

Physically based rendering

Progressive photon mapping

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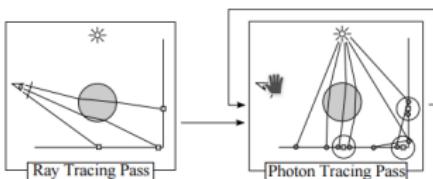
Definition

- Photon mapping belongs to the family of the particle-tracing algorithms
- Constructing paths from the light onto the objects
- 2 stages:
 - ① Generating and sending the photons, with arbitrary accuracy and without storing the full photon map
 - ② Final gathering
- Repeat this principle several times and calculate the average picture

Algorithm

- nbIterations = 10000;
- nbPhotons = 250000;
- calculateAllIntersectionsWithScene();
- for i = 0 to nbIterations:
 - sendPhotons();
 - gatherPhotons();
 - meanRender();

More precisely



Multi-pass algorithm:

- ① Ray tracing pass
 - ray tracing to find all the visible surfaces
- ② Photon tracing passes
 - Every photon tracing increases the solution
 - Convergence to an optimal solution in infinite time

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Criteria of comparison

Several parameters for the progressive photon mapper:

Photons per iteration: The number of photons to be sent at each iteration

Maximum depth: The maximum depth of the final gathering rays

Russian roulette starting depth: The depth before starting to eliminate photons with the russian roulette algorithm

