

# Innovative Research of Digital Restoration Technology in Cultural Monuments and Sites—Take Shuangzhou Ancient City of Liao Dynasty as an Example

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**Abstract:** Shenyang is a famous cultural city with a long history, but unfortunately, from ancient times to Ming and Qing dynasties, Shenyang can preserve a limited number of cultural relics. The ancient city ruins are the precious cultural treasures left for us by our ancestors, which have many values such as history, culture, science and technology, art and so on. Ancient ruins are not only the important material materials for the study of a certain stage of history and culture, but also the historical witness of social and cultural changes. The protection and cultural tourism development of Shuangzhou City in Liao Dynasty are the filling of the missing parts of the spatial pattern and style of the traditional ancient city, the continuation of the city's historical memory, and the "museum-like protection" of historical relics. It is imperative to carry out digital restoration of the ancient city, which can become a new growth point of tourism economy development in Shenbei New Area, and digital restoration led by government departments is the general trend.

The cross-over research on the integration of ancient building restoration technology and digital art design theory is also a pioneering exploration and research on the basic theory of ancient building digital art restoration. The research has the potential to create a new paradigm for the study of digital art restoration of ancient architecture in China, so as to further lead the study of digital art restoration design of ancient architecture in China to a certain degree of practical significance. Take the ancient city site of Shuangzhou in Liao Dynasty as an example for further research. From the four aspects of research and development project necessity, historical factors, regional ethnic cultural and creative industry chain, and Shenyang tourism economic strategy, this paper explores the research necessity of digital technology in the restoration of digital art of ancient architecture, conducts further research, and concludes the research feasibility of digital technology in the restoration of ancient architecture. The implementation model suitable for digital art design in research is observed from the restoration examples of ancient buildings, and then the cultural extension model is obtained from the obtained model, and finally the sustainable development of research and the optimization of design and application are promoted.

## 1. The basic situation of Shuangzhou ancient city in Liao Dynasty

The culture of Liao is the integration of the primitive nomadic fishing and hunting culture from the grasslands and mountains and the farming culture from the Central Plains to the north, which is the essence of the culture of Liaoshen and an important part of the history of the Chinese nation. Liao was a feudal dynasty founded by the Khitan nationality, with nine emperors and 210 years. Jin is the resume of the Jurchen feudal dynasty, a total of ten emperors, enjoy 119 years. Spanning nearly 330 years, Liao and Jin dynasties had a vast territory, developed economy, strong military victory and prosperous culture, which played an important role in the long history of China and had a far-reaching impact on world history. The territory of Liao Dynasty covered the whole territory of Liaoning. It is the common wish of Liao and Shen people to inherit and carry forward the culture of Liao and Jin, and it is also our historical duty. To fully implement the strategy of "culture + tourism" and promote the planning and implementation of cultural tourism projects on the basis of the protection of historical sites in Liao Dynasty is the internal demand of regional economic development and the only way to protect cultural relics and cultural inheritance.

The ancient city of Shuangzhou in Liao Dynasty is located on the south bank of Liaohe River, in the territory of Shifo Si Township, Shenbei New District, Shenyang. It is one of the state cities clearly recorded in Liao History and Jin History. The ruins of Shuangzhou City in Liao Province are rectangular, with walls of 370 meters in the east and west and 190 meters in the north and south, covering an area of about 70,000 square meters. The site is now only the wall, most of the continuous height, built by rammed earth, the rammed layer is about 25 centimeters, the thickness of the wall base is about 6 meters, the highest wall remains up to 4 meters, the lowest is more than 2 meters. As an ancient city of Liao Dynasty, Shuangzhou City has a long history although it is small in scale. The boundary sites of the ancient city, namely the ruins of the city wall, gate and corner tower, have suffered serious damage, and the historical pattern of the ancient city has gradually disappeared. Therefore, it is imperative to protect the ancient city. The general goal of "proper protection, sustainable utilization and sustainable development" should be realized in the restoration project of Shuangzhou City ruins. It is not only necessary to do the corresponding protection of the site, but also to recognize the theme of heritage value and the cultural aspects of it.

