Reaction Report: Fast Separation of Direct and Global Components of a Scene using High Frequency Illumination

In this paper Nayar *et al*. present a technique for recovering direct and global illumination components by shining the single direct source through a high frequency mask. This allows measuring the global component of light in the shadowed areas, and the direct plus global components in the non-shadowed regions. A major limitation of the paper is that it requires only one light source to be present in order to separate the illumination components. Furthermore, the light source has to be located near the camera such that the high-frequency pattern is not stretched over curved surfaces. That is, consider a light source shining at an angle perpendicular to the view direction. In that case, the more the surface normal is oriented towards the camera, the more perpendicular it will be to the light direction, thereby spreading the light over a greater area and hence stretching the pattern. This shortcoming can be overcome by moving the pattern in very small increments in order to sample the stretched region with both shadowed and direct components. However, this means that many more images need to be collected in order obtain the required two samples for such regions. Furthermore, the assumption that only one light source illuminates the scene is often violated. Most indoor environments have multiple light sources. Reflective surfaces also act as secondary light sources. Interestingly, separation of the direct and global components still retrieves the direct illumination component of a source. The global component, however, would include the other light sources. Hence, by obtaining the direct component of each light source in turn and combining them, one could recover the global component.

The notion of relighting the scene gave me the idea of using multiple polarized light sources to illuminate a scene. While the light's polarization is randomized slightly each time it hits and scatters from a surface, for most surfaces we can assume that scattered light of a particular unique polarization is mostly coming from the corresponding light source. Hence filters in front of a camera lens can be used to measure the portion of the scene being lit by a particular light source at each point. If the filter's polarization can be changed quickly, a camera can be constructed that captures a separate video for each light source, allowing for the lighting to be adjusted in post-processing. This of course only works in environments where the light sources can be controlled (e.g., a movie set). By measuring a small region for the polarization of light that is sufficiently distinct from the polarization of each light source one can also estimate the amount of light 'bleeding' for each component of a particular polarization. Techniques such as the one used in the flash/no-flash image pairs paper can be extended to use some of the polarized light sources for transferring detail. Overall, I like the idea of separating light out into various components to allow for greater artistic flexibility in post-processing.