Fast Local Approximation to Global Illumination

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Abstract

Interactive global illumination remains an elusive goal in rendering, as energy from every portion of the scene contributes to the final image. Integrating over a complex scene, with a polygon count in the millions or more, proves difficult even for static techniques. Interacting with such complex environments while maintaining high quality rendering generally requires recomputing the paths of countless photons using a small number of CPUs. This dissertation examines a simplified approach to interactive global illumination. Observing that local illumination computations can be performed interactively even on fairly simple graphics accelerators, a reduction of global illumination problems to local problems would allow interactive rendering. A number of techniques are suggested that simplify global illumination to specific global illumination effects (e.g., diffuse interreflection, soft shadows, and caustics), which can individually be sampled at a local level. Rendering these simplified global illumination effects reduces to a few lookups, which can easily be done at interactive rates. While some tradeoffs exist between rendering speed, rendering quality, and memory consumption, these techniques show that approximating global illumination locally allows interactivity while still maintaining significant realism.