

LONGITUDE AND LATITUDE – EXPLORING THE RELATIONSHIP BETWEEN VIEWERS, ART, AND EXHIBITION SETTING IN IMMERSIVE DISPLAYS.

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ABSTRACT | Currently, exhibitions known as “immersive experiences” constitute an important part of present-day media transformation and have become a major development direction in the field of exhibitions. Immersive displays within the realm of exhibition design entail two distinct requirements: firstly, they necessitate diverse stimuli to complement the artwork itself, and secondly, the exhibitionary complex and its affiliated institutions have to adapt and emancipate themselves from conventional exhibition methods. Based on this premise, the authors explain how the transformation of physical space in immersive exhibitions engenders a new relationship between viewers, art and the exhibition setting through the example of their new media artwork Longitude and Latitude. Shown in the contemporary art exhibition Infinity: The Sequence from Known to Unknown (2021-2022) in the Suzhou West Museum, the artwork utilizes HOUDINI’s point cloud technology and an enhanced cellular automata algorithm to visualize geographic data. This project exemplifies the three stages of data visualization: data transformation - content transformation – and spatial transformation, which includes the output of data into an immersive spatial narrative within the exhibition space. The expansion of the exhibition space through immersive technologies aims to visualize geographic data and simulate the past and future land use in Suzhou for a better understanding of the city’s development. Our design approach aims to create specific modes of perception that affect the interaction between visitors, exhibition architecture, and narrative design.

1. Introduction

In both commercial and museum settings, the use of contemporary immersive media technology has become an important development in the field of exhibitions. These exhibitions, often referred to as "immersive experiences," employ new media forms such as virtual reality (VR), augmented reality (AR), and 3D mapping, leading to the facilitation of immersive communication and experiences, and they constitute a significant part of the broader media transformation.

Immersive exhibitions can emancipate from traditional gallery displays as they offer visitors a distinct mode of engagement. These exhibitions enable visitors to freely explore and interact with their surroundings, resulting in more captivating encounters. Visitors are empowered with autonomy through bodily engagement and spatial positioning, allowing them to plan their own routes and physically navigate through the exhibition space, thereby obtaining diverse and personalized visual experiences. These exhibitions provide multifaceted immersive experiences while also exploring curatorial strategies that create illusions and enhance engagement.

In his research on the digitalization of museums, Ross Parry has previously traced the process of compatibility between museums and digital media. This process includes the digitization of archival systems, the presence of digital objects in exhibition spaces, interactive displays, and the virtualization of museum visits through online resources. These changes have led to the "recoding" of museums, shifting from an emphasis on "object-oriented, conservative structures" to "experience-oriented, user-driven, multi-channel media systems" (Parry, 2007). This recoding encompasses a user-centric, media-driven system that reflects the evolving nature of cultural institutions in response to the digital age.

Overall, the integration of digital media in museums has transformed their operations and engagement strategies, allowing for new forms of interpretation, interaction, and accessibility, signifying a paradigm shift in the curatorial guiding principles of immersive exhibition design. This immersive shift has affected the perspective of visitors, particularly the dynamic relationship between visitors and exhibited artworks. This transformation can be examined from the perspectives of presentation, information dissemination, and aesthetic experience.

Nevertheless, physical architectural dimensions do not constrain spatial narratives, neither does the combination of immersive media technology completely subvert previous modes of exhibiting. Instead, conscious design choices during the art creation and exhibition design process have the potential to complement and extend spatial narratives with the help of new media technologies. Therefore, within immersive exhibitions, physical exhibition settings have the potential to seamlessly integrate with the artwork, offering visitors a holistic and immersive experience.

Based on this premise, the authors explain how the transformation of physical space in immersive exhibitions puts forward this experience-based relationship between viewers, art and the exhibition setting through the example of their new media artwork *Longitude and Latitude* (Zhang, 2022). Shown in the contemporary art exhibition *Infinity: The Sequence from Known to Unknown* (2021-2022) in the Suzhou West Museum, the artwork utilizes HOUDINI's point cloud technology and an enhanced cellular automata algorithm to visualize geographic data. In this case study, the expansion of the exhibition space through immersive technologies aims to visualize geographic data and simulate the past and future land use in Suzhou for a better understanding of the city's development without relying on displaying physical artefacts, embodying an "object-less" immersive experience.

This project exemplifies the three stages of data visualization: data transformation - content transformation – and spatial transformation, which includes the output of data into an immersive spatial narrative within the exhibition space. This approach does not aim to substitute the physical material of exhibits but rather creates specific modes of perception that affect the interaction between visitors, exhibition architecture, and narrative design. This paper aims to compare and analyze immersive

exhibitions from the standpoint of the interactions between the audience, the exhibition spaces, and the artwork. The analysis will be conducted by examining the digital artwork and its display in the context of the "experiential complex," (Hall, 2006), in which visitors no longer remain distant from artworks due to their representational nature, but are fully immersed in the theme of the exhibition.

