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A study of leaf modeling technology based on morphological features

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ABSTRACT

Simulating a leaf's shape is one of the most important modeling methods for plant modeling and visualization. In this paper, a modeling method is presented which is based on the morphological characteristics of leaves. According to these characteristics, the geometric feature points are selected in the leaves' edge outlines firstly; then a geometric model is reconstructed by using a bi-cubic surface for the outlines of these different edges. Secondly, by applying several other modeling methods, such as lighting, texture mapping, projective transforming, rotation transforming, symmetric transforming and rendering, a leaf model is formed. Finally, through the texture mapping transforming, vein textures and leaf surfacing, the curved surface fitting processing has been done, successfully. In this paper, we consider leaves, such as camphor, ginkgo and maple, which have different shapes, as examples. In this study, it is indicated that models for the leaves with different shapes and characteristics can be constructed well, and their shape characteristics can be understood as well. This model has good controllability and high accuracy, and can produce a good realistic effective result.

1. Introduction

In recent years, plant simulation and visualization have become hot topics in virtual plant research. Plant modeling is one of the means used to study plant morphology and its growth process. It also one of the research focuses in computer graphics science [1,2]. A virtual plant uses computer technology to simulate plant morphology, growing conditions and environmental impacts, which involves botany, mathematics, computer graphics, and virtual reality technology and so on [3]. A virtual plant can help researchers to achieve more effective analysis and study of plant growth patterns, and obtain the scientific laws that are hidden in the data. Thus, this technology has a wide range of applications in agriculture, forestry ecology and remote sensing fields.

Plants have many leaf shapes and many growing styles. They also have outstanding structural characteristics. In most cases, the structures are irregular and similar to each other. But the shapes are complex. Therefore, plant leaves' modeling has become one of the main focuses in plant modeling. However, as the plant leaf modeling has great impact on the overall modeling, how to control the characteristic points of a leaf model fast and accurately has high significance for the visualization for the whole virtual plant. Therefore, it has a great application in further research in agriculture and landscape design. Runions et al. simulate dynamic growth of plant leaves through modeling and visualization of leaf vein growth, but they only achieved a two-dimensional plane in the simulation with this algorithm and it is difficult to control the resulting blade edge [4]. Deng and Guo use a cubic *B*-spline curve to simulate the leaves of maize in a three-dimensional shape [5].

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