

Estimating Roughness Parameters of an Object's Surface from Real Images

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1 Introduction

Reflectance of an object's surface plays an important role in image synthesis. Several reflection models have been proposed to realize realistic object representation, but the reflectance parameters are difficult to determine appropriately. Sato et al. [Sato et al. 1997] proposed a method to measure reflectance properties of real objects using the shape information and captured images. For more realistic image generation, it is necessary to measure the roughness parameters of an object's surface from real images. Previous work has been done to obtain bump maps from real images [Rushmeier et al. 1997; Lefebvre and Poulin 2000]. In this paper, we propose a method to model roughness as bump parameters using distribution functions.

2 Reflectance Estimation using Bump Model

Figure 1 (a) shows a real image of a blue painted spherical object which has a slightly rough surface. Both (b) and (c) are generated images whose reflectance parameters are estimated from the real object of (a). The difference of surface representation comes from the use of the bump model in (c).

We define the bump model as the roughness of an object's surface. This bump model is measured around the highlight of the object. So we measure the difference in angle between the theoretical intensity curve and the actual reflected intensity as shown in figure 2(a). By counting the number of these angles, we obtain frequency distribution as shown in figure 2(b). We assume this frequency forms the Gaussian distribution function and expresses the roughness as follows.

$$f(\theta) = \exp\left(-\frac{(\theta - \mu)^2}{2\nu}\right). \quad (1)$$

3 Experimental Results

We apply the proposed method to real objects which have specular and diffuse reflectance. Figure 3 (a) is a real image of a china bowl and figure 3 (b) shows the generated image by using our method. We make an image under different lighting conditions as shown in figure 3 (c).

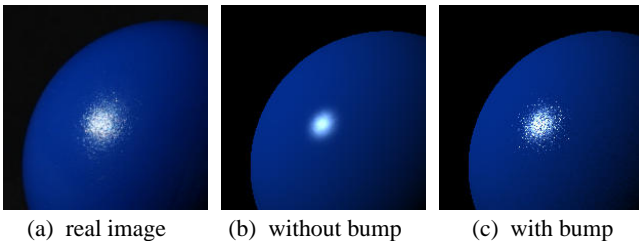


Figure 1: Effect of the bump in image synthesis.

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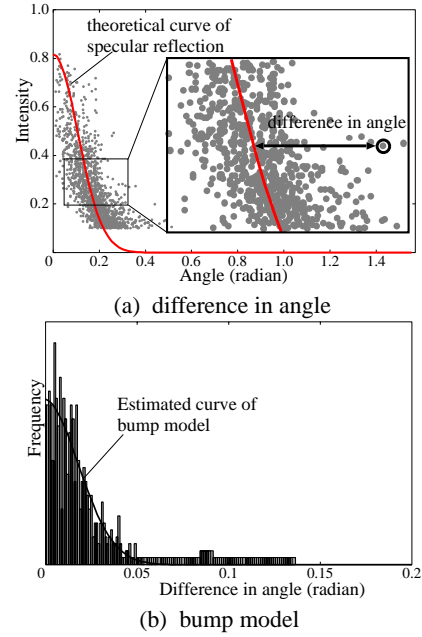


Figure 2: Estimating the bump model parameters.

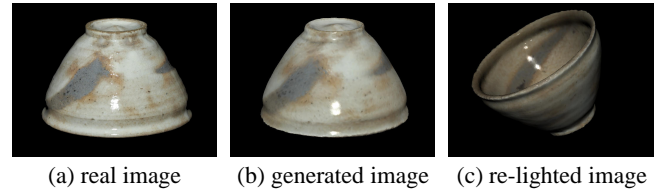


Figure 3: Generated images of china bowl using the bump model.

4 Conclusion

We proposed a method to measure the bump model parameters from real images. We had defined the bump model to represent roughness of an object's surface. In the experiments, we measured reflectance properties and bump model parameters from real images, and showed realistic images of real objects using the bump model.

References

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