## **2. The application background of digital restoration technology**

For a city, cultural monuments and sites and related environment are important symbols and signs of the city, reflecting the evolution of the city and historical changes, and its artistic, cultural and historical value is immeasurable. Cultural monuments do not regenerate, nor do they live forever, but they do degrade over time. Therefore, it is of great significance to use digital technology to preserve and inherit the precious cultural heritage forever. As an ancient city of Liao Dynasty, Shuangzhou City has a long history although it is not large in scale. The boundary sites (city wall, gate and corner site site) in the ancient city have been severely damaged, and the historical pattern of the ancient city has gradually disappeared. Therefore, it is imperative to protect the ancient city.

With the rapid development of The Times, the progress of science and technology, and the transformation and innovation of media, the soil for the growth of digital media art has been cultivated. Digital media art is an art form based on digitalization and information and communication technology. The change and development of multimedia and interactive modes are accompanied by the progress of computer technology and network information transmission technology. With the continuous improvement of science and technology, digital media art will change the way of life, work, employment and living environment of human beings, as well as change the ways and concepts of artistic creation and aesthetic value. The Shenyang municipal government has been vigorously developing the cultural tourism industry, and the tourism resources have shown a diversified and prosperous trend. Integrating "immersive" and "interactive" into the development of ethnic cultural and creative products with characteristics in the existing tourism formats will not only help enrich the content of the existing tourism formats, but also stimulate and drive the vitality of cultural tourism consumption, and contribute to the inheritance and promotion of Chinese national culture.

## **3. The application advantage of digital restoration technology**

### **3.1 Improve the rate and effect of cultural relics exhibition**

Some valuable objects found in archaeological excavations are not easy to preserve and therefore cannot be displayed, but can only be preserved in a specific environment. Using virtual reality technology, the cultural relics are made into digital images, and their original appearance is vividly displayed. Virtual reality technology in digitization can improve the touch and weight sense of high reducibility. With the development and popularization of the Internet, the network can be used to integrate these cultural relics resources processed by virtual reality technology and disseminate them to the society. Under the premise of protecting the safety of cultural relics, the visibility of cultural relics can be enhanced and the pressure of cultural relics protection can be alleviated.

### **3.2 Improve the technological means for the protection of cultural relics**

Cultural monuments and sites are generally non-renewable, and many damaged cultural monuments and sites are prone to peeling, decolorization, and embrittlement. Even after manual restoration, they are difficult to be repeatedly used for research and exhibition. The introduction of digital restoration technology can display images of cultural relics after restoration in advance, and provide multi-angle display and demonstration in cultural relics restoration. In this way, cultural relics can be preserved in a more rigorous environment, and it also has a positive significance for prolonging the life of cultural relics. Especially for sites such as Shuangzhou Ancient City in Liao Dynasty that cannot be relocated and protected, the location, environment and geomorphology can be recorded and preserved in detail by using digital restoration technology.

### **3.3 Inherit and carry forward regional history and culture**

Through the application of digital technology, we can realize the preservation and inheritance of traditional culture, realize the visual presentation of the ancient city of Shuangzhou in the Liao Dynasty, and integrate the new technology and art design with the restoration of ancient buildings. Promote the process of ancient building restoration in a more convenient and efficient way, and at the same time, the participation of digital technology will bring new blood and new direction to ancient building restoration. A more innovative approach will also attract more people to participate and help promote Shenyang's history and culture.

## **4. 3D data acquisition and virtual environment modeling**

### **4.1 Acquisition of 3D data**

In virtual reality technology, it is necessary to apply a large amount of data, use a variety of measurement methods, and obtain more high-precision three-dimensional information. The first step of virtual simulation is to obtain 3D data. In order to build a three-dimensional model of Shuangzhou ancient city in Liao Dynasty, it is necessary to obtain its three-dimensional coordinates, height information, texture information, and topographic relief in the region. Based on the actual situation, point group based method, image based method and map based method can be used respectively. A large number of three-dimensional point group data of Shuangzhou Ancient City can be quickly obtained by using laser scanner and Lidar, and the obtained point group data can be used as the three-dimensional coordinates of the relative system coordinate system. This data acquisition method is mainly based on 3D laser ranging technology, mobile mapping system data acquisition technology and airborne 3D imager data acquisition technology.

