

# Research on the Application of Numerical Control Technology in Hongmu Cultural Creative Product Design

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**Abstract:** This paper briefly analyses the status of hongmu cultural creative product design and the manufacture advantages of numerical control technology for it. Then the processing of numerical control technology applied is introduced through three specific design cases presented. This article tries to explore that the further improvement and development of hongmu cultural creative product design can be promoted by numerical control technology.

## 1. Introduction

Cultural and creative industry takes creativity as the core. It is an industry that integrates and promotes cultural resources by high-tech means. High value-added products can be produced by the development and application of intellectual property rights. [1] Since the beginning of the 21st century, the development of cultural and creative industry has been paid more attention in China and it has become prosperous increasingly. Recently economic development and the improvement of residents' consumption level have been promoted in China, therefore consumer demand for cultural and creative design has increased significantly. Cultural and creative design industry plays more important role in the coordinated development of the economy overall and further adjustment of industrial structure. The principles of cultural creative product design should base on rich traditional cultural resources, and extensively absorb all the contemporary culture of all humans. At the same time, it is necessary to pay attention to the advanced technology and technological achievements, which can realize the unity of traditional inheritance and innovation of the times, the unity of historical culture and modern technology etc. Acceleration of cultural and creative innovation design will promote the new development of China's economy and society.

## 2. Market overview of hongmu cultural creative product

### 2.1 The origin of hongmu culture

The word Hongmu was first used on the material of Dalbergia Spp which called "old hongmu." And the understanding of hongmu is derived from the famous Chinese traditional furniture, especially for Ming and Qing furniture. So it is undoubtedly that the concept of hongmu is from hongmu furniture. British cultural research scholar Raymond Williams once gave the following definition of culture: "Culture is an overall way of life, and art is part of a social organization, fundamentally influenced by economic changes." That means the overall life of society is equal to culture. So hongmu has become a cultural signal and aesthetic element that exists beyond of furniture function. As a living culture, hongmu culture is a balance between utility and art. [2] The prevalence of hongmu culture expresses the pursuit of Chinese traditional culture, the confidence of Chinese culture and national rejuvenation.

Hongmu cultural and creative product design is based on the limited material of hongmu and the core of hongmu culture. And more attention should be paid to aesthetic appeal and the function. [3]

Culture must be landed eventually, same as hongmu culture. The best way of cultural heritage exists in daily life. During the usage of hongmu cultural creative product, the culture of hongmu will be inherited to the next generation.

## **2.2 The current market status of hongmu cultural creative product**

With the hot selling of the Palace Museum's cultural and creative products, such as the cute dolls with different emperors' models, the noble and calm, but also funny tapes with "I got it" said by the emperors and the headsets made by court beads in cinnabar red and palace yellow, which are the traditional colors and symbol of the Palace Museum, and so on. These cultural and creative products are accepted by more and more young people, which create a huge commercial market. So, the cultural of Palace Museum has been widespread.

Compared with the culture of the Palace Museum, the hongmu cultural and creative products are relatively rare. The analysis reveals two reasons. One reason is caused by insufficient consumption capacity, and the other is the lack of creativity. Currently, the consumption subject of hongmu market are middle-aged people mostly who have strong consumption capacity and appreciate hongmu furniture instead of hongmu cultural and creative products. On the other hand, young people have no interest in these hongmu products because of the lack awareness about hongmu culture. It is difficult to recognize the value of hongmu cultural and creative products for these two groups. The demand in the consumer market is insufficient, and companies naturally do not pay attention to the development and production of Hongmu cultural and creative products. At the same time, the innovation of hongmu cultural and creative products is not currently enough. The designers often lack in-depth understanding about hongmu culture and ignore the details of consumer life. In a word high-quality hongmu cultural and creative products are rare.

## **3. Application of numerical control technology in the design process of hongmu cultural and creative products**

### **3.1 Development status of numerical control technology and equipment**

In 1952, the Massachusetts Institute of Technology developed the first CNC system, creating a precedent for CNC technology. In the following three decades, CNC technology entered a period of rapid development. [4] Since 1990s, the digital integration, accuracy, networking and intelligence are the developing trend and characters of numerical control technology and equipment. In China, the development of numerical control technology began in 1958, and already has had a certain degree of independent technology and production scale in recent years. As a member of rapid prototyping technology, CNC technology is also the power source of modern manufacturing systems. It will occupy a pivotal position in the process of manufacturing automation, integration and networking. [5]

Computer Numerical Control (CNC) is an automated machine tool controlled by programs. It controls the mutual movement of the tool and the blank material by digital information, and removes the excess material from the blank material to obtain a part with certain shape and precision. [6] CNC machine tools which developed from general machine tool can make complex shaped parts, and have certain advantages in flexibility, high precision and stability. CNC machine tools develop late and are currently in the development stage in China. Compared with foreign technology, there are some gaps on reliability and functionality. However in recent years, some progress has also been made on multi-axis joint control, openness, and intelligence.

First of all, due to the character of hongmu as a mature steady and thick epic style, it is not easy to be accepted by young people. So how to attract the attention of the young group is very important. For example, combining hongmu with other materials to form a complex visual sense of multiple materials, such as ceramics, precious metals, acrylic, agate, etc. Increasing the modern and fashion style will meet the aesthetic taste of the young group. Therefore, the advantages of numerical control technology can be fully reflected during the manufacture process of hongmu cultural and creative product by CNC technology, and a broader range for material selection are provided to satisfied

design requirement, such as metal, wood, acrylic, industrial wax and nylon and so on. At the same time, the strength and density of products can be guaranteed well.