2. Methodology

The exhibition *Infinity: The Sequence from Known to Unknown* (September 25, 2021, to February 16, 2022) was conceptualized as the first major exhibition of modern art in the Suzhou Museum West, officially opened in September 2021. Designed with a visitor-oriented interior architecture located in a prominent area at Shishan Square, the museum building itself serves as a cultural landmark of Suzhou, holding both permanent and temporary exhibitions that highlight the tangible and intangible heritage of the city (Chen, 2021).

Among the exhibition, the new media artwork *Longitude and Latitude* was created by Prof. Zhigang Wang's team at the Department for Information Art & Design at Tsinghua University, which includes Yuan Zhang, Zichen Xi, Shunni Feng, Ruitao Guo, and a collaboration with ImageSky Remote Sensing Technology Co. The artwork consists of a video display lasting two and a half minutes, displayed within a separate room within the museum. The exhibition design consists of a large-scale screen that projects the video in a loop, and two mirror installations that reflect the image content.

The concept of *Longitude and Latitude* is based on tangible and intangible heritage representing Suzhou's culture and history. The design is driven by data visualization and symbolizes the local customs of Suzhou, the characteristics of Jiangnan culture, and the city's past and future through geographic information data. By selecting the material properties of silk and water as elements that characterize the city's history and culture, the artwork explores the threads of urban development spanning thousands of years.

The image sequences in *Longitude and Latitude* use the motifs of silk and water by displaying horizontal and vertical silk threads as abstractions that correspond to the latitudinal and longitudinal coordinates of rivers, lakes, and commercial waterways on Suzhou's map. On the one hand, the concept of *water* embodies elements of the cityscape following the changes of time. Suzhou's urban development has been shaped by the transformative forces of water bodies such as rivers, oceans, and lakes, highlighting the relation between urban growth and changes in the surrounding bodies of water. The water-based design in the artwork thus presents a macroscopic view of urban development, serving as an abstraction for the city's history and culture.

On the other hand, *Suzhou Silk* holds immense cultural value as it represents Suzhou's artisanry. The *Archives of Suzhou Silk from Modern and Contemporary Times*, which document the silk industry and silk production methods, have been registered as a "Memory of the World" by UNESCO and ICDH, establishing Suzhou as a prominent hub and leading city for China's silk-weaving techniques (ICDH, 2017).

However, the scope of *Longitude and Latitude* extends beyond the content regarding Suzhou's cityscape and cultural heritage. A crucial aspect of our artwork lies in its immersive display method. Our aim is to explore the transformation of physical space within the city, showcased through an immersive exhibition setting that creates a novel dynamic between the audience, the absence of physical objects, and the artwork within the limited physical space of the exhibition. As a result, the creation process of the artwork follows a three-stage artistic transformation model, encompassing not only the image sequence but also the innovative display approach (Figure1):

1. Data Transformation – Geographic data collection using historical documents and remote sensing technology.
2. Visual Transformation – Video production using Houdini, Blender, Procreate, Adobe AE, PS, AI and PR.
3. Spatial Transformation – Exhibition space production using Kinect, Resolume Arena Projector, Mirror Material, etc.

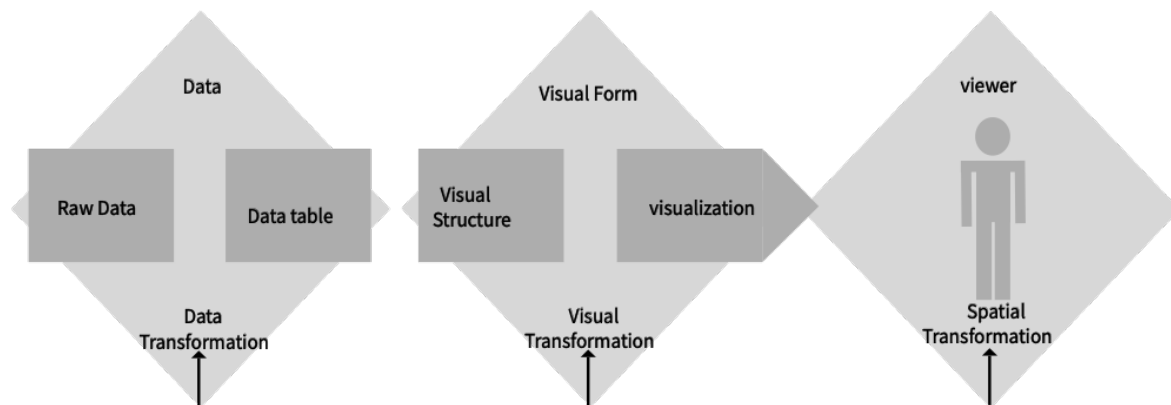


Figure 1. Three-stage artistic transformation model (© Yuan Zhang).

Our production process thus involved a data collection process of physical historical documents and remote sensing maps, followed by the organization, analysis, and transformation of the data into 2D vector graphics using manual and algorithmic techniques, and the visualization of the data through multi-dimensional methods, ultimately creating a comprehensive video format. The last step involves the spatial transformation of the exhibition venue.

