

# A New Light on Rendering

A novel illumination process enhances the value of image-based rendering for a broad range of applications

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The advent of image-based rendering a couple of years ago represented a significant breakthrough in computer graphics. For example, the ability to realistically render a scene by projecting photographs onto digital geometry promised artists and designers a reprieve from the painstaking task of generating complex image data from scratch. As is often the case, however, the new technology's promise was and continues to be burdened by some pesky limitations.

The most obtrusive of these limitations is the difficulty of making changes to the geometry or lighting conditions of image-based rendered scenes. This is because the lighting in photographs is fixed, so scenes built with the photographs can only be rendered with the same illumination as the original photographs. This also means that changes to the geometry cannot be accommodated because, in the real world, changing objects, which reflect light, would alter the lighting in a scene. Generating a new rendering to accurately reflect geometric changes or to vary the lighting conditions of the scene requires re-computing the interaction of light with the surfaces in the scene. This is possible only if the reflectance properties (such as the diffuse color and shininess) of every surface is known before the image is re-rendered. Unfortunately, such information is not readily available from the scene geometry or from photographs.

While attempts have been made to estimate reflectance properties of real surfaces from dense measurements of isolated surface areas, most of these have seen little success, because reflectance properties of real scenes change over space and time.

In an effort to bypass the shortcomings of traditional image-based rendering, researchers in the Computer Science Division of the University of California at Berkeley have recently developed a promising approach whereby the reflectance properties of an entire scene can be predicted based on data from photographs, and the surfaces can be illuminated based on their actual properties, rather than those of isolated samples. With the technique, the researchers are able to simulate the realistic appearance of a rendered

scene under various lighting conditions, including those resulting from changes to the geometry. The resulting image parallels that which would be captured in a photograph if one were taken under the desired conditions.

The heart of the process is an algorithm designed to achieve inverse global illumination by recovering the reflectance properties of all surfaces in a real scene. This information together with the scene's geometry serves as the basis for a lighting-independent model of the scene, which can then be rendered using traditional methods.

As the name suggests, inverse global illumination is the inverse of traditional global illumination, which uses known geometry, lighting, and reflectance properties to produce radiance maps, or rendered images. In contrast, inverse

A clock tower rendered using image-based techniques is viewed under various lighting conditions. Researchers simulated the lighting variations using radiance data acquired from the original photograph of the tower.



