

Modeling Design of Ceramic Products Based on 3d Image Reproduction Technology

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Abstract

With the diversified development of modern design means and methods, we can enrich the modeling design means in ceramic products, and create ceramic products with consumer personality characteristics. This paper discusses the three-dimensional image reproduction technology of ceramic modeling, and discusses the way of ceramic product modeling design, so as to create ceramic products suitable for consumer demand. Three-dimensional image reproduction technology is a comprehensive technology developed in 1970s, which spans computer graphics, pattern recognition, computer vision, image processing and other fields. Three-dimensional technology has been widely used in the field of product design because it can accurately and truly display the plane design drawings in the form of three-dimensional images. Compared with other products, ceramic products have the characteristics of white body, so there are special requirements for the design of ceramic products.

Keywords: *Three-dimensional image reproduction technology, Ceramic products, Modeling design*

I . Introduction

With the rapid development of computer hardware technology and the increasing maturity of three-dimensional image technology, computers have become an effective driving force for the development of art [1]. Computers are involved in various fields. Computer-aided product design has been widely used in industrial product modeling. Ceramic design is a part of industrial design. Today, when traditional manual design methods are difficult to meet modern daily ceramic design, ceramic design and computer Combination has become an inevitable development [2]. With the rapid economic growth, the improvement of people's living standards, the diversification of user needs and consumer products, ceramic product design will face more opportunities, but also a great challenge [3]. Ceramic materials are rich and colorful, and various production processes are becoming more and more mature, which makes designers have less and less constraints in the process of creating ceramic products. The problem to be solved urgently is to seek practical design concepts and methods for ceramic products [4].

Like many other product designs, the design of ceramic products should not only consider the performance and practicality of the products, but also take into account the beauty and artistry of the products. Therefore, the designer of ceramic products is a combination of engineering designer and art designer [5]. Handmade ceramic product modeling design is. Designers first draw the product appearance and surface texture map, then make the initial mold, carve and repair it until they are satisfied [6]. The computer-aided ceramic product modeling design system allows designers to avoid the process of making prototypes and carving repairs, and design, modify, display and optimize on the graphic terminal. In addition, the beautiful patterns produced by mathematical methods can also be used to match fading patterns. Therefore, computer-aided ceramic product modeling design is a hot technology in the current and future ceramic industry [7]. In the process of designing ceramic products, designers need to communicate with different people according to the characteristics of ceramic products. Design expression plays a very key role in the communication in the design process. Only using hand-painted renderings can not effectively present the three-dimensional effect of the design products to users. There are some differences between the two-dimensional display mode and the final ceramic products [8].

Therefore, it has important application value to propose a ceramic product modeling design based on 3D image reconstruction technology. Nowadays, computer aided design software is more and more used in ceramic design.

3D technology has been widely used in ceramic design field because it can accurately and truly show the shape of products [9]. Three-dimensional software converts two-dimensional drawings into three-dimensional models, then assigns materials, arranges the scene, and finally obtains product design renderings through rendering. In this process, the three-dimensional image is a very important link [10]. Our commonly used 3D output aid design software includes 3DSMAX and Rhinoceros, etc., these software provide a wealth of image methods for users to use. Compared with other products, ceramic products have their own characteristics in shape [11].

II. Ceramic Product Modeling Design and 3d Image Reproduction Technology

A. Modeling Design of Ceramic Products

Informatization brings not only opportunities but also challenges. For enterprises, it has a great influence on the design and production process, so it is necessary to improve the quality of product design to the greatest extent. Only in this way can the enterprise be invincible [12]. Under the action of digital information age. Product modeling can achieve high-quality design through digital interactive technology. Ceramic product modeling design system is an interactive graphic display system. It requires at least a color graphic display terminal, a floating marker, a mathematical instrument, etc. [13]. The graphics software can be a standard software package such as GKS.core, or it can be a basic graphics software that only contains commands or subroutines such as points, lines, color selection and color matching for drawing graphics [14]. Ceramic products are divided into daily-use porcelain, furnishing porcelain, architectural ceramics and other types, ranging from wine cups to bathtubs, with a wide variety of shapes. Compared with plastic, metal and other products, ceramic products have their own characteristics in shape [15].