Initial radius: Initial photon query radius

Photons per iteration

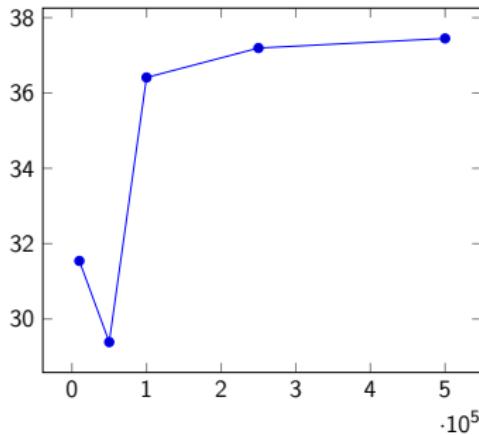


Figure: PSNR according to the number of photons per iteration

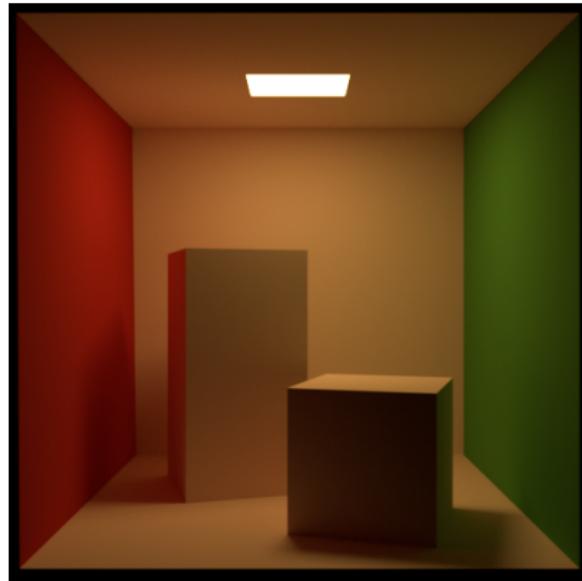


Figure: Rendu parfait

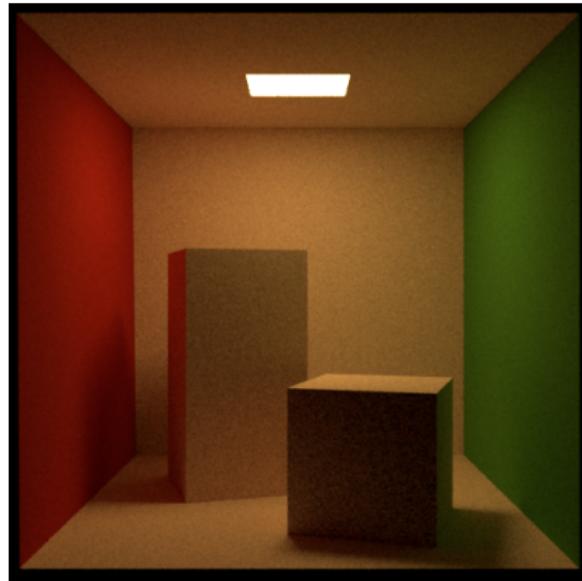


Figure: 500 000 photons per iteration

Maximum depth

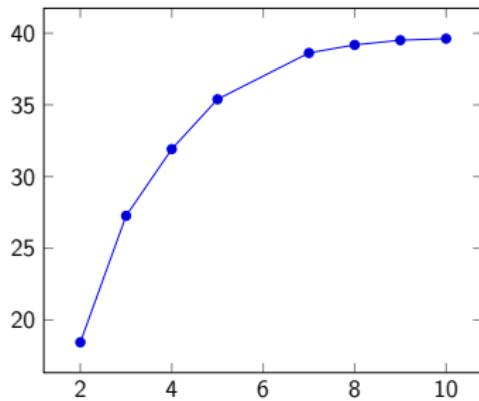


Figure: PSNR according to the maximum depth

