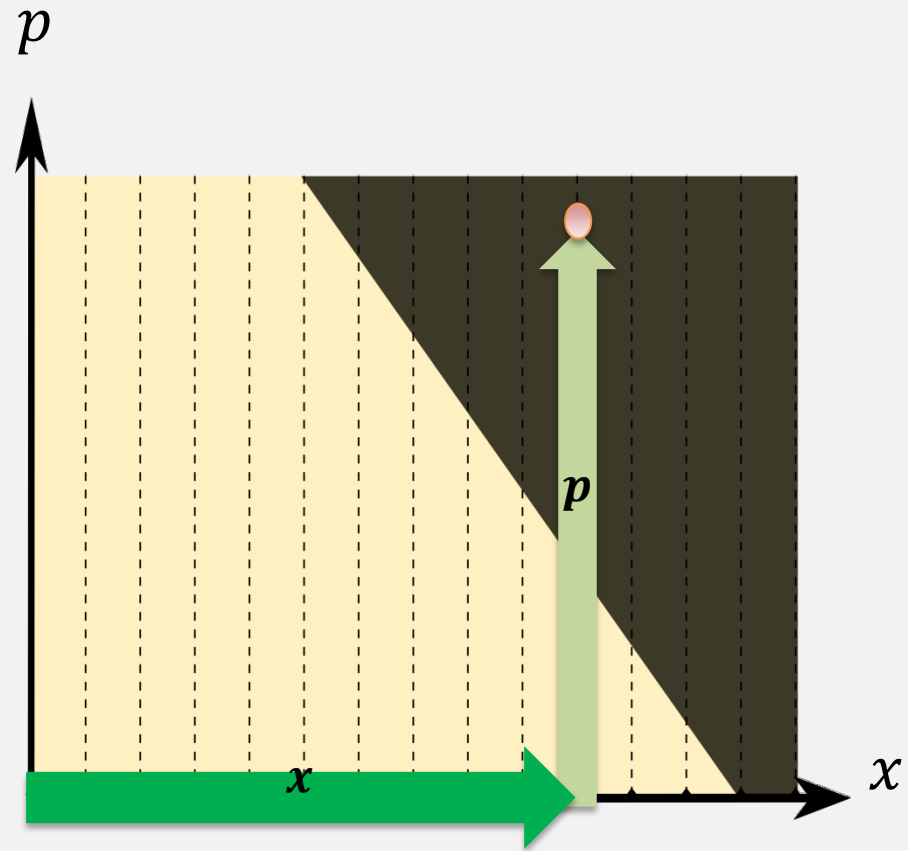




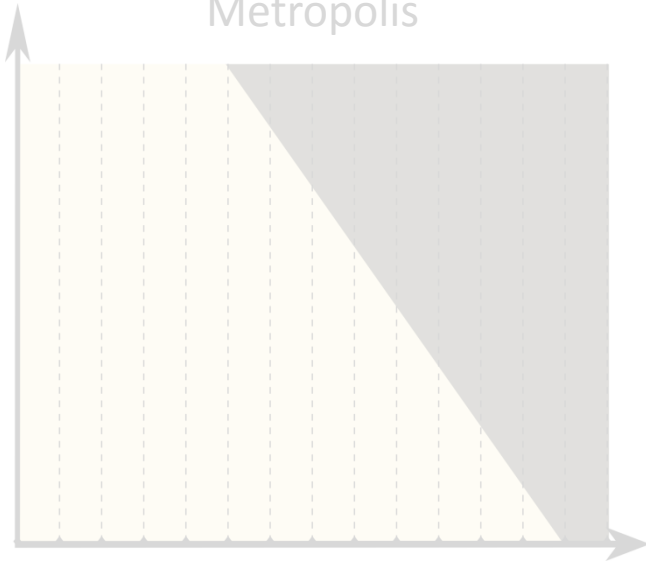
Scene



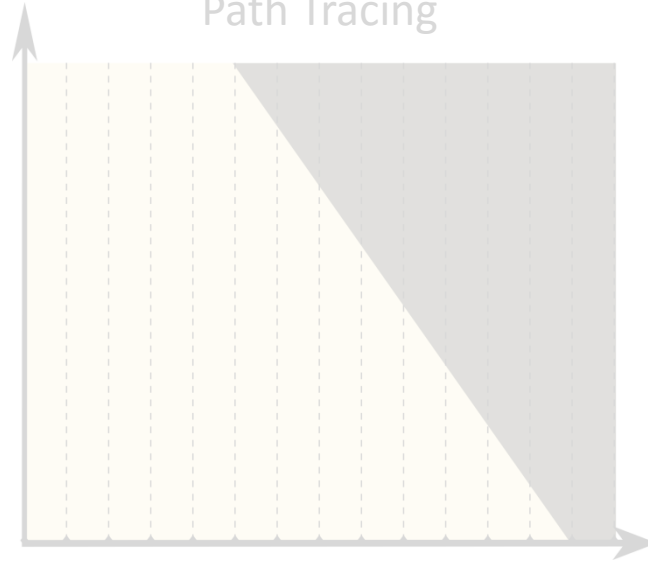
Path Space



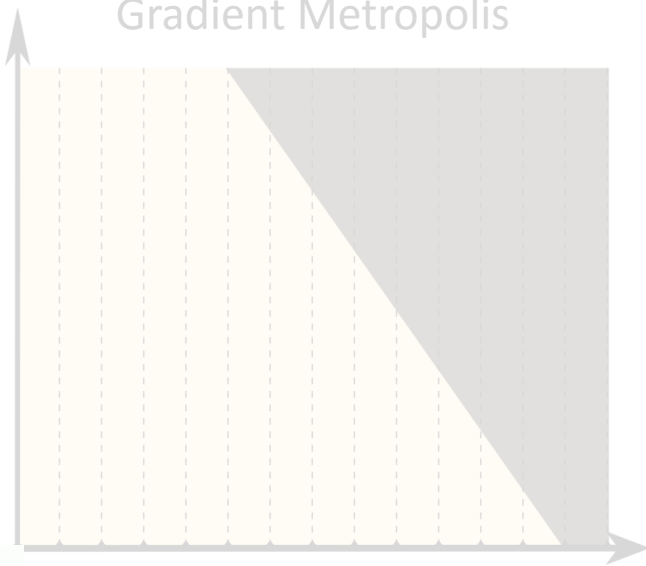
Metropolis

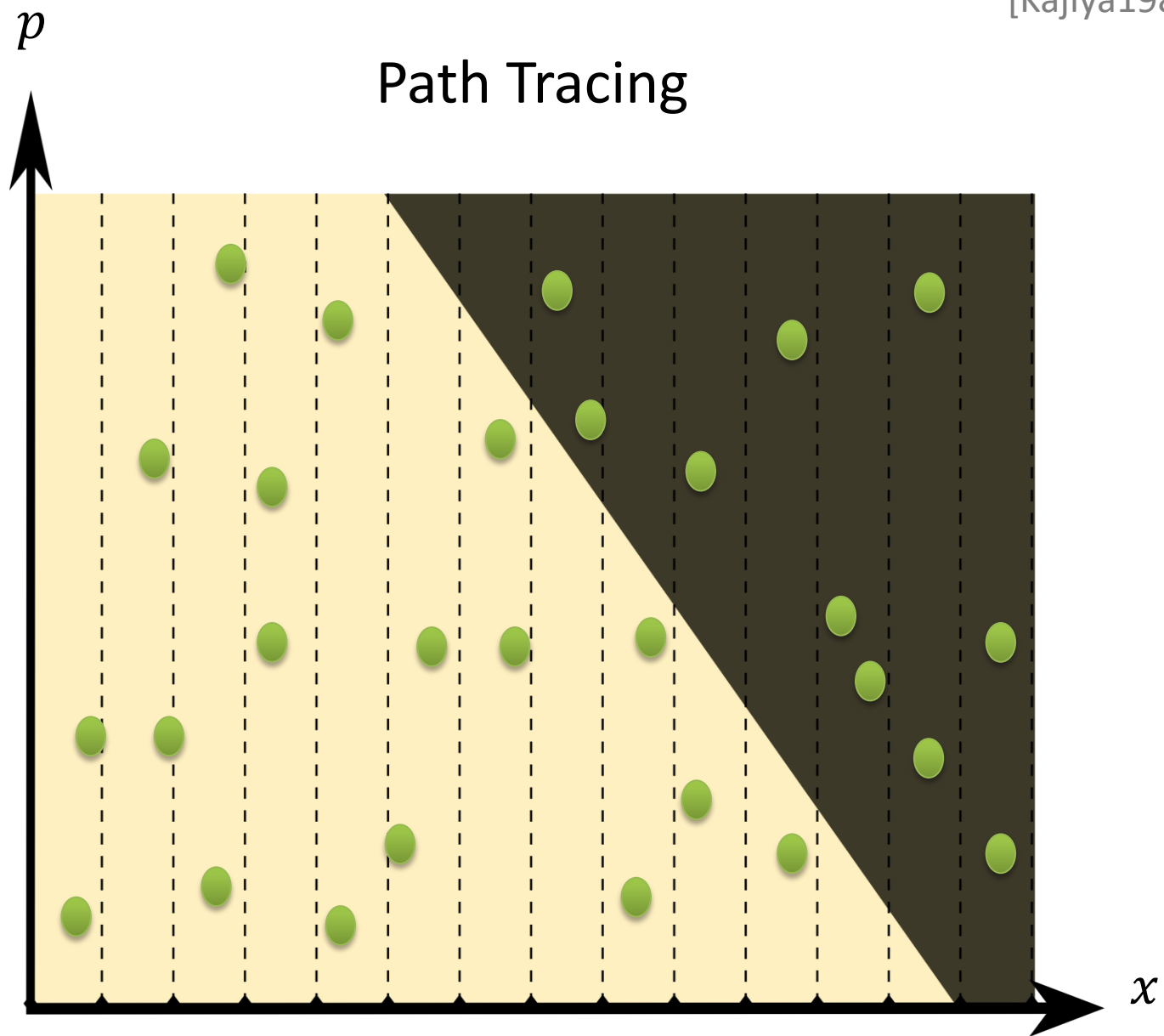


Path Tracing

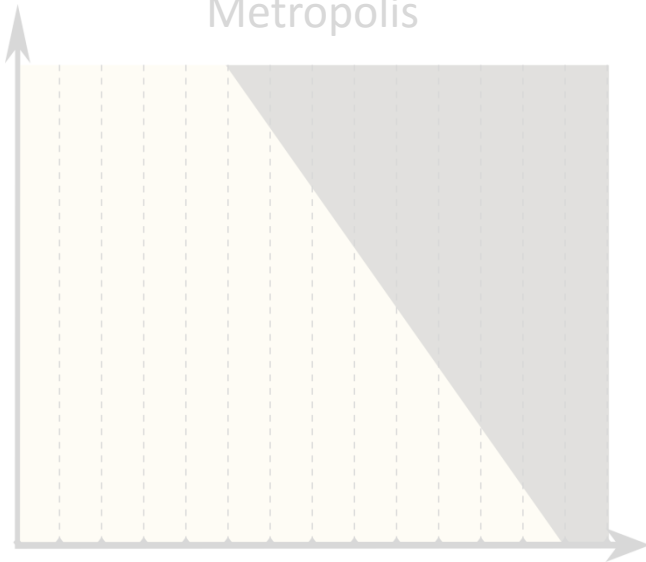


Gradient Metropolis

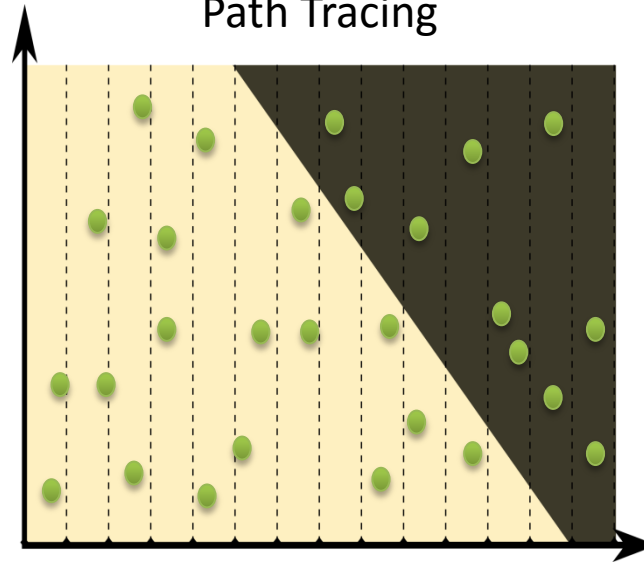