Fig.1 Creative Ceramic Product Design

Due to the limitation of manufacturing technology, ceramic products are easy to deform when they adopt linear shape. Therefore, curve modeling is used in the design of many products to avoid this problem, which makes these ceramic products rich in surface changes. In addition, the ear, handle, mouth, button and other components of ceramic products are generally bonded when they are made of clay. They are glazed and fired in the later stage of Ding Dynasty. This joint will become smooth because of the adhesion of the glaze layer, and will not form a sharp turning point like that of Metalware, It is this smooth connection that makes the ceramic product more like an integrated article. In addition, many ceramic products are decorated with lines or patterns in the form of relief [16]. In the three-dimensional image of ceramic products, the image method should be selected according to these characteristics.

Ceramic modeling design can enhance the artistry of ceramic products, can arouse the perceptual resonance of the audience, and give people a strong feeling. There are many classification methods in ceramic product modeling design. As far as modeling is concerned, it belongs to the external manifestation of ceramics. The language describing product modeling includes form, material, color, etc., and its constituent elements have differences in quality and quantity. Words, rhetorical exaggeration, reduction, paradox, imagery and other categories. Through the design method and the law of beauty, through the reasonable use of technology and materials, designers want to create products that meet people's aesthetic needs, and obtain a psychological experience from the products, and produce the reverie of beauty, the hope of beauty and the enjoyment of beauty.

Table 1 the Basic Form and Connotation of the Morphological Components of Ceramic Products

Structural elements	The combination, connection mode and connection method among the various elements that make up a particular thing are the pursuit of human beings for the purposeful “goodness” of products and the “truth-seeking” of regularity.
Formal elements	An important carrier that carries product functions and emotional connotations. The rational content is established based on the objective and rational law of things to people. The emotional connotation is established based on the cognition of the subjective psychology of the aesthetic subject.
Functional elements	The foundation of practical value, the premise of creating symbolic value, and the main content element of the aesthetic object of technical products. Mainly include technical function, character matching function (human factor) and aesthetic function.
Artistic elements	It has special value in improving people's aesthetic ability and promoting the direction of social life. It has a certain image, infectious, social and novelty.
Technical elements	The technical function of the technical product as a thing, the matching function with people, the economic function of the society, and the environmental function have the characteristics of utilitarian, practical and contemporary.



Fig.2 Design Principles and Styles of Daily Ceramics

B. 3D Image Reproduction Technology

Three-dimensional image reproduction technology is a comprehensive technology developed in 1970s, which spans computer graphics, pattern recognition, computer vision, image processing and other fields. It is to extract the three-dimensional graphics from the two-dimensional data of the sample. In the process of reproducing the three-dimensional model of the object, it is necessary to ensure that the reproduced three-dimensional graphics are vivid and realistic, and can truly reflect the structural characteristics of the object. At the same time, we should also pay attention to the time taken for 3D image reproduction, that is, the speed of 3D image reproduction, that is to say, the 3D graphics of objects can be displayed in real time after reproduction.

At present, the algorithms for 3D image reproduction are mainly divided into two categories: one is the surface rendering algorithm. One type is volume rendering algorithms. The three-dimensional structure of the object is described by the method of constructing the intermediate geometric primitives and fitting the geometric primitives to the surface of the object. This method is called the surface rendering method. Surface rendering algorithms mainly include cube method, split cube method, moving cube method (MC algorithm), and moving tetrahedron method (MT algorithm). The volume rendering method is to directly project a two-dimensional screen image from a volume data field, and mainly includes a ray projection method, a patch projection method, and a frequency domain rendering method. The most widely used foot patch projection methods, mainly including unit projection, footprint conversion method, polygon approximation method and so on.