### **4.2 3D virtual environment modeling**

In the realization of virtual reality, the digital reconstruction of 3D virtual environment model is a very important link, and it is also crucial in the digital display of Shanzhou Ancient City. In practical application, the scene modeling technology based on geometric modeling and computer graphics can be used to abstract the real scene data of Shuangzhou Ancient City, construct the three-dimensional model of Shuangzhou Ancient City by using various polygons, add corresponding materials, complete texture mapping by parameter setting, and then use three-dimensional software to model. Adjust the environment and light accordingly, and complete the virtual picture rendering. The image-based scene modeling technology mainly uses specific picture data in the real world to replace the traditional modeling technology and uses picture space transformation to meet the rendering requirements. This method has better rendering speed and realism in scene construction.

## **5. Using digital restoration technology to realize the development and restoration of cultural monuments and sites**

### **5.1 Using digital technology to realize the development of Shuangzhou ancient city in Liao Dynasty**

Virtual reality technology can be applied to the exhibition, introduction and demonstration of the existing relics of the ancient city of Liao Dynasty to provide assistance to the original display. In this way, the audience can have a more comprehensive and vivid understanding of the specific situation of Shuangzhou Ancient City, and the digital way is also more convenient for modern people's behavior and habits of obtaining information. For the parts of Shuangzhou Ancient City that cannot be shown to the public for various reasons, virtual reality technology can be used for exhibition. In addition, a variety of the cultural display means such as multimedia presentations, historical and cultural activities, experimental archaeology, and archaeological training can be adopted to transform people from passive audiences to active participants. In addition, the application of virtual reality technology can support the development of virtual tourism, and complement the real tourism, so that the pressure of development and protection of Shuangzhou ancient City scenic spot can be eased, and people can have a more in-depth tour and experience of Shuangzhou Ancient City in the Liao Dynasty. In this way, the publicity is raised and more tourists are attracted to visit.

### **5.2 Using digital technology to realize the restoration of Shuangzhou ancient city in Liao Dynasty**

In the restoration and protection of Shanzhou Ancient City, the application of the virtual reality technology can play a good role in promoting and promoting. Using the digital restoration method, reasonable selection and application of 3D imaging technology, non-contact measurement technology, etc., through the field shooting and collecting data, synthesize the corresponding 3D animation, the architecture image three-dimensional model of Shuangzhou Ancient City is virtual. Using 3D virtual reality technology, the restoration and protection work will be made into a vivid, accurate, specific and comprehensive interactive demonstration film, which will be provided to tourists as a supplementary tourism project product. It is of great value to the continuation, renewal, protection and publicity of Shuangzhou City in Liao Dynasty. For architectural sites and other ancient scenic spots can be virtual restoration, to provide tour visit function. In addition, changes in the ancient utensils, life scenes, living environment, paleontology, ancient landforms, etc., can be restored by virtual reality technology.

## **6. Conclusion**

In the protection and restoration of traditional cultural relics, digital restoration technology is widely used, but for the Liao Dynasty Shuangzhou Ancient City, such a large cultural heritage site, the application is relatively rare. In the recent years, the digital restoration technology has made great progress, and the research on cultural relics has been increasingly in-depth. The introduction of digital technology is of great significance to the inheritance and protection of cultural monuments and sites, and provides good technical support in the development and restoration process of Shuangzhou Ancient City.

## **References**

- [1] Zhang Yijing. On the application of virtual reality technology in the protection of material cultural heritage -- A case study of the ancient house of red bricks in southern Fujian [J]. Art Education Research, 2017
- [2] Chen Fei. Application of virtual reality technology in tourism culture promotion and display in Inner Mongolia: Yanjialiang Site of Baotou Museum as an example [J]. Art Technology, 2015

- [3] Yang X. Application of virtual reality technology in the sustainable utilization of Canal cultural heritage -- A case study of Huaian River Ancient Town [D]. Peking University, 2013
- [4] Yang Jianguo, Zhong Jiahui. Application of virtual reality technology in the protection of ancient sites: A case study of the three-dimensional virtual simulation of the Royal Palace Site in South Vietnam [C]. Symposium on Digitization and Preservation of Chinese Cultural Heritage, 2020
- [5] Zhang Yugai. Exploration of digital tourism development in Liaoning Province [J]. Science and Technology Forum. 2013(23)