Guided path tracing using clustered virtual point lights

Importance sampling

- BRDF
- Incoming radiance



Incoming radiance has more influence for diffuse scenes. How to add incoming radiance sampling to path tracing?

Previous works

- Parameterize incoming radiance distribution by
- 2D grid [Jensen, 1995]
- Cones [Hey and Purgathofer, 2002]
- Gaussian mixture model [Vorba et al., 2014]
- Incoming radiance estimated by nearest neighbour photons.

Evaluations



- In our test scenes, our sampler works effectively even for small number of VPLs.
- Method by [Vorba et al.] only outperforms when photons are relatively dense.
- VPLs VPL cluste Paths Initializatio Path tracin Memory

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Main idea

- Virtual point lights (VPLs) can estimate incoming radiance well in diffuse scenes.
- Use VPLs for incoming radiance sampling.
- Sample by Metropolis algorithm so parameterization is not required.
- Build the sampler on top of existing many-light rendering techniques.
- Use multiple importance sampling to combine with BRDF sampling.

















	Kitchen	Breakfast	Conference
ers on ng	50 K 1200 150 7.5 mins 311 mins 2.6 GB	48 K 2000 150 8.25 mins 280 mins 1.5 GB	39 K 1200 130 3 mins 233 mins 1.5 GB





Future work

- VPL or photon?
- Bidirectional path tracing.
- Other interpolation techniques.
- Wayne, W., 2014. The breakfast room Cycles Blender 2.71 (Breakfast scene). More mutation techniques.

Steps



Generate VPLs



Gather point clustering Generate scene points and cluster them into cache points using a 6D kd-tree (positions and normals)



VPL clustering We use matrix row-column clustering and then refine clusters for each row [Ou et al., 2009].



Interpolation Query VPLs in a small cone to compute incoming radiance for a direction.



Metropolis sampling Two mutations:

 Generate a direction uniformly • Perturb the previous direction in a small cone.



[Vorba et al.] (600K photons)









- Vorba, J., Karlik, O., Sik, M., Ritschel, T., and Krivanek, J. 2014. On-line learning of parametric mixture models for light transport simulation.
- Hey, H. and Purgathofer, W. 2002. Importance sampling with hemispherical particle footprints.
- Jensen, H. W. 1995. Importance driven path tracing using the photon map.
- Ou, J. and Pellacini, F. 2011. Lightslice: matrix slice sampling for the many-lights problem.
- Hardy, J., 2012. Country kitchen Cycles Blender 2.62 (Kitchen scene).



Implementation

- At each cached scene point, create a Metropolis sampler and
- store directions

generated in a buffer.

- To avoid correlation, scramble the samples in the buffer.
- To compare with the method by [Vorba et al.], we generate photons by tracing one more bounce from the VPLs.