In the 1980s, a variety of imaging technologies emerged, such as X-CT, MRI, US, Oct, etc. these imaging technologies can obtain a series of serial section images of biological tissue structure, but these sections can only provide two-dimensional sectional images of the internal body, but can not show the three-dimensional geometric relationship between the lesions, defects and the object. Therefore, three-dimensional image reproduction has become a problem that must be solved in the medical field, industrial detection and other fields, which promotes the development of three-dimensional image reproduction technology to a great extent. At that time, three-dimensional image reconstruction algorithms were mainly volume rendering and surface rendering. In 1987, lorenson et al. Proposed a method to construct isosurface MC algorithm is one of the surface rendering algorithms. It is to use triangular patches to fit isosurface on voxels. Later, many scholars improved MC algorithm. The volume rendering algorithm was also proposed in 1980s. Because the volume rendering algorithm directly projects the image in the 3D volume data field onto the 2D screen and displays it, this algorithm has attracted the attention of many researchers. In this paper, 3D image reconstruction is realized by FDK algorithm. The FDK algorithm is a 3d image reconstruction algorithm proposed by Feldkamp et al. in the late 1970s. at present, most 3d reconstruction algorithms are extended from this algorithm.

III. Ceramic Product Modeling Design Based on 3d Image Reproduction Technology

A. Fdk Algorithm

Figure 3 describes the geometric coordinate relationship of the cone beam circular scanning track, where: O-xyz represents the world coordinate system, O-uv represents the projection data coordinate system, and O-ts represents the ray source coordinate system. And suppose that the z-axis is the central axis of rotation, and the s-axis has passed through the center of the ray source and is perpendicular to the detector plane. In order to facilitate the analysis, this paper converts the detector projection data into plane projection data passing through the origin o according to the geometric ratio.

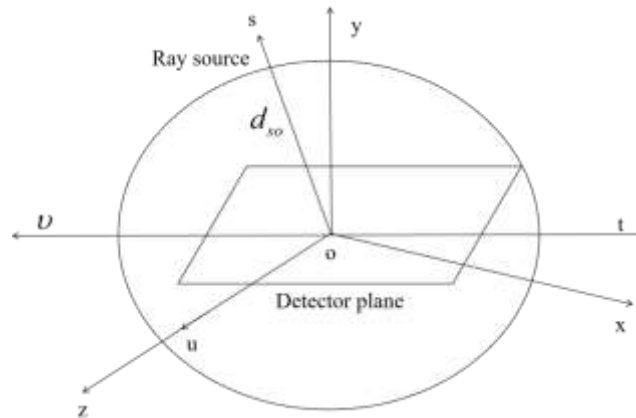


Fig.3 Geometric Coordinate Relationship of Cone Beam Circular Scanning Trajectory
FDK calculation mainly includes the following two steps:

(1) Filtering:

$$P_{\theta}^*(i, j) = \left(\frac{d_{so}}{\sqrt{d_{so}^2 + i^2 + j^2}} p_{\theta}(i, j) \right) * h(i) \quad (1)$$

(2) Back projection:

$$f(x, y, z) = \int_0^{2\pi} u^2 p_{\theta}^*(p, q) d\theta \quad (2)$$

In Figure 1,

$$t = x \cos \theta + y \sin \theta \quad s = y \cos \theta - x \sin \theta \quad (3)$$

$$u = \frac{d_{so}}{d_{so} - s} \quad p = ut \quad q = uz \quad (4)$$

Where: d_{so} is used to describe the distance between the center of the radiation source and the origin o. $p_{\theta}(i, j)$, $P_{\theta}^*(i, j)$ is used to describe projection and filtered projection data under rotation angle θ respectively. $H(i)$ is used to describe convolution function. (p, q) is used to describe the address of the back projection point on the projection plane. $F(x, y, z)$ is used to describe the image data reproduced at voxel points (x, y, z) .

Product modeling can make the expression of the ceramic product design stage more intuitive. Through ceramic product modeling design and three-dimensional image reproduction technology, the overall shape of the ceramic product can be reflected in an all-round and three-dimensional manner. Because the product modeling is relatively flexible, and the digital model is highly maneuverable and editable, the designer adjusts to new problems at any stage of the design, and the time required to establish a digital model is significantly lower than that of manually drawing two-dimensional drawings and physical models. Because the computer is used for drawing, the efficiency is obviously improved, and the effect is better.

