An ambient light illumination model.

S. Zhukov*, A.Iones*, G.Kronin**

Creat Studio,
*Applied Mathematics Dept., St.-Petersburg State Technical University (Russia),
**Calculus Dept., St.-Petersburg State University (Russia)
{zh,iones,kronin}@creatstudio.spb.ru
www.CreatStudio.com

Abstract. In this paper we introduce an empirical ambient light illumination model. The purpose of the development of this model is to account for the ambient light in a more accurate way than it is done in Phong illumination model, but without recoursing to such expensive methods as radiosity. In our model we simulate the indirect diffuse illumination coming from the surfaces of the scene by direct illumination coming from the distributed pseudo-light source. The estimation of indirect illumination is based on the concept of obscurance coefficients that resemble the integrated weighted form-factors computed for some vicinity of a given point. The same idea is used to account illumination of a given point (patch) from light sources. This illumination is computed as a sum of direct illumination calculated using the standard local reflection model and empirically estimated indirect illumination based on the same obscurance concept.

Keywords: illumination model, ambient light, radiosity, form-factor, obscurance.

1. Introduction

The principal goal of realistic image synthesis is to develop the methods that would allow to visualize three-dimensional scenes realistically. To achieve this goal a number of illumination models have been elaborated. These models range from local illumination models that are easy to implement and fast to compute to much more complex global methods that allow the generation of photorealistic-quality images [Watt92, Foley92]. The latter methods range from classic schemes [Goral84, Whitt80] to more modern approaches [Hanr91, Cohen93, Sill94, Sbert93, Sbert96]. The other way to create realistic images is based on the use of more ad hoc techniques (e.g., procedural shaders in MentalRay® or RenderMan® [Upst92]) that strive to recreate the most appealing lighting effects and may sacrifice the physical realism for this goal.

In this paper we introduce an empirical ambient light illumination model. Our model simulates the indirect diffuse illumination coming from the surfaces of the scene by direct illumination coming from the distributed pseudo-light source. The use of this model enables to account for ambient light without recoursing to the expensive radiosity method. Due to the nature of indirect illumination simulation, it is possible to reproduce appealing and realistic images without explicit light source setting at all. This feature enables us to quickly preview the scenes that look appealing and realistic.

G. Drettakis et al. (eds.), *Rendering Techniques' 98*

The idea of the method lies in computing the *obscurance* of a given point. Obscurance is a geometric property that reflects how much a given surface point is open. For a given scene, obscurances for each patch can be computed only once and stored into file. This will enable to quickly recompute the lighting in the environment with moving light sources.

The computation of obscurances involves form-factor determination in the vicinity of a given point. Due to the locality of the method, it is much faster than radiosity, while the generated images are realistic and look similar to the ones generated by radiosity after a number of iterations.

The same idea is used to account illumination of a given point (patch) from light sources. This illumination is computed as a sum of direct illumination calculated using the standard local reflection model and empirically estimated indirect illumination based on the same obscurance concept.

2. Observations leading to the obscurance illumination model.

Most local illumination models use ambient light to account for secondary diffuse reflections in the environment. These models usually assume that ambient light is constant over the whole scene. Clearly, this is just a rough approximation. E.g., in a room lit with the diffuse light the illumination over the surface of the walls is not constant – it is normally darker near the room corners. A similar effect is a shadow under the car standing on the snow in a cloudy day. These lighting (darkening) effects in the obscured areas can be modeled with the use and at the expense of radiosity method, since this global illumination model takes into account secondary diffuse reflections.

Our goal is to develop an illumination model that would enable us to reproduce the darkening effects in the obscured areas by empirically accounting for indirect illumination without recoursing to the expensive radiosity solution. We simulate indirect illumination by a direct illumination of a specific distributed ambient light source. The darkening in the obscured areas is achieved by measuring the geometric obscurance in these areas.

The rest of this paper is organized as follows. We start with the 'practical' explanation of our illumination model, showing how it works and how to compute the illumination using it. Then we give some physical foundations of the model. Finally, we show some results.

3. Obscurance illumination model.

As it was stated above, our illumination model is based on a more accurate empiric accounting for the indirect illumination than it is done for ambient light in Phong illumination model and does not involve expensive computations like the ones in radiosity. Similarly to radiosity, our model is view independent and is based on subdividing the environment into discrete patches.

Our primary observation is that in the environments illuminated by diffuse light it is usually darker in obscured areas. Our illumination model is based on the notion of *obscurance*. Roughly speaking, *obscurance* measures the part of the hemisphere obscured by the neighbor patches. E.g., near a corner of a room the obscurance of patches is higher than on the plane open parts. From the physics of light transport point of view, obscurance simulates the lack of secondary light ray reflections coming