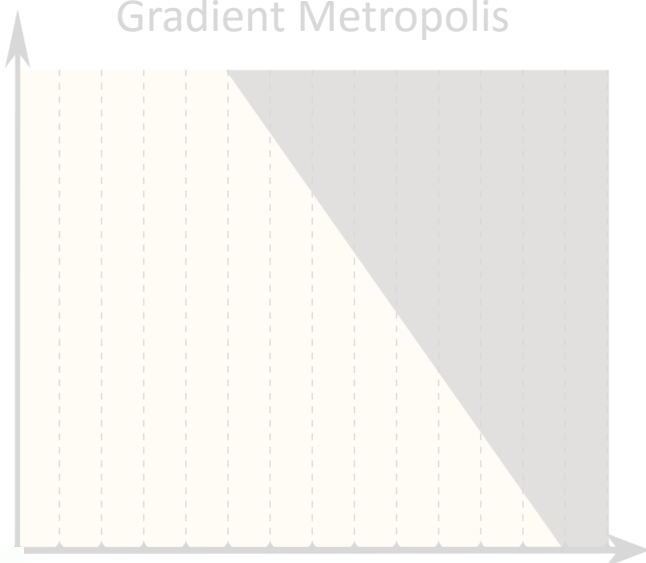
Metropolis



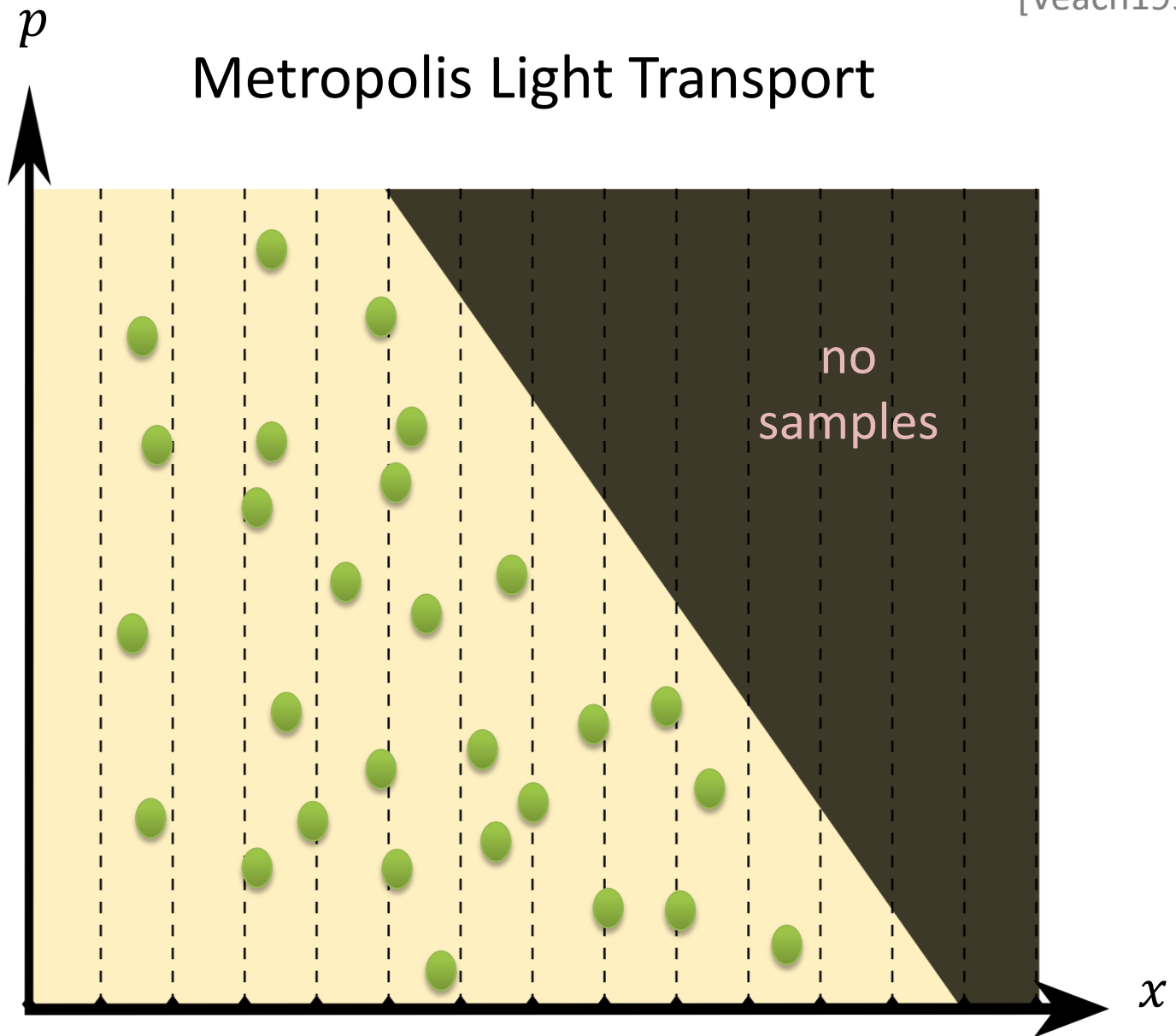
Path Tracing



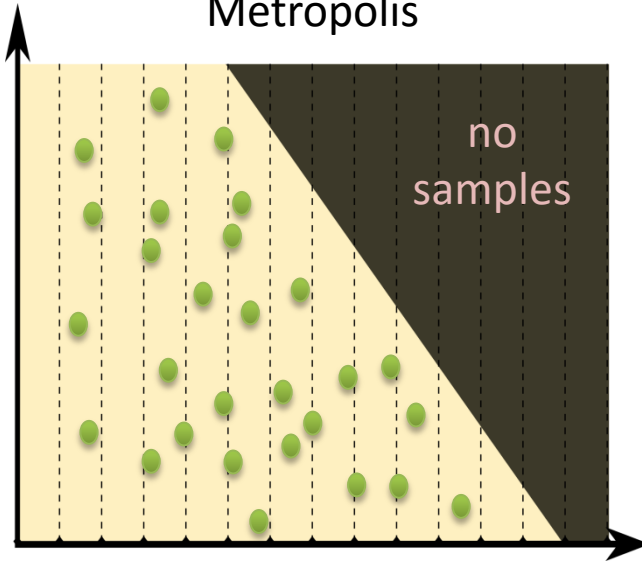
Gradient Metropolis



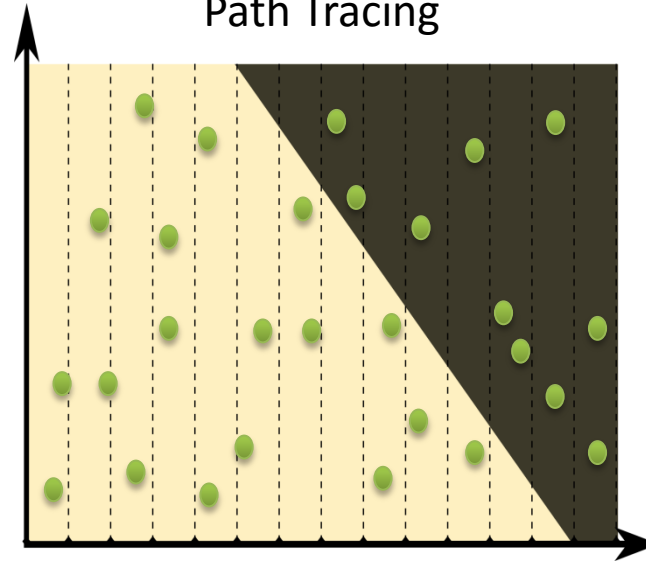
Metropolis Light Transport



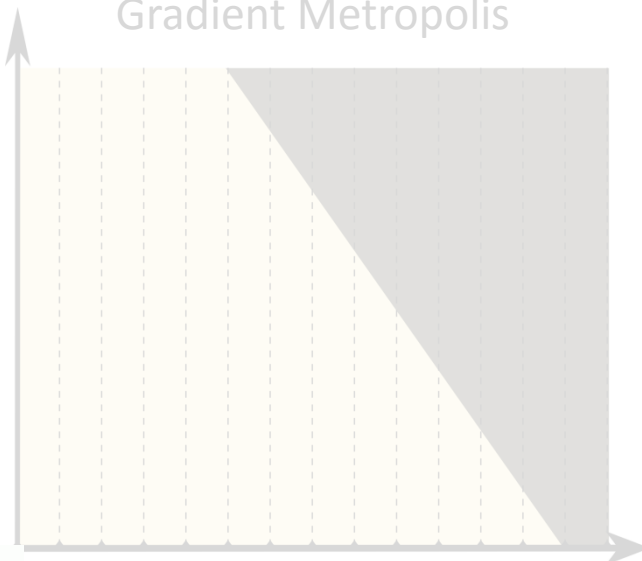
Metropolis

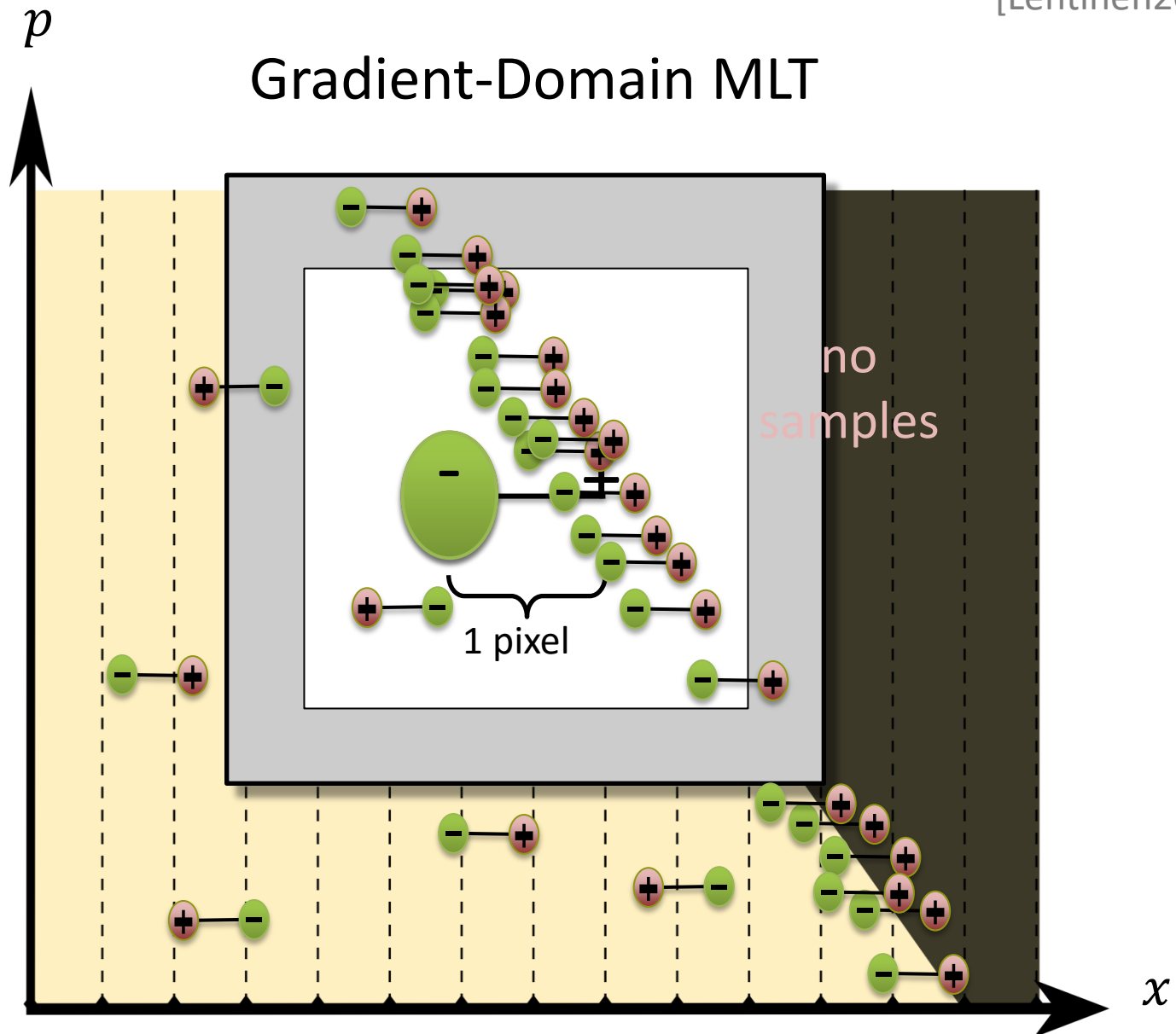


Path Tracing



Gradient Metropolis