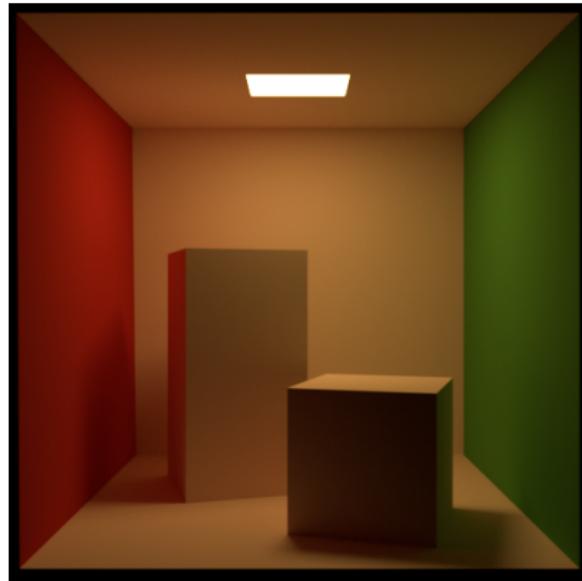


Figure: Rendu parfait

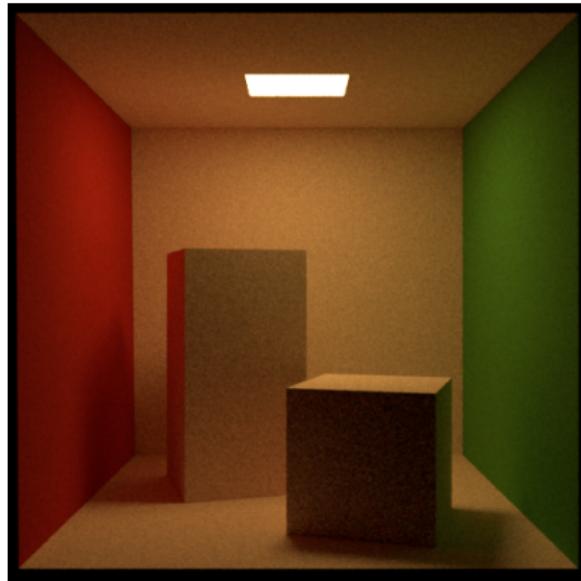


Figure: Max depth = 10

Initial radius

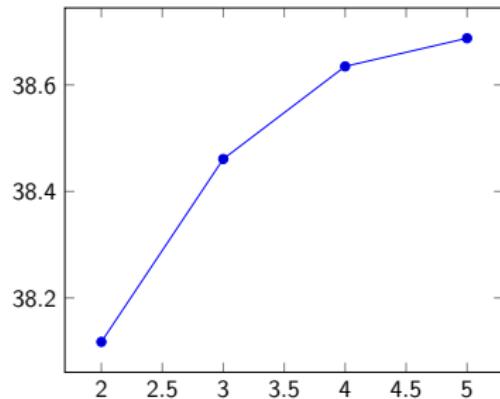


Figure: PSNR according to the initial radius

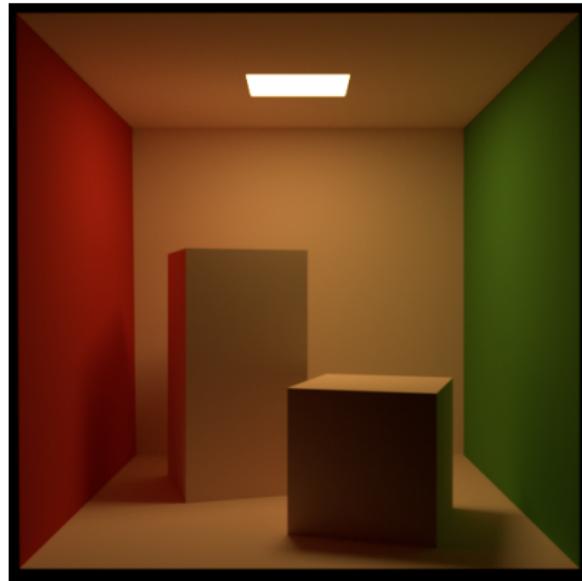


Figure: Rendu parfait



Figure: Initial based on scene

Russian roulette starting depth

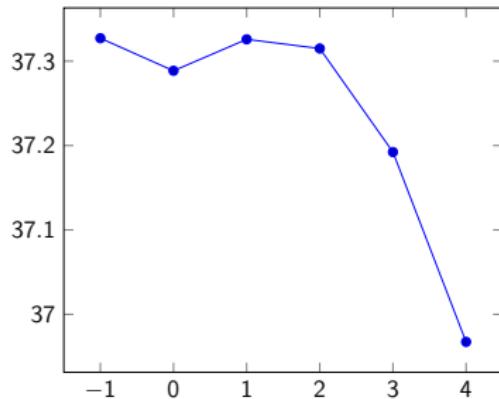


