Image Based Relighting using Room Lighting Basis

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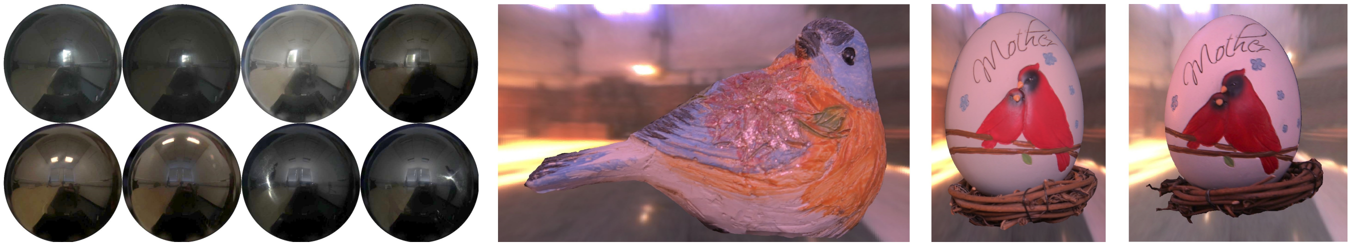

(a) Room lighting basis (b) Relit results under Grace cathedral (c) Ground truth

Figure 1: *Room lighting basis (a) used to relight two decorative pieces (b) (bird, egg). The relit result of egg qualitatively compared to to ground truth (c) generated with dense sampling from 142 lighting directions using free-form acquisition [Masselus et al. 2002].*

Abstract

We present a novel approach for image based relighting using the lighting controls available in a regular room. We employ individual light sources available in the room such as windows and house lights as basis lighting conditions. We further optimize the projection of a desired lighting environment into the sparse room lighting basis in order to closely approximate the target lighting environment with the given lighting basis. We achieve plausible relit results that compare favourably with ground truth relighting with dense sampling of the reflectance field.

1 Introduction

Conventional image based relighting requires capturing a dense set of incident lighting conditions using special purpose devices such as a Light Stage or free-form acquisition with a hand held light source [Masselus et al. 2002]. However, the requirement for dense sampling of reflectance field remains with these approaches which can be difficult for hand-held acquisition. We demonstrate relighting results for objects acquired in a regular office room environment by manually controlling available light sources and employing them as basis lighting conditions. Unlike a densely sampled reflectance field, the acquired sparse lighting basis does not achieve desired results simply through basis projection of a given lighting environment. Hence, we employ an optimization procedure to obtain a weighted combination of the projection to closely approximate a desired lighting environment.

2 Method

We manually control the available light sources in an office room and record the incident illumination due to these sources using a light probe (Fig. 1, a). This includes frontal illumination from two large windows which we partition into two smaller light sources each by drawing the blinds half-way to obtain four basis light conditions (Fig. 1, a: top). The room also has a set of two fluorescent ceiling lights that can be individually controlled and we add additional LED illumination using a mobile phone from the two side walls. This provides four additional lighting conditions to the basis (Fig. 1, a: bottom). We also photograph the rooms ambient illumination for dark level subtraction and also use it as an additional basis condition to model global illumination. We then record the objects to be relit under these lighting conditions. For the relighting step, we first partition the room into Voronoi cells with area inversely proportional to the width of the lights. We then project the desired lighting environment into this sparse basis to obtain basis coefficients. However, directly using these coefficients produces suboptimal results. Similar to the approach of [Tunwattanapong et al. 2011], we perform constrained optimization of a weighted linear combination of the basis projections in our sparse over-complete basis that closely matches the desired lighting environment (Fig.1,b).

3 Results

We present relit results of decorative figurines (bird and egg) in the Grace cathedral environment in Fig. 1, and a qualitative comparison to dense sampling of reflectance field with the approach of [Masselus et al. 2002]. Some differences in the results are due to employed LDR capture for the ground truth [Masselus et al. 2002], while HDR capture is employed for our room lighting basis. Fig. 2 presents additional relighting results. Additional results can be found in the supplemental document.

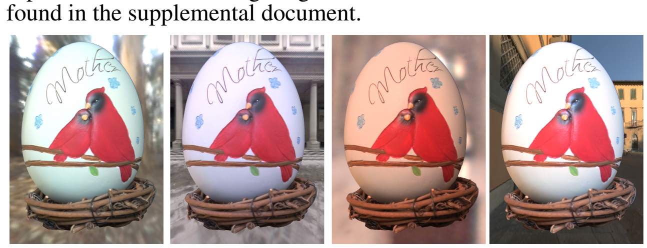

Figure 2: *Relit results in various lighting environments.*

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