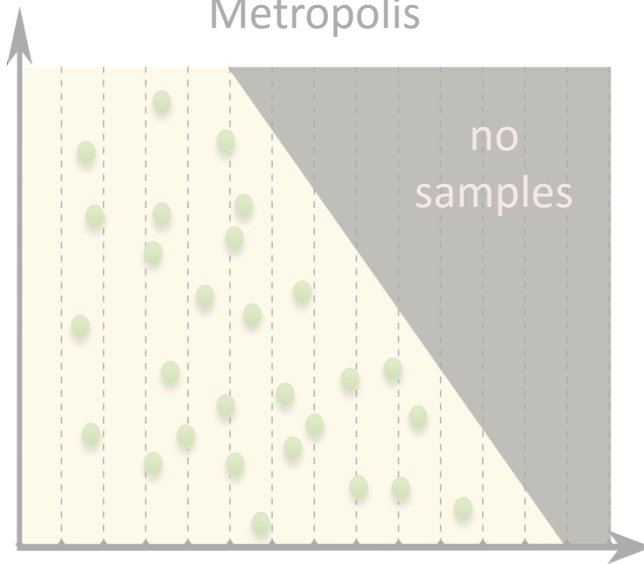
Screened Poisson Problem



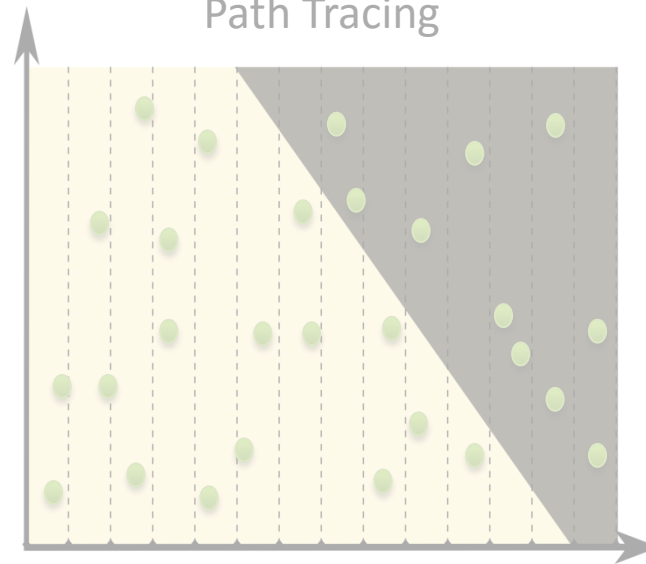
Reconstruction



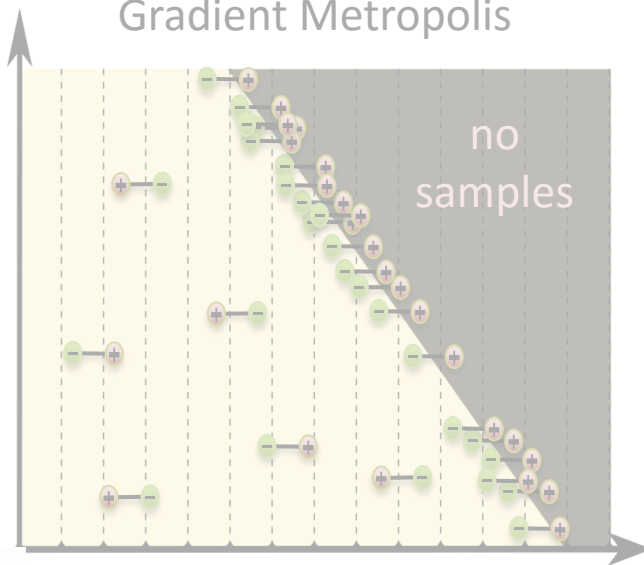
Metropolis



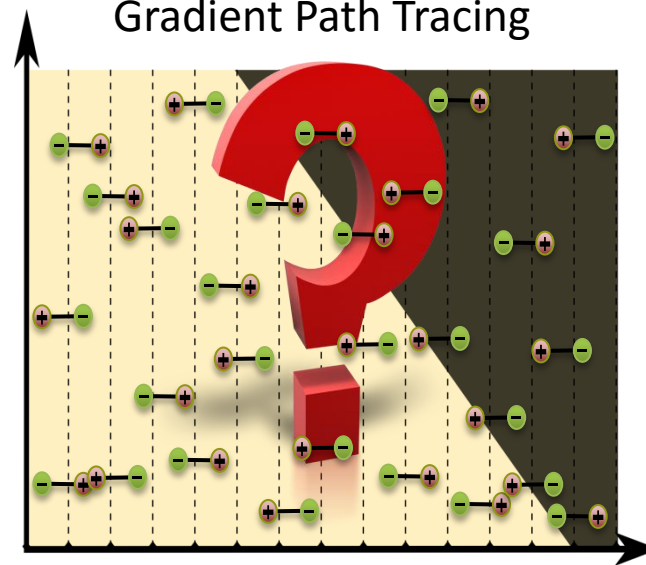
Path Tracing

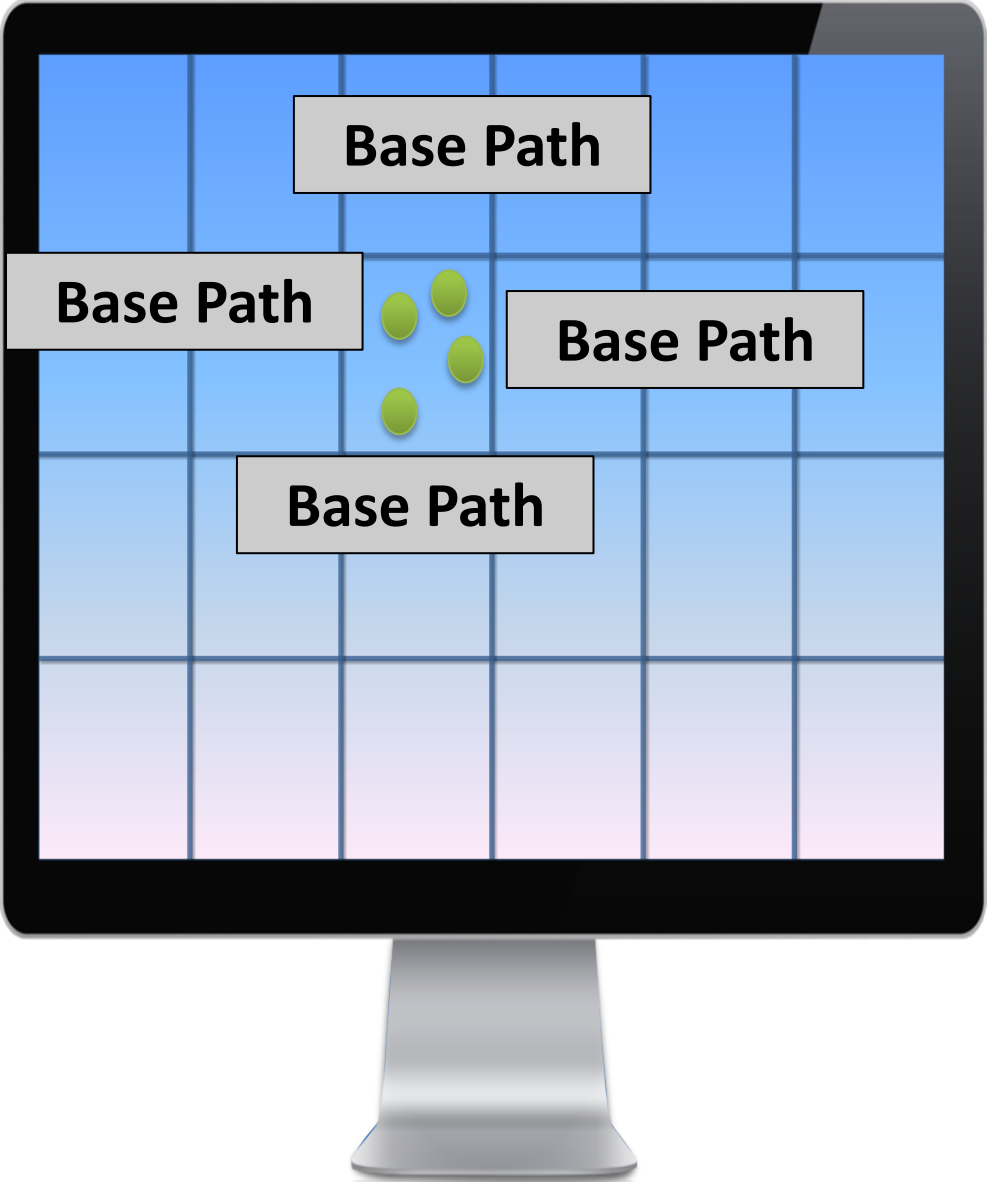


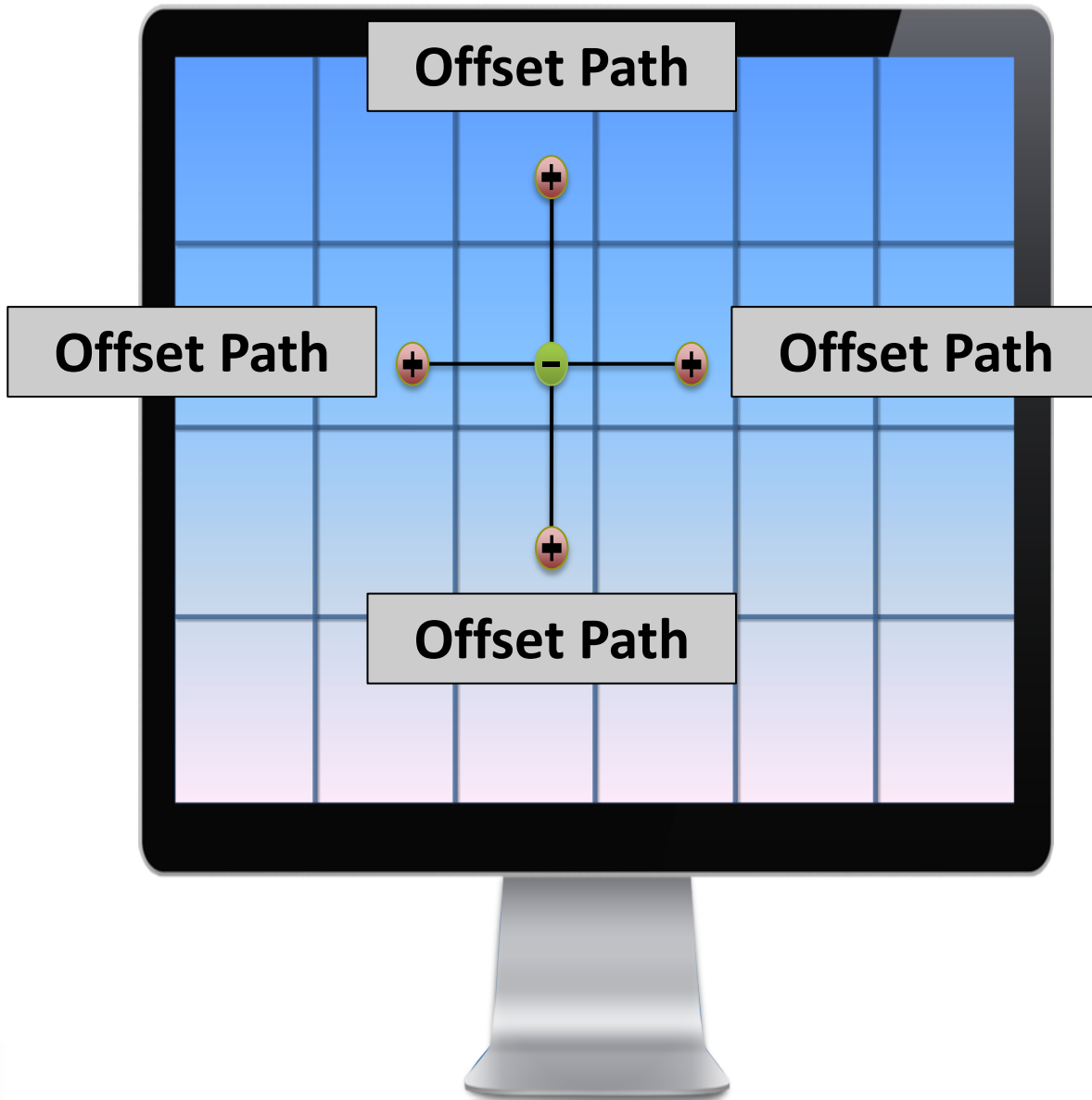
Gradient Metropolis



Gradient Path Tracing

