Stochastic Progressive Photon Mapping

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Introduction

Photon Mapping (PM)

Progressive Photon Mapping (PPM)

Stochastic Progressive Progressive Photon Mapping (SPPM)
Progressive Photon Mapping

Multi-pass photon mapping algorithm

Progressive Photon Mapping, Hachisuka et al., 2008
Progressive Photon Mapping
Progressive Photon Mapping

First pass: Ray tracing to find all visible surfaces

Bounce ray until the first non-specular bounce is seen
Progressive Photon Mapping

Other passes: Photon tracing passes

Emit photons into the scene

Loop over all ray trace hitpoints

Find all photons within search radius

Use photons in radius to refine the radiance value in the ray trace hitpoint
Progressive Photon Mapping

Other passes: Photon tracing passes

Search radius is reduced after each photon pass

No need to keep photon map after each photon pass
PPM - Strengths

Robust with complex caustic illumination
More efficient than Monte Carlo methods
Progressive radiance estimate converges to correct solution as more photons are added
PPM - Weaknesses

Radiance estimation on one point

Increase in render time

- PM 1 hour
- PPM 4 hours
Stochastic PPM

Computes the correct average radiance value for a region, instead of a point with PPM

Stochastic Progressive Photon Mapping, Hachisuka and Jensen, 2009
Stochastic PPM

Eye Pass  →  Photon Pass  →  Distributed Ray Tracing Pass
Stochastic PPM

PPM calculates radiance for points

Average radiance over a region needed for distributed ray tracing effects.

Use shared statistics over the ray tracing region.
Stochastic PPM

Use randomly generated points in the distributed ray trace region

Shared radius over the distributed ray trace region
SPPM - Strengths

Radiance estimation over a region
Robust with distributed ray tracing effects
Less passes for better result
SPPM - Weaknesses

Rendering time ~10% longer than PPM
Limited to surface
More biased - leads to blurriness
Shadow leaks
Future research

Radiance estimation within a volume

• Illuminate medium

Function to determine of required photons

Dynamic SPPM

Conclusion

Adds distributed ray tracing pass
+Deals with motion blur and depth of field
+Reduces the noise
-Shadow leaks
-Biased
Demo

Result after 4.5 hours