Figure: PSNR according to the russian roulette starting depth

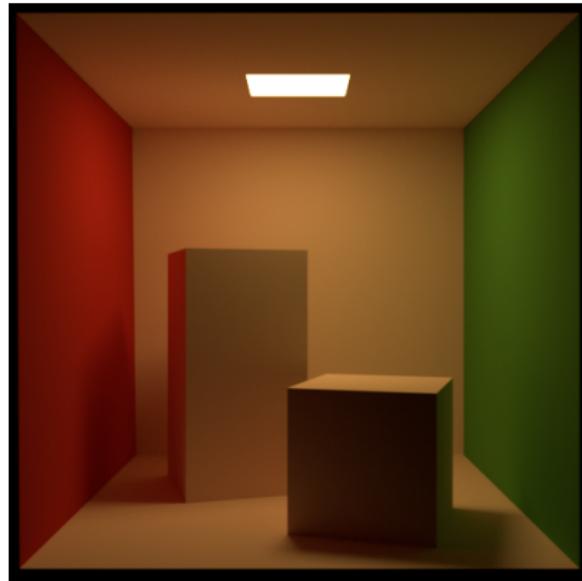


Figure: Rendu parfait

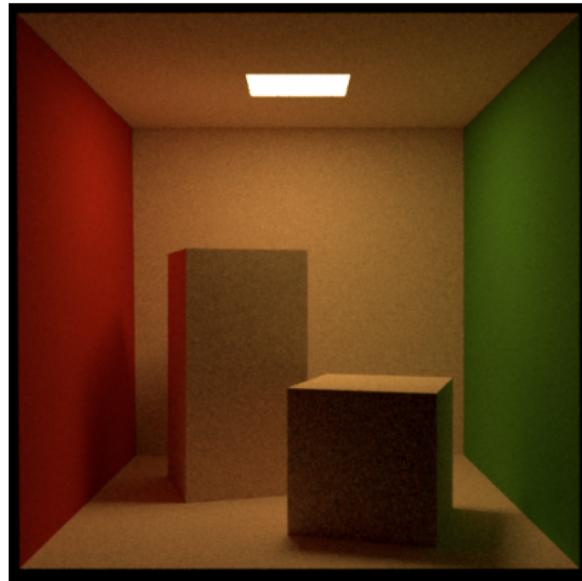


Figure: Russian Roulette based on scene

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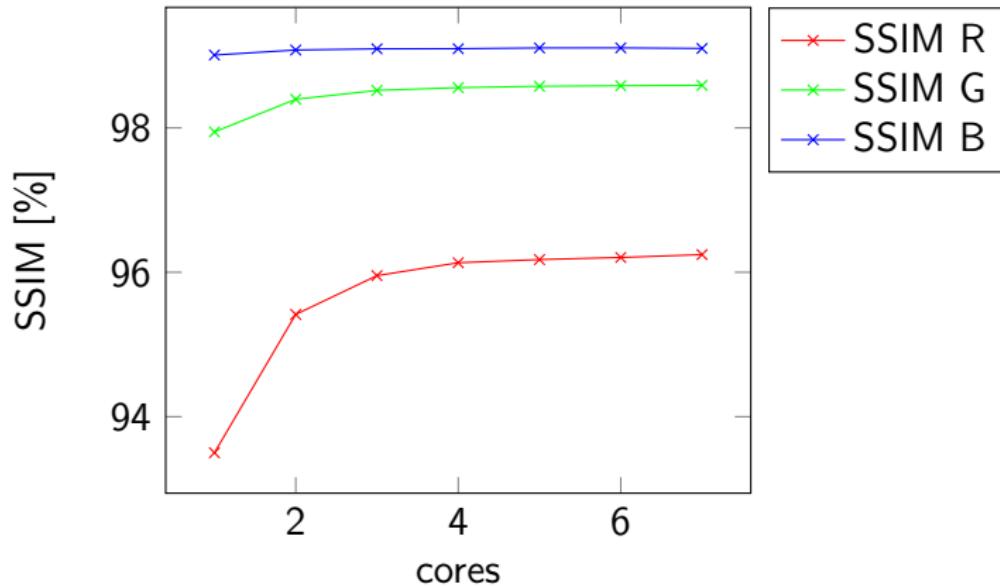
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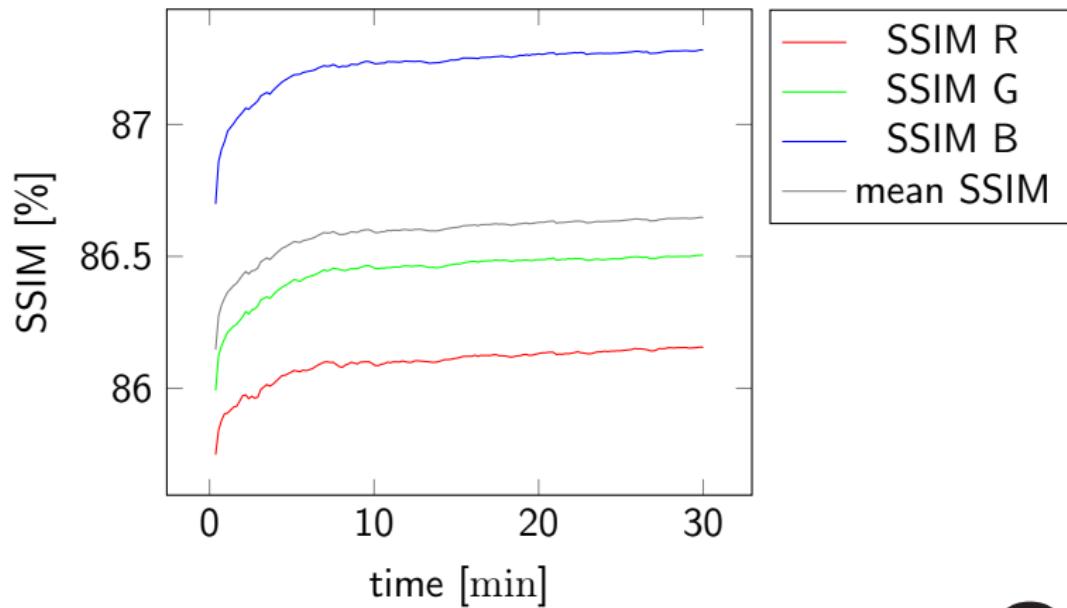
Context

