

Chapter 28

Inexpensive, Simple and Quick Photorealistic 3DCG Modeling

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ABSTRACT

The process of creating photorealistic 3-dimensional computer graphic (3DCG) images is divided into two stages: modeling and rendering. Automatic rendering has gained popularity, and photorealistic rendering is generally used to render different types of images. However, professional artists still model characters manually. Moreover, not much progress has been achieved with regard to 3-D shape data acquisition techniques that can be applied to facial modeling. This is an important problem hampering the progress of 3DCG. Generally, a laser and a highly accurate camera are used to acquire 3-D shape data. This technique is time-consuming and expensive. The eyes may be damaged during measurements by this method. In order to solve these problems, this chapter proposes a simple method for 3-D shape data acquisition using a projector and Web cameras. This method is economical, simple, and less time-consuming than conventional techniques. This chapter describes the setup of the projector and Web cameras, shape data acquisition process, image processing, and generation of a photorealistic image. As an example, the authors take a reconstructed photorealistic 3DCG image of Japanese vegetable “bitter melon,” whose surface is extremely bumpy. The authors evaluate the error margin of this technique. They also verify the accuracy of this method by comparing the photograph of a face with its rendered image.

INTRODUCTION

Recent progress of 3-Dimensional Computer Graphics (3DCG) has made photorealistic images. The 3DCG is researched in various fields according to the purposes, and is one of the main

research themes (Lee, Terzopoulos & Waters, 1995; Young, Beeson, Davis, Rusinkewicz & Ramamoorthi, 2007). The process to express photorealistic images is divided into the modeling which defines and creates the data of 3-D irregular object shape, and the rendering which outputs a final picture from the modeling data. The rendering is comparatively easy for automatic

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creation and it can generate photorealistic images from complicated form easily. However, modeling has to be performed by an expert handwork, and its efficient improvement is slow. Highly precise 3-D irregular modeling is an important problem of 3DCG. Conventional slit ray projection method (An, Woodward, Delmas, Gimel'farb & Morris, 2006; Araki et al., 1995; Narasimhan, Koppal & Yamazaki, 2008) research is difficult to apply to measurement data for the creation of computer graphics. Also, destroyed polygons are a hindrance to creating computer graphics. The aim of the modeling is to reconstruct the shape without the noise. In this Chapter we have proposed a new system of shape reconstruction based by slit ray projection method. To acquire the data of the object is developed as follows.

1. The projection method that can measure delicate ups and downs precisely.
2. Image processing and regularization images methods to calculate shape data.
3. Computation of value method to coordinates value at the vertex point.
4. Application to 3-D irregular objects modeling and accuracy enhancement.

Concretely, the projection method with an inexpensive web cameras and the projector device is developed in the first step (1), the line extraction, the noise processing, the line thinning, and regularization of several cameras images are developed in the second step (2), computation of value is developed in the third step (3), and application to 3-D irregular object modeling and accuracy enhancement are developed in the fourth step (4).

RELATED WORK

Achieving highly precise geometric modeling is an important challenge in 3DCG. Conventional methods such as stereo imaging and 3-D scanning are used for 3-D modeling. Stereo imaging

makes use of a stereo camera that can simulate binocular vision, which is often called binocular stereo. Binocular stereo algorithms producing a dense 3-D data set have been developed and applied for face reconstruction (Chan, Delmas, Gimel'farb & Leclercq, 2005; Enciso, Fidaeo, Noh & Neumann, 1999; Leclercq et al., 2004; Scharstein & Szeliski, 2002; Woodward & Delmas, 2004). The 3-D scanning involves and use of a laser scanner and a CCD camera. In 3-D scanning, the vertical planes of an object are measured using the laser scanner by the 2-D scanning method, in which a method of measuring the objects shape of carrying the cross section is developed (Lee et al, 1995; Zhang, Sim & Tan, 2004). Unfortunately, the price of 3-D scanning equipment makes this approach impractical for most lab situations (Woodward, An, Gimel'farb & Delmas, 2006). As an another approach of 3-D modeling, a photometric stereo is developed, which uses three lights sources (Faugeras, 1993; Kette & Schuluns, 1998). However, conventional methods have some disadvantages. Stereo imaging is difficult to use under varying light conditions, because the shadow of the object is misinterpreted by the turbulence light. In 3-D scanning, we can acquire large high-density data by only one scan in short time. Then, a large amount of memory is required because it is necessary to scan the object in all directions. In 3-D scanning, the object size in the passage direction is misinterpreted when the speed and direction of object change in the measurement domain.

WORKFLOW OF OBJECT MODELING

A slit ray projection method is a simple and well known one to reconstruct the objects in the computer. It is expected in the method that the line is horizontal from anywhere when the horizontal line is projected to the plane. However, the line has been often curved when this line is projected

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