B. 3D Image Reconstruction of Ceramic Product Modeling

For manufacturing industry, digital information brings both opportunities and challenges to enterprises, and enterprises need to face more and more fierce competition in the world. Therefore, in the face of such a competitive market, every enterprise needs to make breakthrough changes in production process and design to maximize the competitiveness of the enterprise. Only by doing so can it occupy a place in the global market. As an important part of product development-product design, it is influenced by technical means to a great extent. Since the information age has arrived, this influence has penetrated into the field of product development and design, which will soon have a great impact on the design ideas and design techniques of this industry.

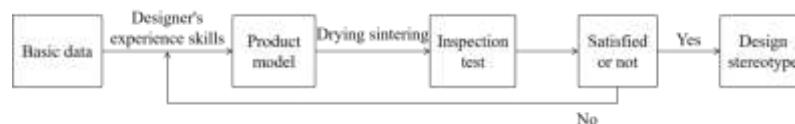


Fig.4 Ceramic Product Design Process

Ceramics is a product closely related to people's production and life. From history to today, it has always been a culture that Chinese people are proud of. With the progress of society, the demand for ceramics is increasing, and the requirements for output and quality are also higher. There are many types of ceramic products, and the shape changes greatly. Different ceramic products should be selected according to the characteristics of their modeling. Different image methods should be selected. You cannot simply think which image method is powerful, and use this image for all shapes. the way. For example, to create an ordinary bowl model, if the multi deformation image method is used to create, although the required model can also be obtained, the time consumed will increase sharply, and the gain is not worth the loss. However, the turning method can be easily done, which not only ensures the effect, but also improves the efficiency. Excellent design can enhance the artistic conception of products by blending shape, color and quality, and reflect the product spirit hidden behind the material form.

The artistic conception of ceramic modeling is an image of blending scenes, combining things with me, and unifying subjectivity and objectivity. Therefore, the image of ceramic modeling reflects people's thoughts and feelings, and is the scene of people's situation. Image is the concrete image in the chest, which is formed by the fusion of the perceptual image of the object and the state of mind. The creator expresses his feelings through ceramic modeling. At this time, the ceramic modeling has been very familiar with ceramics, which is a form of personality with the designer's feelings and experience. When users come into contact with these ceramics, they combine with their own experience and experience to produce an image of cognition. In the process of ceramic product modeling design, the construction of digital models based on three-dimensional reproduction technology is critical to the entire design. Ceramic product designers can intuitively describe the characteristics of the work according to the digital model and image object, improve the design scheme efficiently, and provide design data and technical support for resource demanders. The concept of industrial design is to make the relationship between products and people more profound and more scientific through the comprehensive consideration of design. The starting point of industrial design is how to adapt to people's various needs. Ceramic product modeling design is a branch of industrial design, so in the future what form of modeling can also better adapt to and meet the needs of people in daily life, and with a reasonable production process is the development of ceramic products need to explore.

IV. Conclusions

The application of computer three-dimensional image technology in ceramic modeling design came into being and developed with the rapid development of science, technology and production, the improvement of market competitiveness of products, and the face of many drawbacks of traditional design methods. Computer 3D image technology has shown broad development potential not only in theory but also in practice. The composition and

simulation of the model are beyond the reach of traditional design methods. The purpose of applying digital information technology to product design is to improve the quality of enterprise product design. With the development and popularization of computer-aided ceramic product design, computer-aided ceramic product design has become an irresistible trend, whether it is abroad or at home. Because of the incomparable advantages of 3D design software in assisting ceramic product design, its application will become more extensive. In this paper, a ceramic product modeling design technology based on 3D image reproduction technology is studied. The FDK algorithm is used as a 3D image reproduction technology to establish a ceramic product modeling system structure. With the popularization and application of computer 3D software technology in ceramic product design, computer aided ceramic product modeling design has become a trend. Three-dimensional image design provides a technical platform for ceramic modeling innovation and a new technical means for new product research and development. Let's look forward to the arrival of a brand-new ceramic modeling design concept.

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