- Image rendering for the cinema (e.g special effects)
- Time-constrained rendering (each render must not take more than a specified amount of time)
- Possibility of a render farm: the method must be scalable
- Signal-perfect images are not necessary:
 - Each image will not be on the screen for more than 1/24th of a second
 - (Often) presence of motion blur

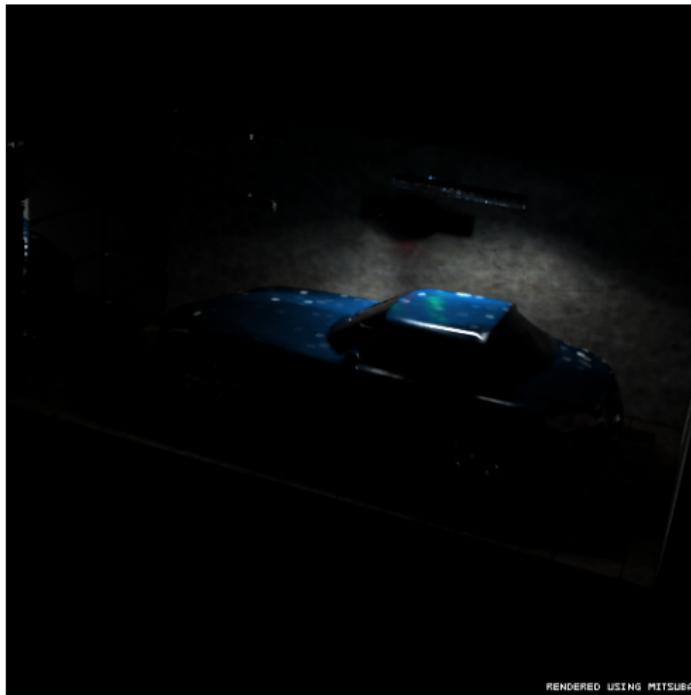
Scalability



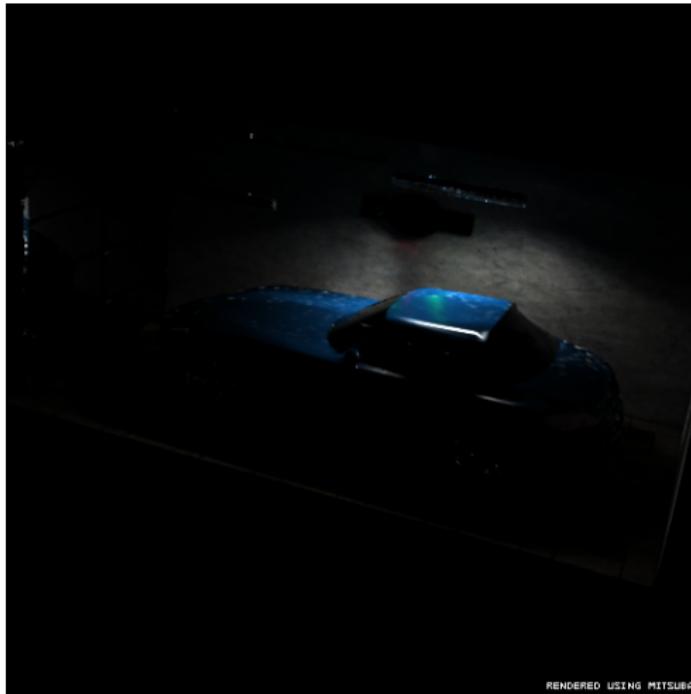
Time-constrained rendering



Render process (1/4)



Render process (2/4)



Render process (3/4)



RENDERED USING MITSUBA

Render process (4/4)



RENDERED USING MITSUBI