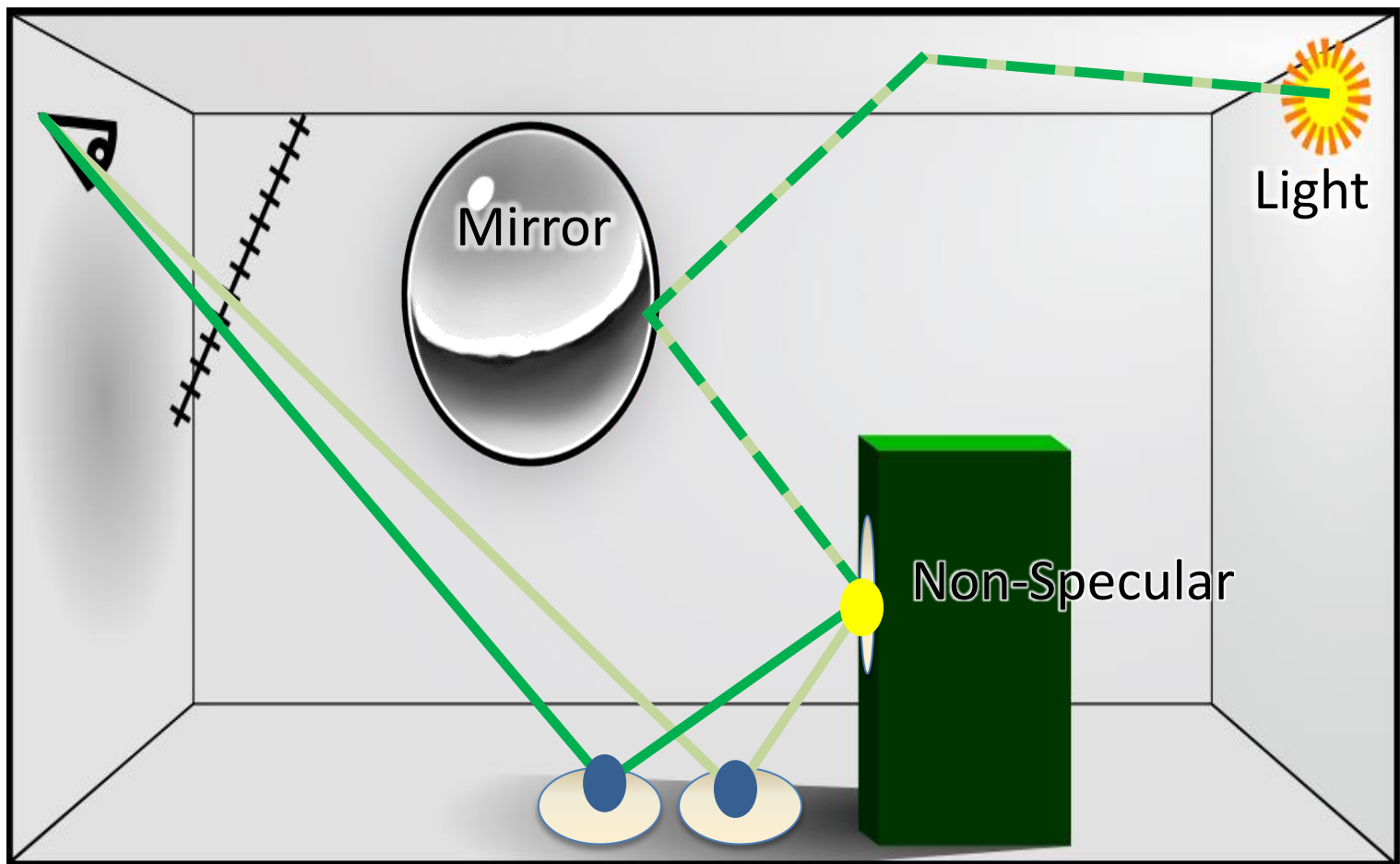






Case: Reconnect

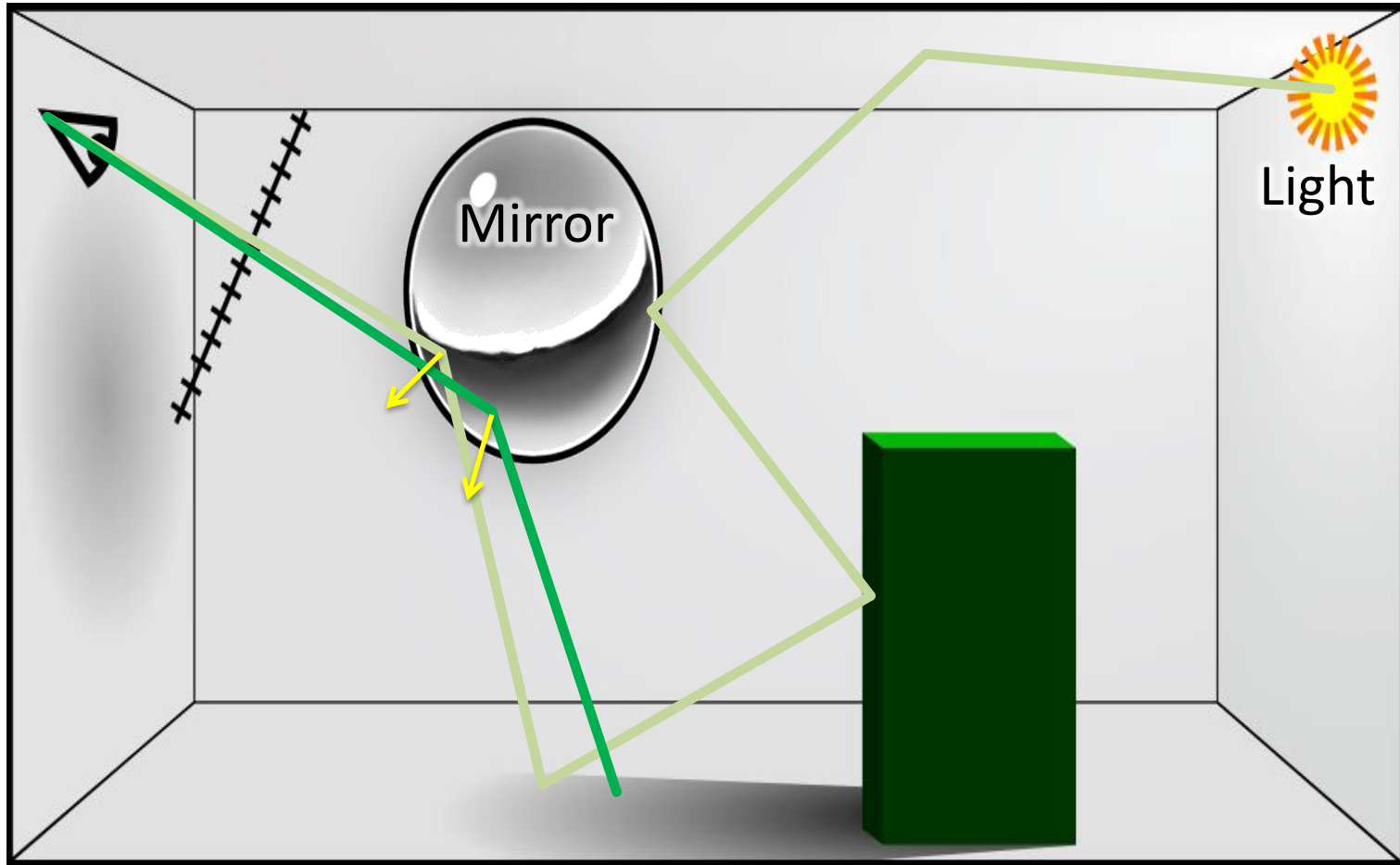
- Base Path
- Offset Path



Non-Specular Non-Specular

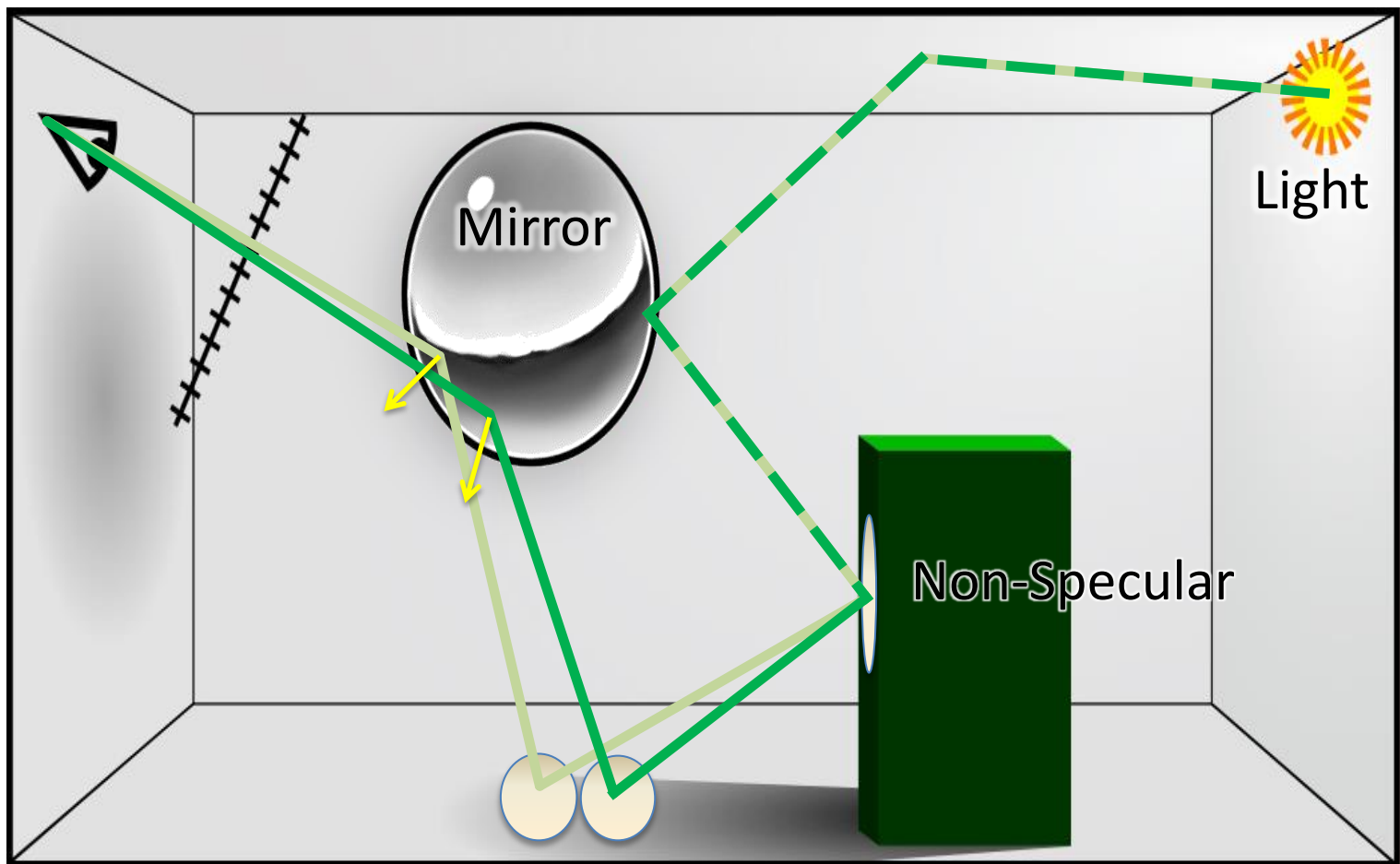
Case: Continue

- Half-vector
- Base Path
- - Ideal Reflection
- Offset Path



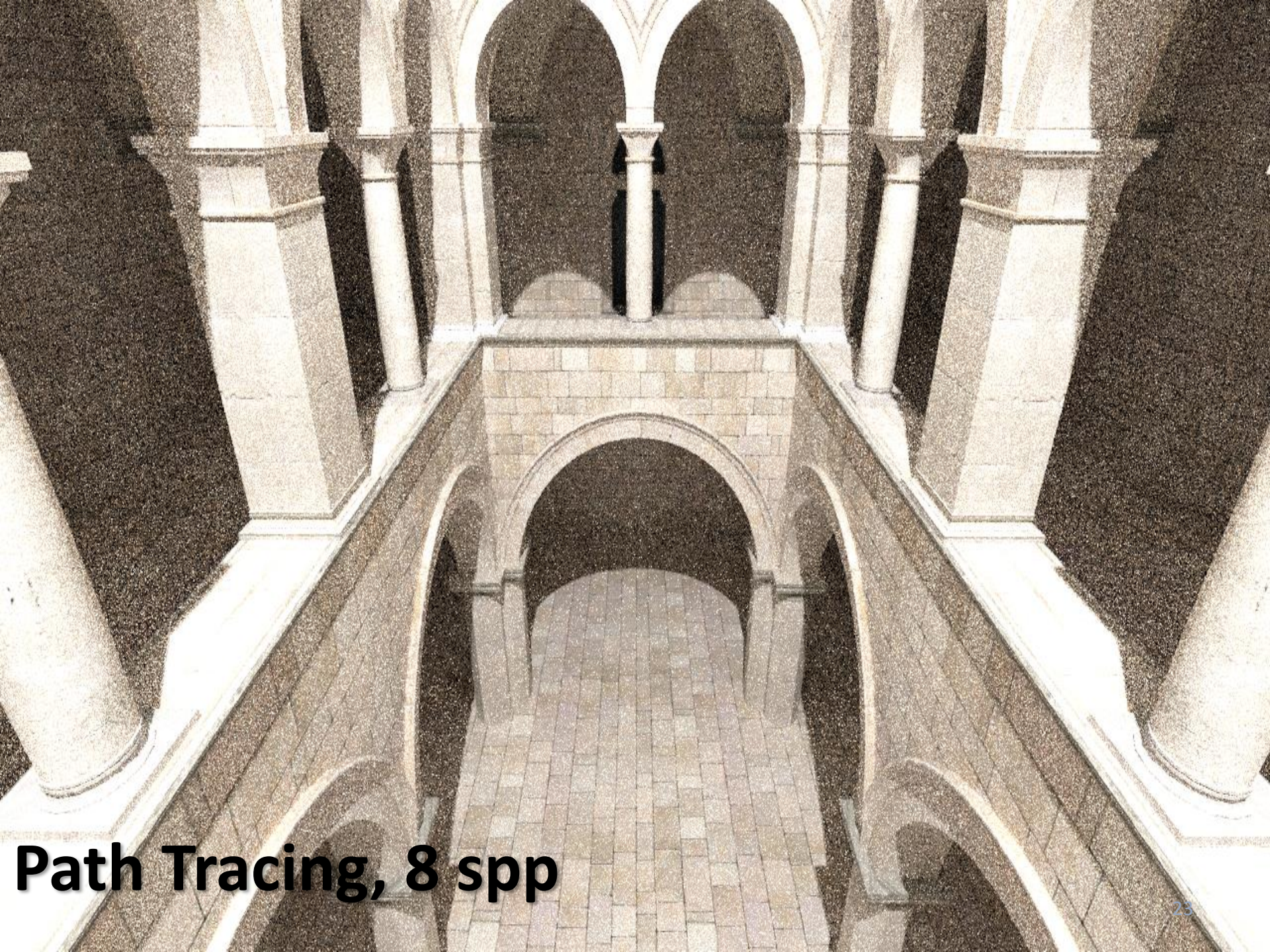
Case: Continue

- Half-vector
- Ideal Reflection
- Base Path
- Offset Path



