Spatial Image Based Lighting

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1 Introduction

When compositing computer generated imagery into photographed scenes, image based lighting (IBL) [Debevec 1998] is used so that synthetic and real objects are consistently illuminated. Traditional IBL takes light captured from a single point in space however light varies spatially in many scenes. Unger et al. [2003] captured a light field for lighting, but the acquisition procedures were not practical for typical scenes. I present a practical IBL method for rendering scenes with spatially variant light.

Figure 1: *Images rendered with spatial IBL*

2 Light Acquisition

To sample the light field I use an unconstrained camera with fisheye lens. High dynamic range imaging captures the full dynamic range of the scene while tracking markers are used to calibrate the unconstrained light field samples to a common coordinate space. To reconstruct the light field from the sparse samples I employ inverse distance weighted interpolation, depth correction [Unger et al. 2003] and occlusion correction [Pronk 2006].

3 Light Rendering

For global illumination rendering the reconstructed light field is implemented as a self illuminating object. When a ray from the renderer intersects the light field geometry a reconstructed light field ray is returned, effectively lighting the scene. Although global illumination rendering produces realistic images it requires significant computation time to overcome unwanted noise such as when dealing with highly diffuse surfaces. In these situations a more practical rendering solution is direct lighting.

For direct lighting the reconstructed light field is processed to build a three dimensional grid with importance sampled direct lighting at each cell vertex. To illuminate a point on an object I apply the direct lighting at each of the eight surrounding cell vertices and combine these with trilinear interpolation.

Differential rendering [Debevec 1998] is used to generate scene shadows and as a preprocess to update the reconstructed light field to include the effects of the synthetic object being placed within it.

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4 Results and Future Work

Figure 2 displays the results of rendering a group of spheres into a hallway exhibiting spatial lighting variation (the left image is daylight whilst the right image is a combination of incandescent and fluorescent lighting).

Figure 2: *Spheres rendered in hallway with spatially varying light*

In Figure 1 you can see the result of rendering typical objects into the same hallway. The left image has Stanford Bunnys placed along the hallway while the right has a specular Stanford Buddha; both include scene shadows generated with the direct lighting model. All renderings have been created with V-Ray and custom shaders implementing the techniques discussed.

I have begun investigating an alternate direct lighting interpolation procedure involving matching and interpolating direct lights between cell vertices. This allows interpolation to occur before shading providing a significant performance improvement. Other areas for further investigation include deriving practical metrics for light field acquisition, C^1 interpolation for light field reconstruction and adaptive direct light grid creation.

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References

DEBEVEC, P. 1998. Rendering synthetic objects into real scenes: bridging traditional and image-based graphics with global illumination and high dynamic range photography. In *SIGGRAPH '98: Proceedings of the 25th annual conference on Computer graphics and interactive techniques*, ACM Press, New York, NY, USA, 189–198.

PRONK, J. 2006. *Spatially Variant Real World Light for Computer Graphics*. Honours thesis, University of New South Wales.

UNGER, J., WENGER, A., HAWKINS, T., GARDNER, A., AND DEBEVEC, P. 2003. Capturing and rendering with incident light fields. In *EGRW '03: Proceedings of the 14th Eurographics workshop on Rendering*, Eurographics Association, Aire-la-Ville, Switzerland, Switzerland, 141–149.