Honours Thesis Proposal

Spatially Variant Real World Light for Computer Graphics

(Sparse Incident Light Fields for Image Based Lighting)

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Background

Computer graphics lighting is the process of illuminating computer graphic 3d objects in such a way as to mimic the effect of light in the real world. Computer graphics lighting is an integral step in creating the look of computer generated image renderings. A common process in feature film visual effects[1] and architectural visualisation is to place a computer graphic 3d object into a live action scene. The 3d object must appear to have been in the scene when it was originally photographed. As human visual perception is well attuned to the subtleties of light and shadow, a computer graphics render destined for photographic integration requires an accurate lighting simulation.

Historically lighting in computer graphics has involved manually defining the orientation of simple theoretic lights[2] (e.g. point light or spot light) to simulate illumination. The process can be tedious, time consuming and very hard to achieve when attempting to match the multi-dimensional, visually rich light often encountered in the real world.

A recent advance in computer graphics lighting is Image Based Lighting[3]. Image Based Lighting is the process of acquiring real world lighting data for use in the illumination of 3d objects. The real world lighting data is typically a high dynamic range image [4] of a highly reflective sphere, also known as a light probe[3]. The reflection on the probe represents incoming light from all directions at one distinct point in space. A problem with this technique is it assumes light to be uniform in the scene. With film visual effects becoming ever more advanced and occupying more and more screen time this restriction will need to be overcome.

Proposal

I will investigate a procedure for acquiring spatial incident illumination data to convincingly light computer graphic 3d objects for integration into photographed scenes. Key areas of investigation include efficient acquisition of the lighting data, interpolation of the data at the render stage[5,6], importance sampling during rendering[7,8], extraction of environment geometry for accurate light field reproduction and integration with different rendering methodologies (e.g. scanline, raytracing, real-time hardware).

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References

[1]
Visual Effects from Wikipedia
http://en.wikipedia.org/wiki/Visual_effects

[2]
Lighting Controls for Synthetic Images (1983)
David R. Warn
http://portal.acm.org/citation.cfm?id=801127

[3]
Rendering Synthetic Objects into Real Scenes (1998)
Paul Debevec
http://www.debevec.org/Research/IBL/

[4]
Recovering High Dynamic Range Radiance Maps from Photographs (1997)
Paul E. Debevec and Jitendra Malik
http://www.debevec.org/Research/HDR/

[5]
Capturing and Rendering with Incident Light Fields (2003)
Jonas Unger, Andreas Wenger, Tim Hawkins, Andrew Gardner, Paul Debevec
http://www.debevec.org/Research/ILF/

[6]
Light Source Interpolation for Sparsely Sampled Reflectance Fields (2005)
Billy Chen and Hendrik P. A. Lensch
http://graphics.stanford.edu/papers/light_source_interpolation/

[7]
A Median Cut Algorithm for Light Probe Sampling (2005)
Paul Debevec
http://gl.ict.usc.edu/research/MedianCut/

[8]
Efficient illumination by high dynamic range images (2003)
Thomas Kollig, Alexander Keller
http://portal.acm.org/citation.cfm?id=882411