Non-Specular Non-Specular





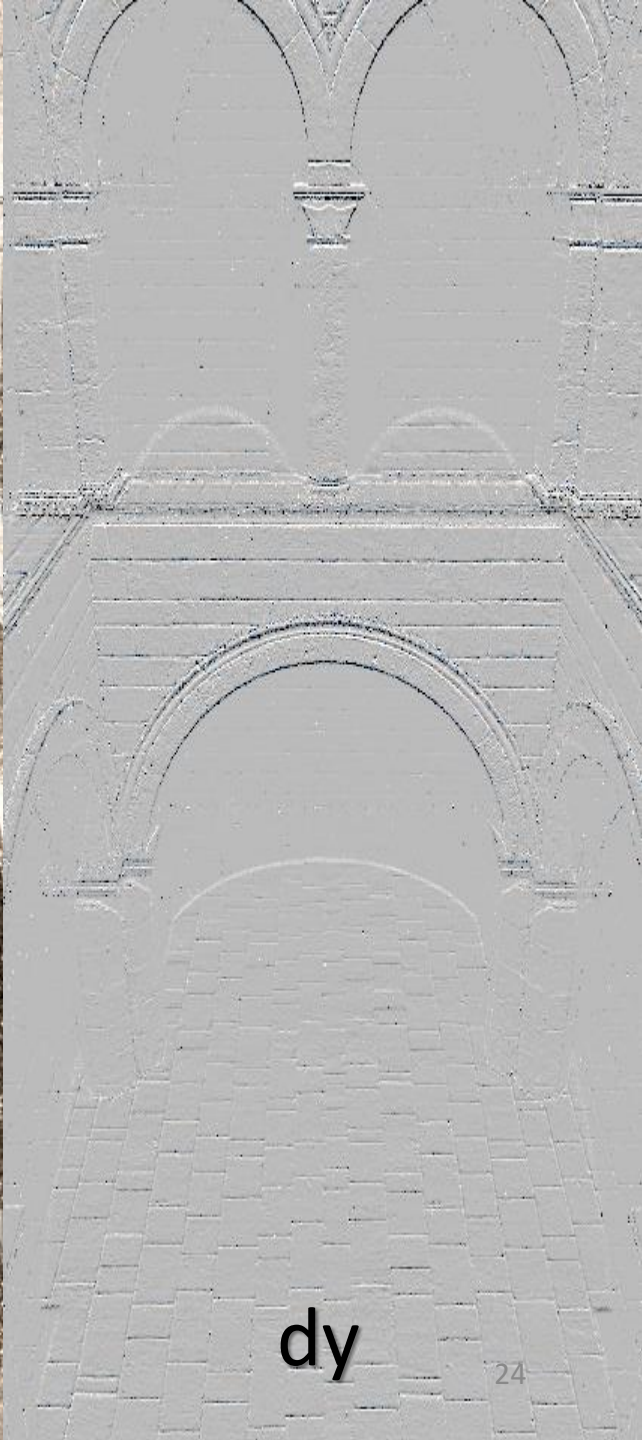
Path Tracing, 8 spp



dx



throughput



dy



Our Result, Equal Time



Path Tracing, 8 spp



Ours, Equal Time

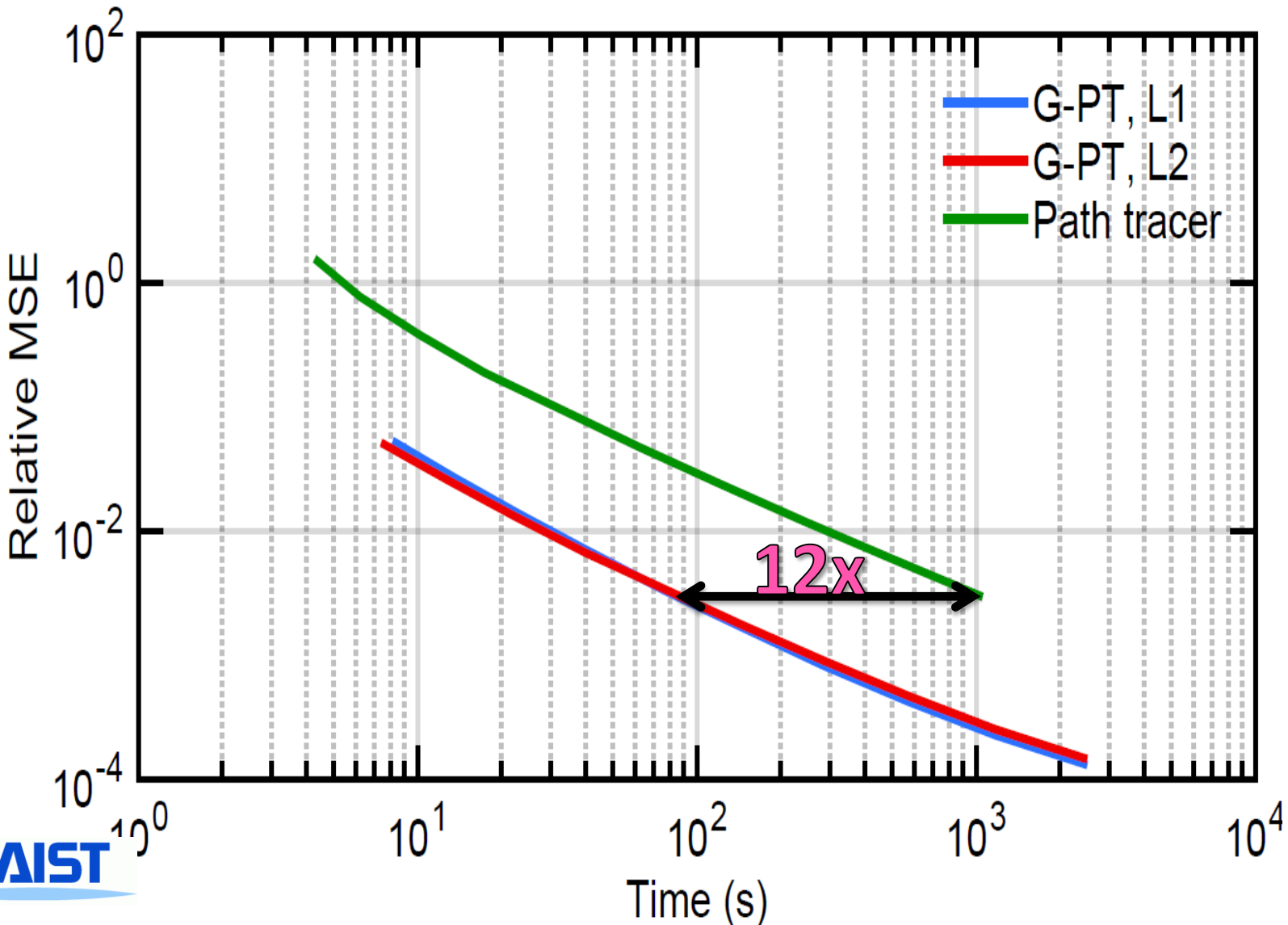


Path Tracing, 128 spp



Ours, Equal Time

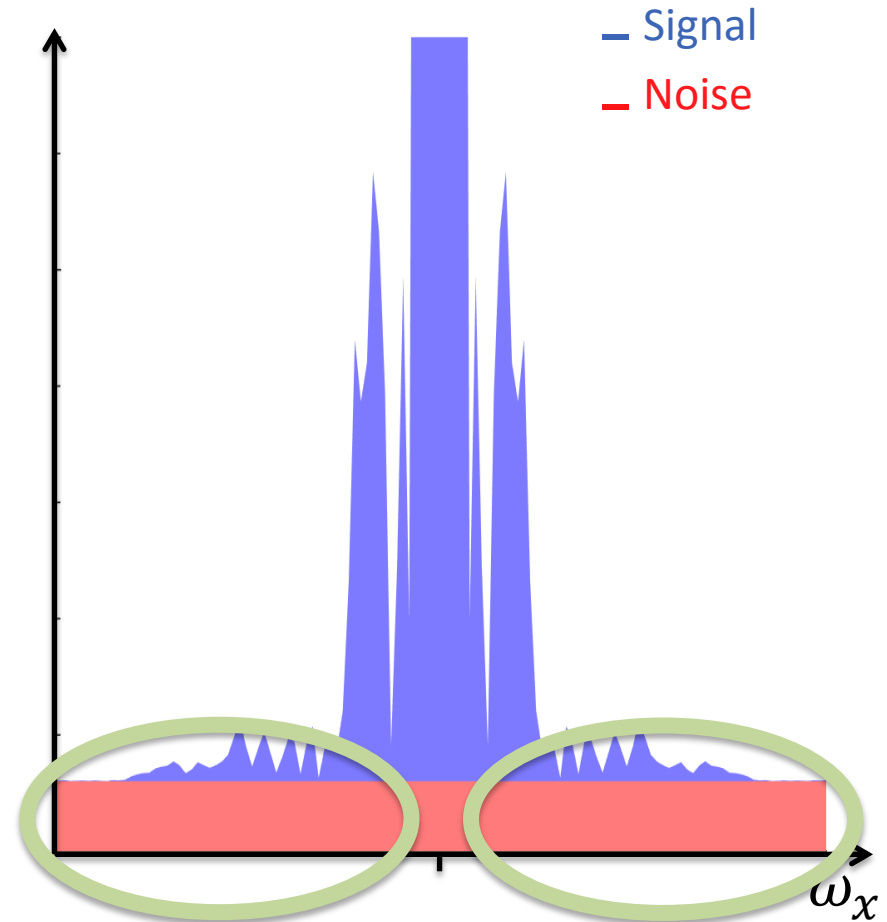
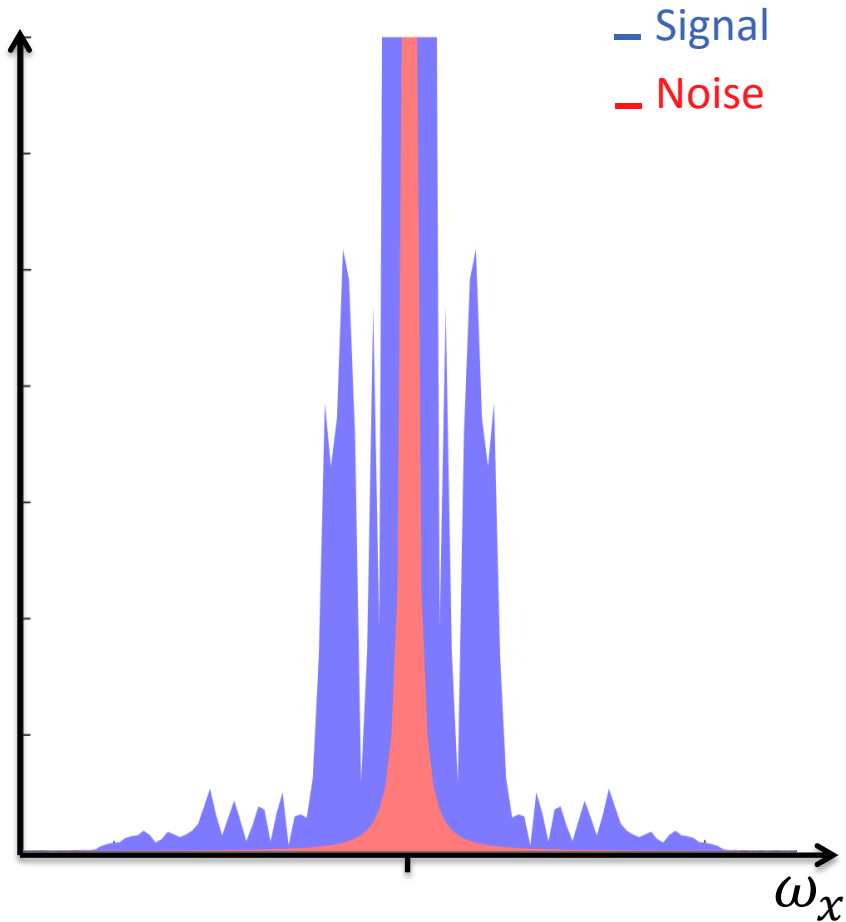
Error vs. Time (Sponza)



