Related Work

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Indirect Illumination

In the area of ray tracing and computer graphics, Global illumination is an important problem. While direct illumination comes inherently through ray tracing, indirect illumination is more difficult to produce efficiently. Indirect illumination provides another level of realism in computer graphics lighting, color bleeding and light scatter contribute greatly to the appearance of a scene. There are a number of existing algorithms that factor in indirect illumination to ray tracing. Most methods employ a form of sampling, or approximation of direct illumination from a point or intersection. The main difference, and point of interest for this thesis, is the way that irradiance is cached or stored prior to light calculations.

Photon Mapping

Photon mapping is a two pass method that creates a map of light samples (photons) [1]. Sampling from the lights into the scene, a map of photons is created; storing the illumination and direction. During the second pass of rendering, rays are cast from the camera. For an intersection, the lighting is computed, taking into account the light contributions from neighboring photons. Similar to the method of radiosity [2], this method of providing samples from the light, gives an added level of realism to the renderings. Additionally, light samples can create caustics in a scene. Overall, this method provides highly realistic renderings but at the cost of creating a photon map.

Monte Carlo Ray Tracing

Monte Carlo ray tracing [3] is another method of incorporating indirect illumination into lighting. This method relies upon casting additional rays, in order to sample the neighboring geometry of an intersection. The lighting computation calls for an integral of all incoming light on a hemisphere about an intersection. This calculation is handled by the stochastic sampling of rays about the hemisphere. Additional methods like path tracing and light tracing look to trace the path back to the light source, or a number of steps. While Monte Carlo has no setup required, the number of rays cast for indirect illumination is significantly higher.

Point Based Color Bleeding

Point based color bleeding[4] is a more recent approach to indirect illumination, now widely used in movie animation and production. This method is also broken into a two step process, collecting direct illumination, then casting rays. The direct lighting is stored by creating a point cloud of surfels. These surfels are organized into an octree for easier traversal in the rendering phase. During rendering, intersections create box samples of direct illumination of surrounding geometry. Using these samples, the global illumination can be correctly approximated. This technique makes use of octrees and

point clouds to speed up the process and store direct illumination so it does not have to be recalculated. Approximations made from the point cloud of surfels can be adjusted to be of very high resolution, and therfore very realistic.

Interactive Indirect Illumination
One of the most recent approaches at improving indirect illumination, is interactive indirect illumination [5]. The paper introduces a technique that provides real-time indirect lighting computations with dynamic lighting and geometry. The algorithm described uses a sparse voxel octree to store incoming radiance from each light. Second, the octree is then filtered for higher levels as a form of mipmapping. Lastly, after the scene has been rasterized, the indirect illumination is gathered using voxel cone tracing and then overlayed on the scene. This method, provides efficient storage of illumination, higher level approximation, and interactive rates.

References

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