be found in the image through extracting the color information of the respective pixel position. In practice, this method allows for a run-time reduction of 10:1, especially if the graphics hardware is able to quickly produce and store false color images. Figure 9.14 illustrates the use of such an index image for the rendering of a shrub.

9.9 Plant Images Using Radiosity

In the rendering of landscapes, radiosity has so far rarely been used. The enormous amount of geometric information causes extreme computing times and needs a huge amount of memory. Soler and Sillion [204] decreased this by integrating hierarchical instancing in radiosity procedures (see Sect. 8.5).

hierarchical radiosity →

With the hierarchical version of the algorithms, Eqn. (9.7) is not solved in one step, but rather this is accomplished through a recursive mechanism that first calculates directly the energy exchange between the larger part of the scene, and only then includes the smaller units when a given error threshold is crossed [202]. The hierarchical instancing is integrated into the hierarchical structuring of the scene using so called clusters, for which the energy exchange with the environment is managed through a simplified and geometry-independent representation.

However, the computing time still is extremely high. For example, a scene with 1 million triangles still needs approximately 2 hours on an efficient workstation (SGI Origin 2000). Here it should be noted, however, that the computed solution is independent of the viewing location, and an animation can later be produced relatively quickly.

applications →

The correct calculation of the light exchange between plants, and especially the backscattering of vegetation, is of interest for satellite-based earth observation. Here the reflection behavior is used for determining the type and the condition of the vegetation. Various rendering methods were applied in the past to adjust satellite data using computer models [145]. However, also here the procedures fail often because of the complexity of the geometric data.

Max et al. [133] reduce this complexity, in that they compute the illumination only relative to the height above the ground and not for the individual locations on the plane. Thus for homogeneous vegetation the originally three-dimensional problem of the light exchange can be reduced to one dimension.

9.10 When Do Computer Images Appear Real?

In concluding this chapter, some questions remain when viewing images, such as those on the following pages. Why is it actually possible to reproduce using relatively simple methods a sometimes astonishing degree of realism? One reason could possibly be the relatively simple lighting conditions within the plants that are easy to approximate using traditional computer graphics procedures.

Another reason lies in the complexity of the data. The eye is used to process large amounts of visual information at the viewing of images. If this information is missing, an impression of flatness is created.

Although the images shown so far were produced with standard computer-graphics algorithms that produce an almost synthetic impression with other data, the images shown appear relatively "natural". A reason for this effect could be the extremely high visual complexity of the data, which misleads the eye into accepting the visual information as "authentic".

This impression of being authentic is obviously not easily defeated once it was accepted by the brain. Another example: All images in this book were rendered without any collision prevention, meaning that every single geometric object might grow through others, such as in Fig. 9.15–9.22. Here we see how daisies overlap or how grass grows right through flowers. The eye ignores these errors maybe just because the lighting conditions appear realistic, and the complexity of the scene is sufficiently high.

These observations suggest the same kind of conclusions with regard to other computer-generated images. The synthetic impression still dominating in many images may originate from the lack of geometric complexity of the objects. Too smooth surfaces, missing dust or dirt, and too regular shapes produce extremely low amounts of information. These facts could possibly be judged by our brain right from the start as "not real", although the light conditions appear realistic. During recent years some weathering and dirt effects have been considered [45, 46, 47]; however, generally accepted analysis is still missing.

In Chap. 11, we will take another direction: here nonphotorealistic images are created. Within the context of the motives that were described at the beginning of this chapter for the rendering of images, these illustrations pursue different goals and need other fascinating instruments for their production. However, let us first address another important area in connection with virtual outdoor scenes. The question is how, by using the right methods, can the amount of data be reduced efficiently to further speed up the rendering process.

Figure 9.15
Synthetic meadow with six different herbs and dandelions

Springer

http://www.springer.com/978-3-540-40591-7

Digital Design of Nature
Computer Generated Plants and Organics
Deussen, O.; Lintermann, B.
2005, XII, 295 p., Hardcover
ISBN: 978-3-540-40591-7