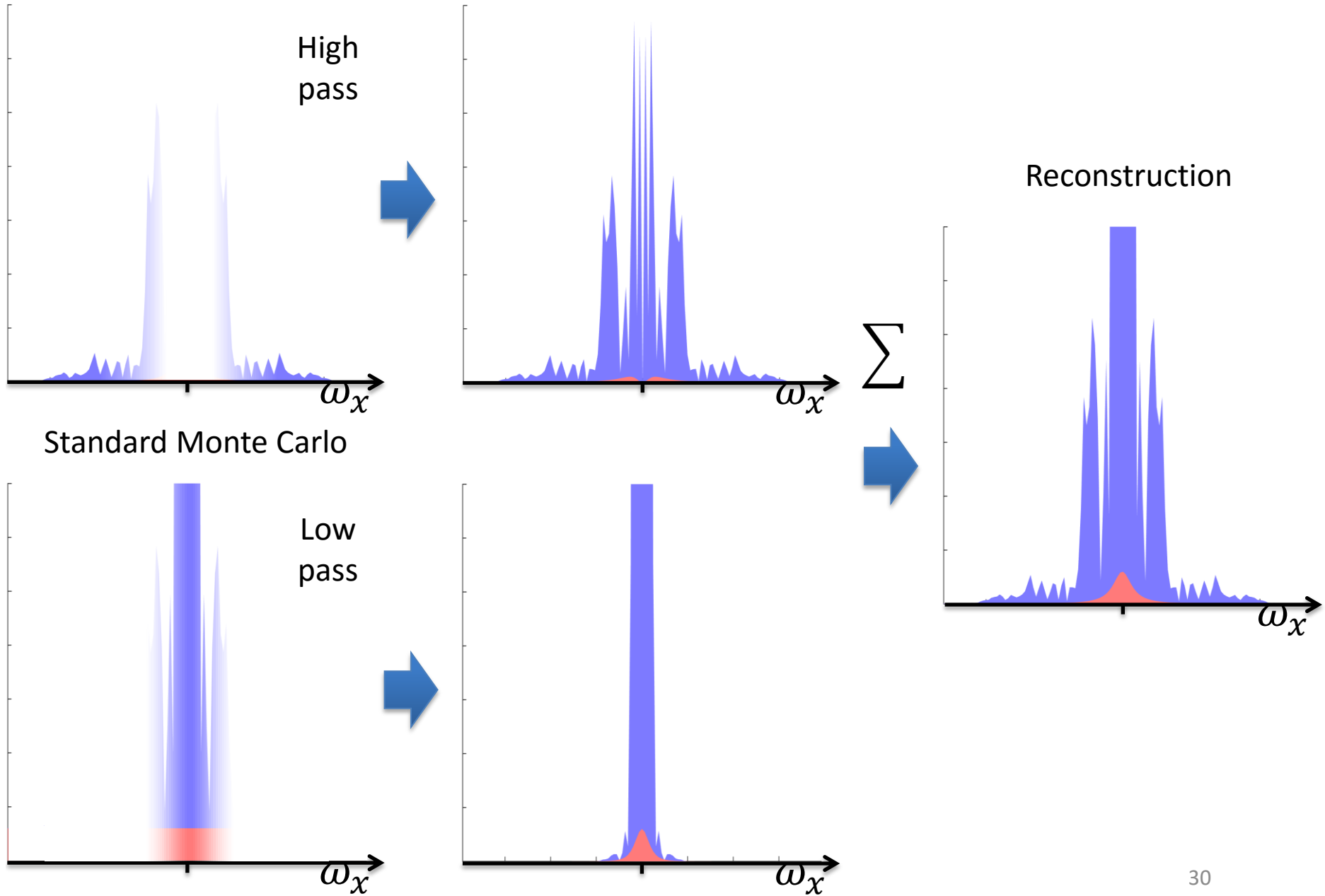
Fourier transform of Path function

Integrated Gradients

Standard Monte Carlo



Integrated Gradients



Integrated Gradients



High pass



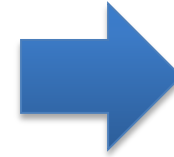
Standard Monte Carlo



Low pass



Σ



Reconstruction



Primal

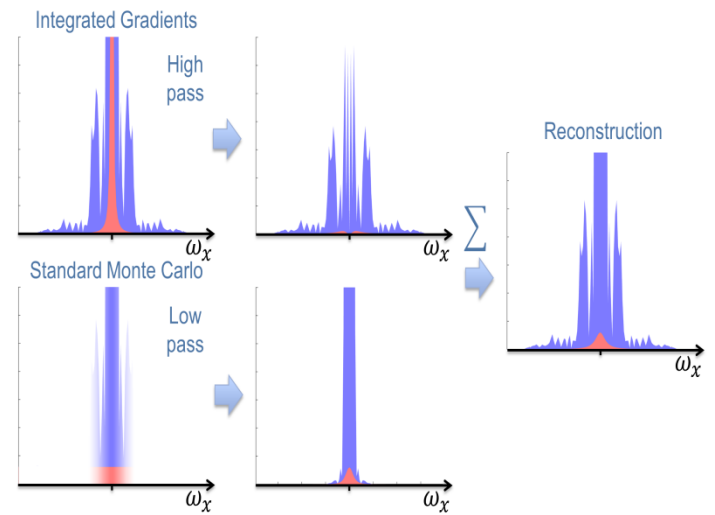
Screened Poisson problem

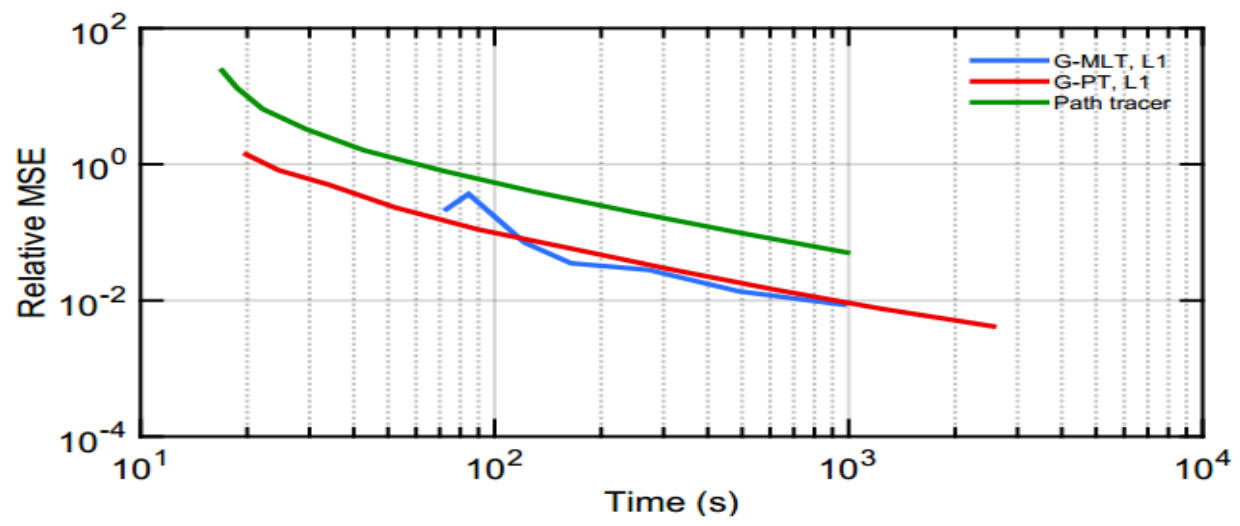


$\arg \min_{\mathbf{X}}$

$$\left\| \nabla \mathbf{X} - \begin{bmatrix} dx \\ dy \end{bmatrix} \right\|_2^2 + \alpha^2 \|\mathbf{X} - f\|_2^2$$

Fourier





Gradient-domain path tracing
 >
 Gradient-domain Metropolis
 >
 Path tracing

Gradient-Domain Path Tracing

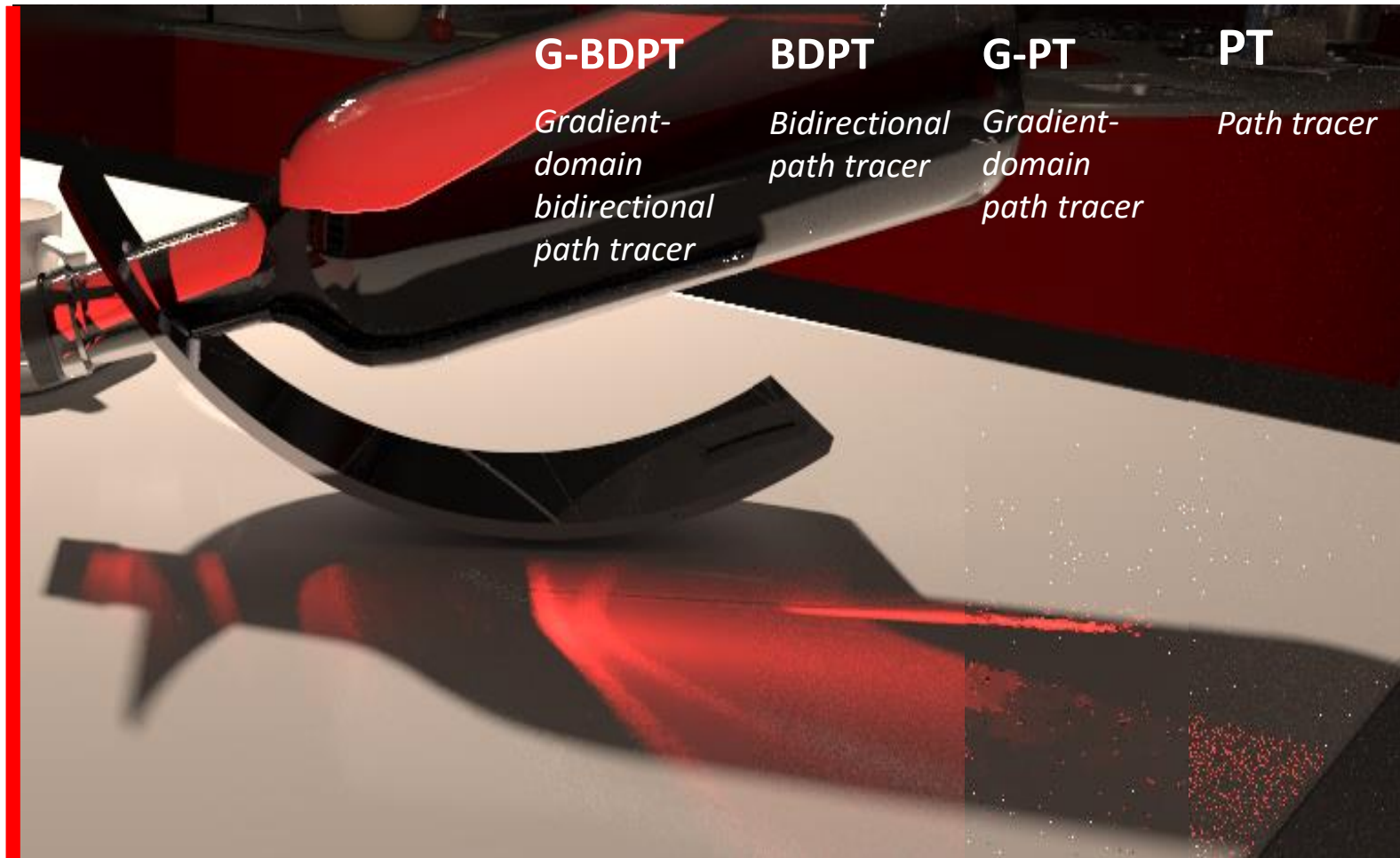
(Proc. SIGGRAPH 2015)

