RI3004A 3D Graphics Rendering

Discussion 8 (Answers)

For **Lecture 11: Global Illumination**

Please attempt the following questions before you go to your discussion class. Some of the questions may be quite open-ended and some may be even ambiguous. In those cases, you are encouraged to make your own (reasonable) assumptions.

(1)   Why is it not possible to simulate caustics using Whitted or distributed ray tracing?

Caustics is caused by the focusing of indirect illumination. In Whitted or distributed ray tracing, at a hit point, we do not trace multiple rays towards the light source through indirect paths via other specular/translucent objects.

(2)   Explain why Whitted ray tracing and distributed ray tracing algorithms cannot simulate diffuse-to-diffuse interactions.

This is because when a ray hits a diffuse surface, it stops spawning secondary rays to the environment.

(3)   Suppose we run a radiosity algorithm on the diffuse surfaces of a scene, and store the radiosity values of the surfaces in illumination maps. Then, a distributed ray tracing pass is performed to trace rays from the eye. When a ray hits a point on a diffuse surface, the stored radiosity value is retrieved and used instead of the result computed using the Phong lighting model. **(i)** Use the light path notation to describe the global illumination solution produced by this hybrid approach. **(ii)** Can it simulate caustics? Why?

(i) LD*S*E

(ii) Cannot. Because the light path notation for caustics is LSS*D, which is not a substring of the light path notation of the hybrid approach.

(4)   Why using the BRDF of a surface for importance sampling is generally not enough?

Because the incoming radiance from the hemispherical environment may be very far from being uniform.

(5)   Consider a scene that has a small and very bright light source and a mirror-reflective surface.

(i) For a path tracing algorithm that uses importance sampling, why is it difficult to render such a scene satisfactorily (the image usually looks very noisy)?

(ii) Suppose the only reflective surface in the scene is a planar mirror. Consider the rendering of a diffuse surface point, write the light path (using light path notation) of the sequence of interactions that has the greatest contribution to the noisy image.

(i) Without prior knowledge of the distribution of the incoming illumination, the sampling can miss the strong indirect illumination from the mirror-reflective surface. This results in strong noise in the image.

(ii) LSDE.

(6)   List <u>two advantages</u> of the <u>photon mapping</u> method over the traditional <u>two-pass ray tracing</u> method.

1. There is no need to 2D parameterize the scene surfaces for irradiance caching.

2. Can simulate complete global illumination solution.

3. Can be easily extended to volume rendering to simulate sub-surface scattering.

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