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Contributions

- We introduce shader lamps as a new mode of visualizing 3D computer graphics. Our idea treats illumination basically as a 3D perspective projection from a lamp, and thus, it can be created using traditional 3D computer graphics. We present techniques that can replace not just textures, i.e. diffuse component, but can reproduce virtually any BRDF appearance.
- We present new algorithms to make the process of illumination practical. We first identify a simple radiance adjustment equation for guiding the rendering process and then present methods for the corresponding intensity correction.
- We introduce a new algorithm for determining pixel weights and computing feathering intensities across transitions in projectors' regions of influence in the presence of depth discontinuities.

2. Previous Work

Theater and entertainment. Naimark [Naimark84] used a rotating movie camera to film a living room, replete with furniture and people. The room and furniture were then painted white (neutral), and the captured imagery was projected back onto the walls using a rotating projector that was precisely registered with the original camera. This crucial co-location of the capturing and displaying devices is common to most of the current demonstrations that use pre-recorded images or image-sequences. A limited but compelling example of this idea is the projection of pre-recorded video to animate four neutral busts of singing men in the Walt Disney World "Haunted Mansion". In addition, a patented projector and fiber-optic setup animates the head of the fictional fortune teller "Madame Leota" inside a real crystal ball [Liljegren90].

Slides of modified photographs augmented with fine details are also used with very bright projectors to render imagery on a very large architectural scale. A well-known modern realization of this idea is the *Son et Lumiere* (light show) on the Blois castle in the Loire Valley (France). In addition, the medium is now being used elsewhere around the world. Influenced by *Son et Lumiere*, Marc Levoy [Levoy00] has recently experimented with projection of imagery onto small-scale fabricated statues. Instead of photographs, he first renders an image of a stored 3D model similar to our techniques and then manually positions the projector to geometrically register the projected image. The [Hypermask99], an exception in terms of automatic registration, involves projecting an animated face onto a moving mask for storytelling.

All these systems create compelling visualizations. However, the cumbersome alignment process can take several hours even for a single projector. Our technique avoids this problem by forming a 3D geometric understanding using well-known computer vision techniques described in Section 4 and then moves beyond simple image projection to reproduce reflectance properties.

Tangible luminous interfaces. The Luminous Room project treats a co-located camera-

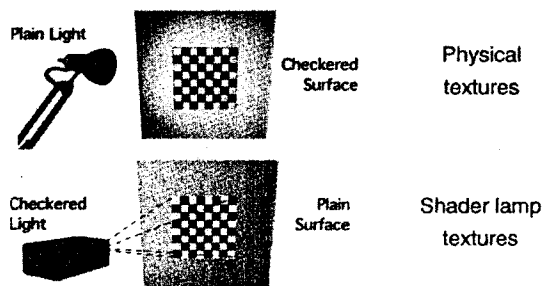


Figure 2: Concept of *shader lamps*.