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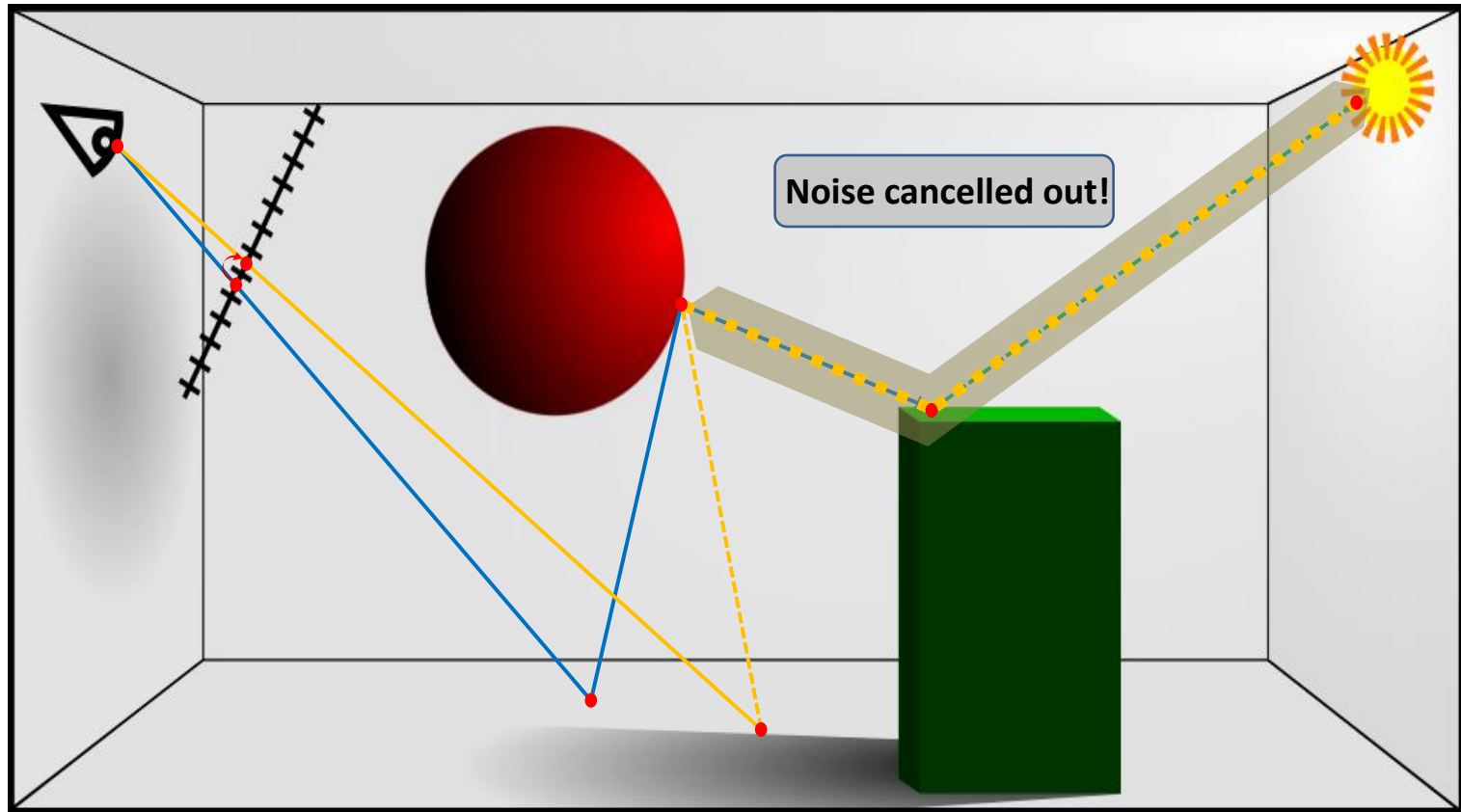
Previous work

Gradient-Domain Bidirectional Path Tracing

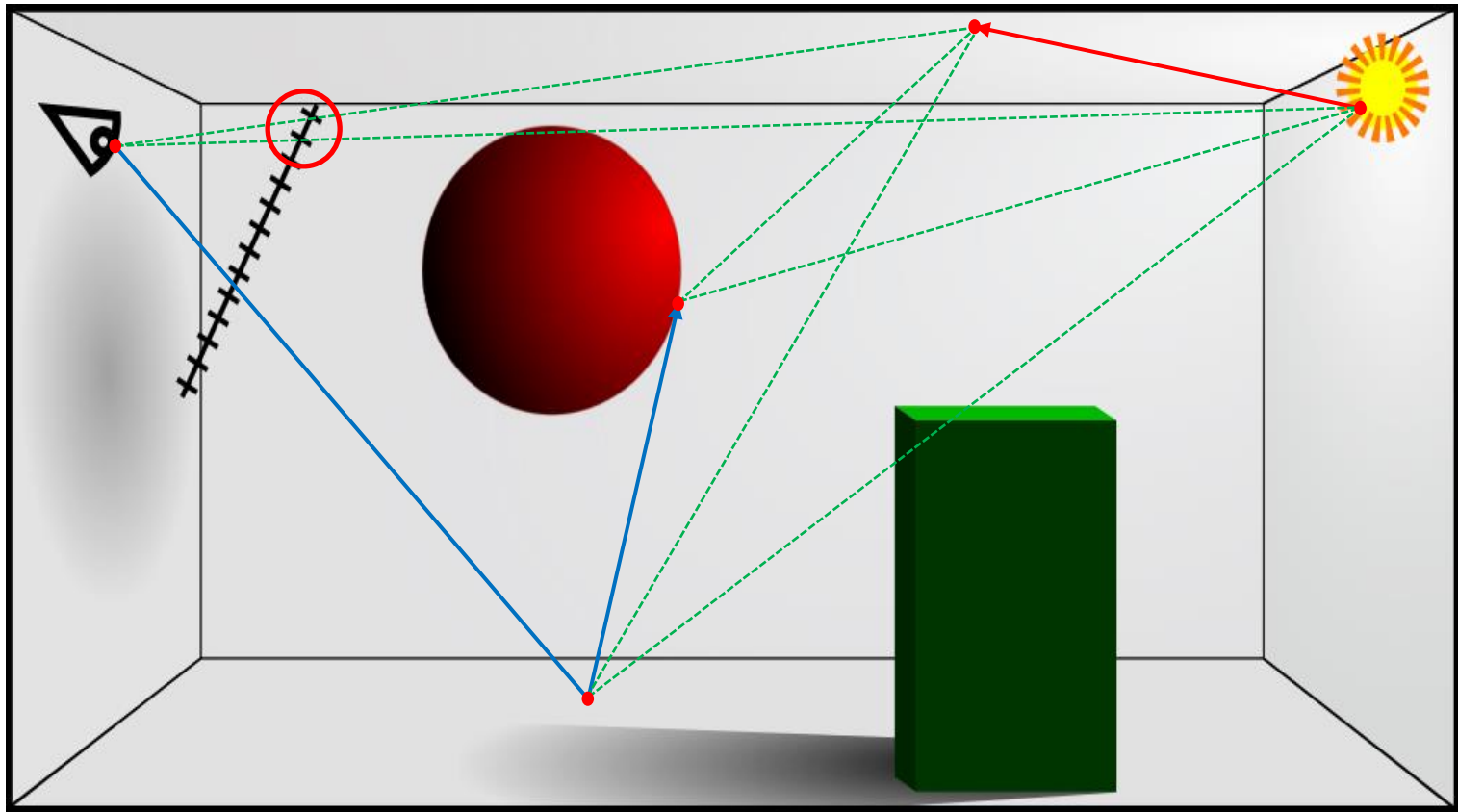
[Kettunen et al. 2015] (SIGGRAPH 2015)