Secondly, the design level of most hongmu cultural and creative products are not high, specifically the lack of good design and rough production. It cannot reveal the additional value of culture and creative design but reduce the inner sense of value with hongmu material from the hearts of people. As we know, hongmu is wood with special and beautiful wood texture and with a hard and fine structure for higher manufacture requirements. So numerical control technology can meet this need better. On one hand, the integrated product shapes or some of the more complex modelling components from the culture and creative design are more suitable processing by CNC system, on the other hand, CNC system will provide higher precision and stability compared with the traditional machine tool, which can realize automatic and manual compensation more efficiently. For CNC machine tools, it can process more precise and high-quality parts with processing accuracy of 0.005~0.1 mm [7]. The high-precision manufacture is the best paraphrase of the value of hongmu culture.

### 3.2 Display cases of hongmu cultural and creative products

Firstly, complete the building of computer model by 3D design software (such as 3Dmax or Rhino 3D modeling software etc.) and material rendering to obtain the expected visual effect before numerical control manufacture which is the basic factor for processing material selection and product parameters setting. Secondly building more accurate Computer-Aided Design (CAD) data based on the model of 3D design software for importing processing data into CNC machine tools. The Computer-Aided Design data instead of the data of the 3D design software can avoid failure caused by various model quality problems because the latter doesn't have solid concept. Finally, according to the design scheme, the appropriate materials are selected to complete the processing, including the surface treatment such as grinding, polishing and coloring.

The first case named "The sound of snow falling" in figure 1 is a table incense pedestal with hongmu and acrylic. This design focuses on heaping up of incense ash on the curves of the hongmu roof which just like the beautiful scene of snow falling in Jiangnan garden. The warm feeling of hongmu combined with transparent acrylic can create fashion sense. Figure 1 shows the expected renderings and CAD model files, and figure 2 shows the finished product. Figure 3 and figure 4 show another table incense pedestal design named Moonlight. The surface of hongmu board has a moon shape by precious metal is set against the acrylic board carved with water ripples. Rich details bring aesthetic sense in this design. The product in figure 5 and figure 6 is a shell-shaped storage utensil. The feature of rounded shape shows the wonderful wood texture of hongmu thoroughly.

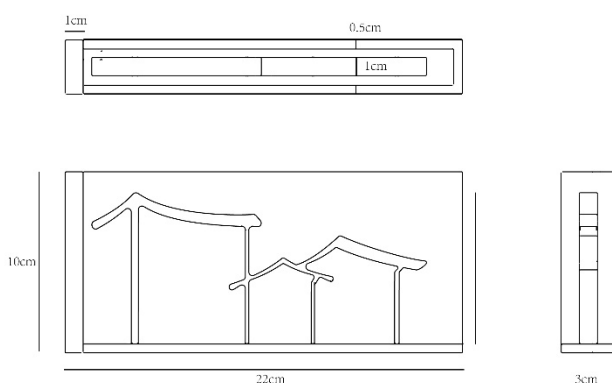


Figure 1. Rendering picture and CAD file of "The sound of snow falling"



Figure 2. The finished product of “The sound of snow falling”



Figure 3. Rendering picture of “Moonlight”



Figure 4. The finished product of “Moonlight”

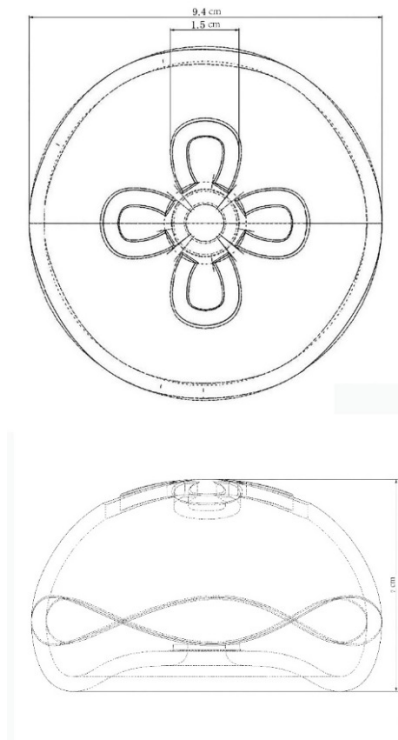


Figure 5. CAD file of storage utensil design



Figure 6. The finished product of storage utensil design

The above three hongmu culture and creative designs are all carved by CNC machine tools from Beijing Jingdiao Group Co, Ltd, lvjdm400p with three-axis. The machine with three-axis needs to manufacture location once to complete all plane and curved surface processing. Plane processing includes planar region processing and contour processing; curved surface processing includes rough processing of slicing region, curved surface finish processing, and curved surface semi-finish processing.

As the products in cases which use multi-material of hongmu and acrylic, different treatments are selected during cutting processing. Acrylic need cooling oil to avoid chips sticking under a high temperature. To avoid burning, hongmu should be treated by dry cutting with low speed of processing parameters. Also the shell modeling of storage box in case 3 must be double-sided processed to guarantee dimensional accuracy, which makes sure the two parts overlap completely. It is important to set a standard position in programming design.

#### **4. Conclusion**

Traditional hongmu furniture is mostly produced by hand or semi-manual methods, which require higher manual technique and more time. Under the wide application and mature technology of CNC technology, everything is simplified, especially for hongmu cultural and creative products. The research and development of hongmu cultural and creative products have a positive effect on promoting hongmu culture and strengthening Chinese cultural genes. The relationship between the manufacture of hongmu cultural and creative products and industrial civilization is strengthened by numerical control technology. Moreover, the hongmu culture gets promotion and development through these products.

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