Gradient-domain rendering

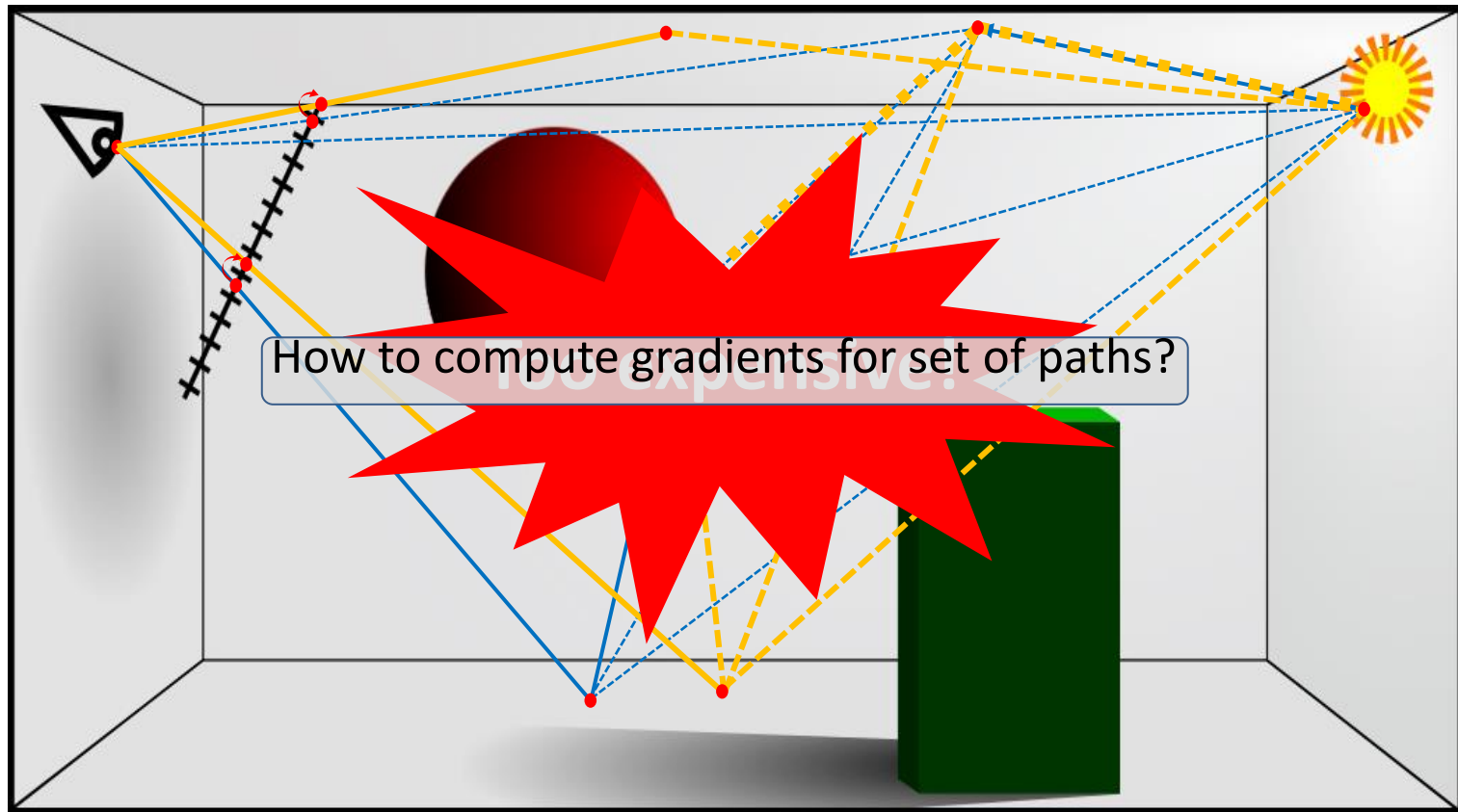


Bidirectional path tracing



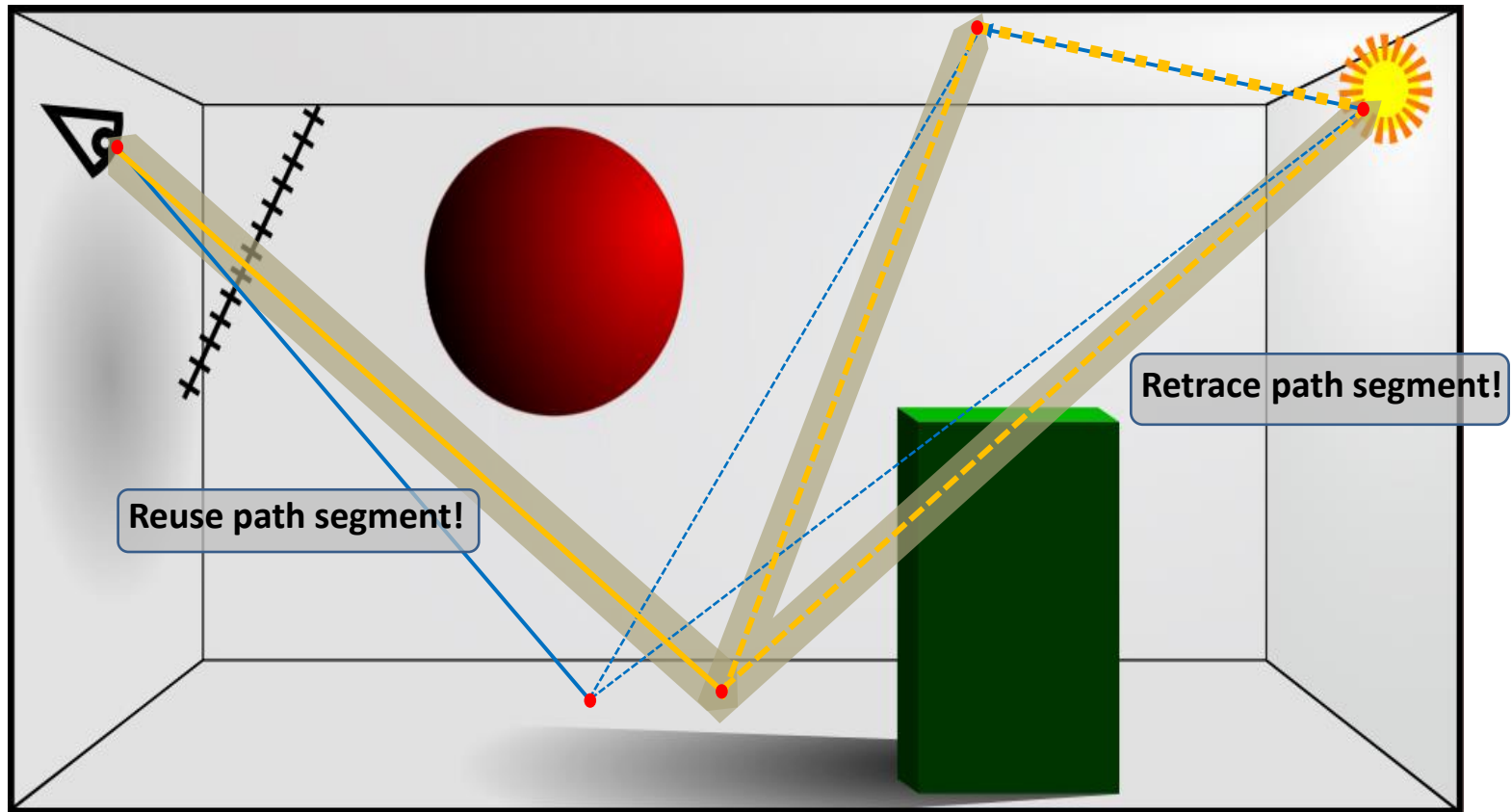
Gradient-domain BDPT

Gradient Sampling



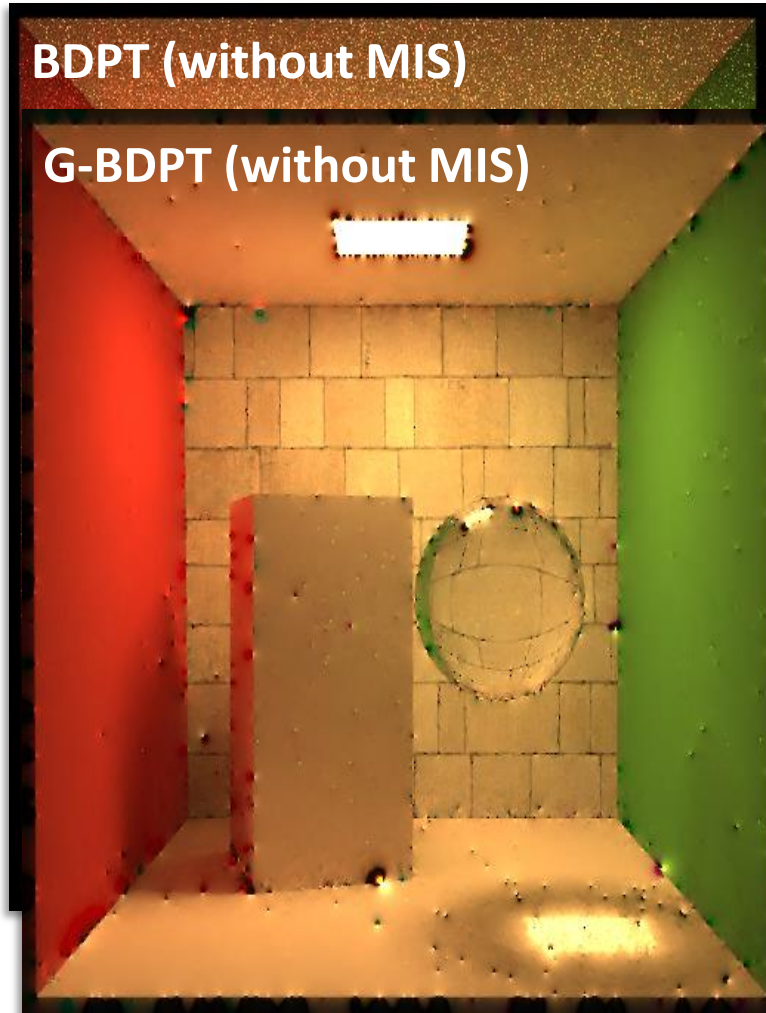
Gradient-domain BDPT

Efficient Gradient Sampling



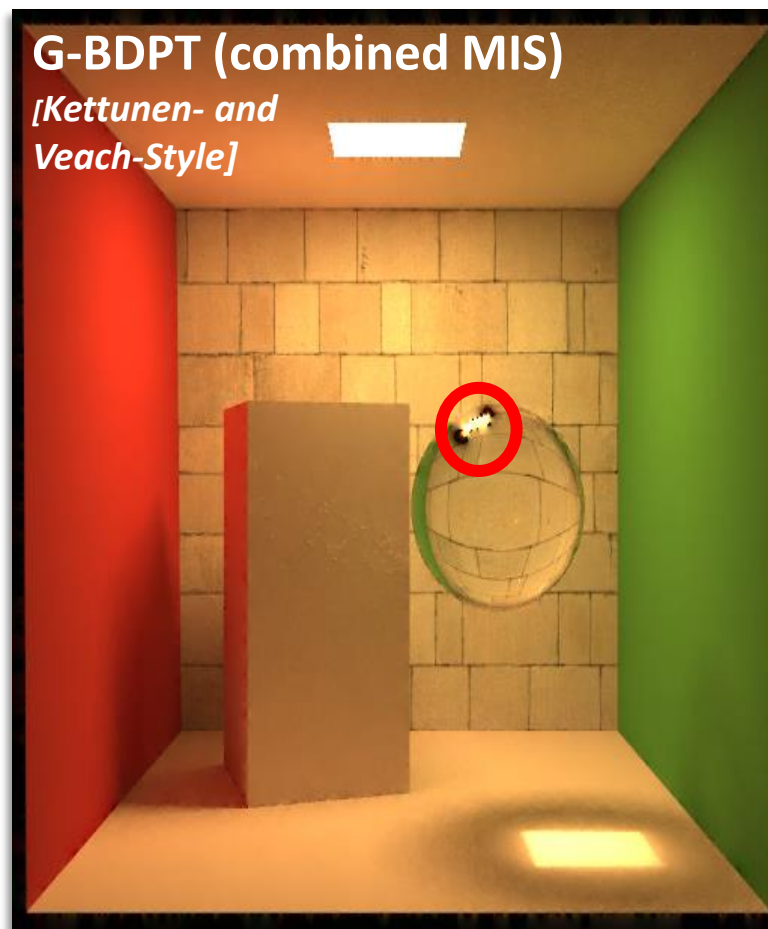
Multiple Importance Sampling

(over the sampling strategies) [Veach and Guibas 1995]



Multiple Importance Sampling

(over the gradient sampling direction) [Kettunen et al. 2015]

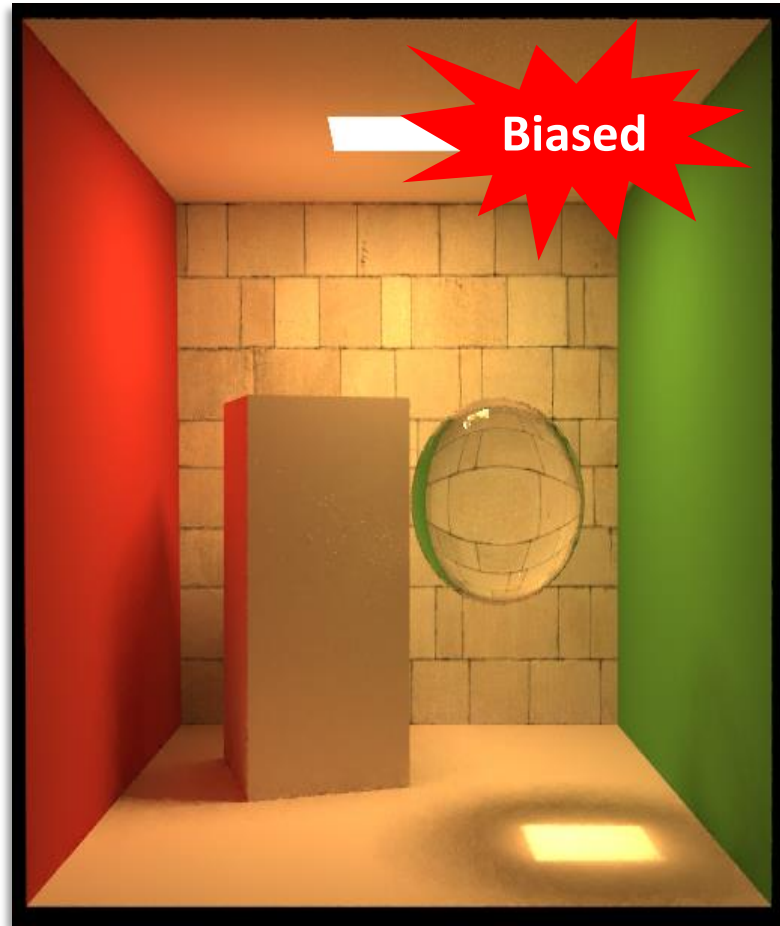


Reconstruction

L2 screened
Poisson reconstruction



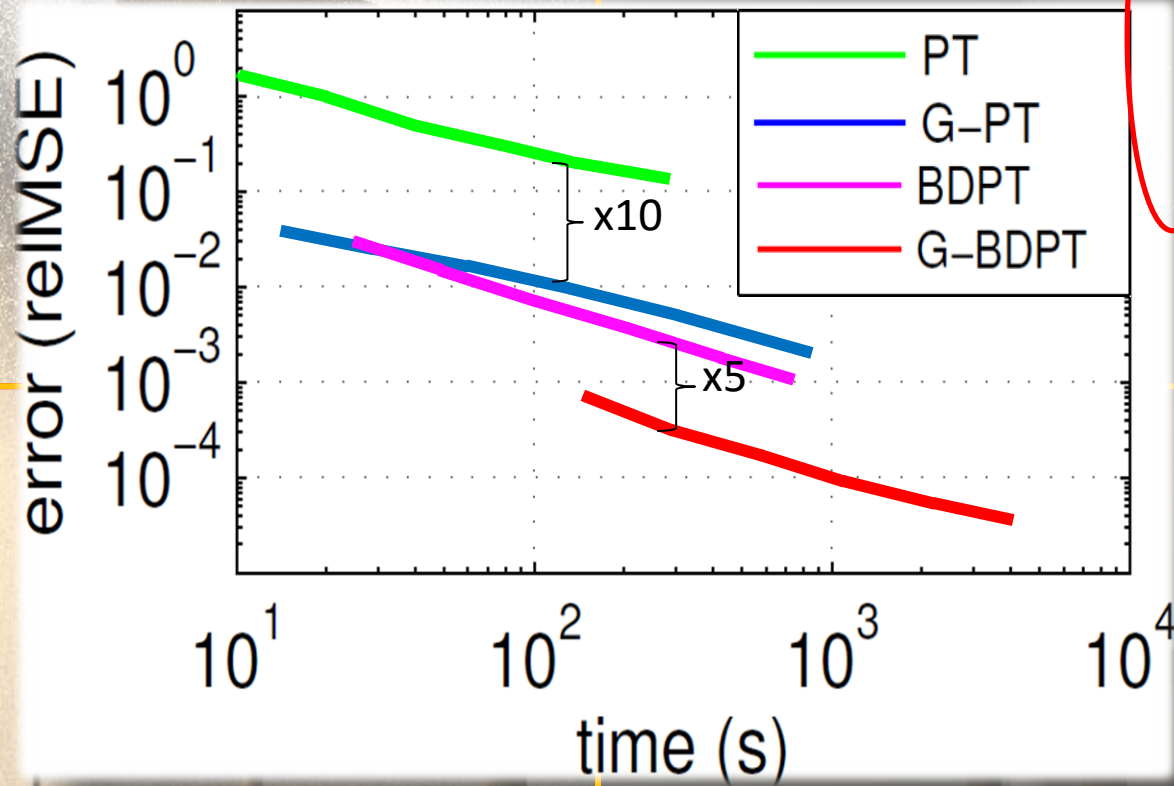
L1 iterative reweighted
least square reconstruction



How well does it work?

PT, 3mins

G-PT, 3mins



BDPT, 3mins

G-BDPT, 3mins

Thank you for your attention !
Any questions ?