2.1 Data Transformation

The process of data visualization allows for the transformation of complex datasets into visually compelling representations. In this context, the creation of *Longitude and Latitude* involved geographical data, processed in a multi-step approach, which was inspired by the information visualization model proposed by Card et al (Card et. Al, 1999). Our data transformation process is comprised of four steps (Figure 2), aimed at processing and transforming geographical data into visually meaningful 2D vector graphics for further video production:

1. Data collection;
2. Collation, analysis, and extraction;
3. Transformation into vector mapping through the manual and algorithmic generation;
4. Visualization.

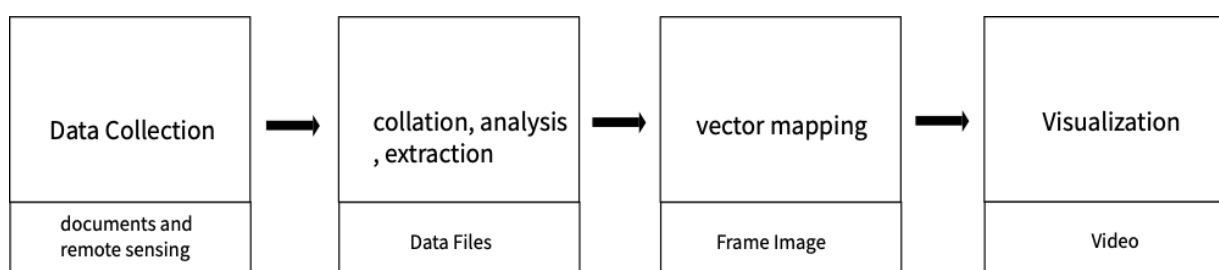


Figure 2. The Process of Data Transformation (© Yuan Zhang).

During the initial step, we collected geographic data derived from two primary sources – physical historical documents and remote sensing maps of Suzhou. We obtained the latter through a collaborative effort with ImageSky Remote Sensing Technology Co.

The physical historical documents serve to contextualize the development of Suzhou's landscape from ancient times to the present day, providing insights into the changes caused by rivers, agriculture, commerce, and various other societal and natural factors. In contrast, the remote sensing maps focus on the effects of specific economic and political decision-making, such as the establishment of water systems, scenic spots, national railroads, subways, green areas, and the impacts of congestion from 1984 to 2021. We recorded and saved information derived from both types of sources in the format of videos, pictures, and text for further usage in the subsequent stages of the data transformation process.

The second step of the data transformation stage involves the tasks of organizing, analyzing, and extracting geographical data, which includes the selection of appropriate technologies for different data formats, the transformation into desired formats, and the subsequent classification, compression, and decompression. We employed ArcGIS to transform the main initial remote sensing data and then used the built-in script module of Houdini to classify the land types in Suzhou based on the obtained information.

The third step involves the conversion of the extracted information into 2D vector graphics through a combination of manual and algorithmic generation techniques. The manual approach specifically focuses on utilizing information from archaeological historical materials and physical historical maps to create vector graphics. These graphics relate to several aspects of Suzhou's history, including water bodies, agriculture, commerce, and war, spanning from the Qin dynasty (221 BCE-206 BCE) to the Qing dynasty (1644 CE-1912 CE). For example, we manually extracted the topography in the case of a 1229 Song dynasty (960 CE-1279 CE) Suzhou city map, known as the *Pingjiang* Map, which remains as the largest surviving ancient city map of China (Zhang, 2013). Our effort included capturing details on Suzhou's *Water Network Change Map*, *Lake Boundary Line Change Map*, *Location Map of Human Settlements*, etc., in addition to vectorizing canals, moats, city rivers, lakes, ponds, bays, and other water-based entities that affected urban freight and trade exchanges of Suzhou's ancient commerce.

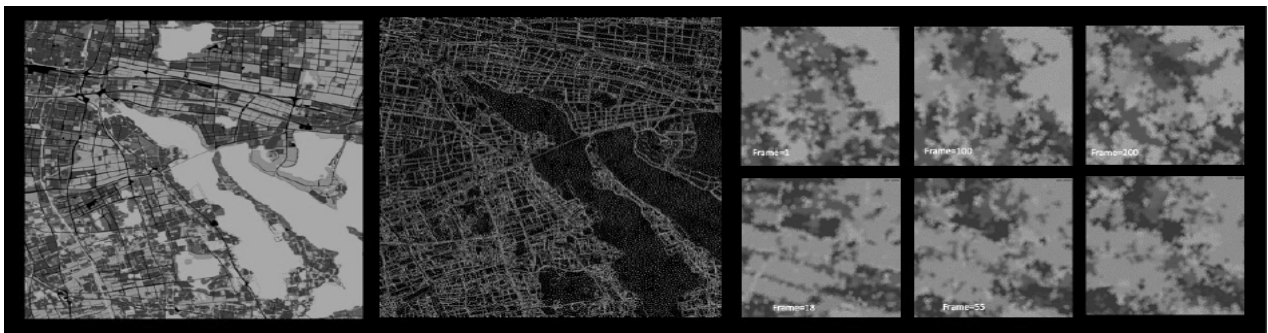


Figure 3. Algorithm Generation Process (© Zichen Xi).

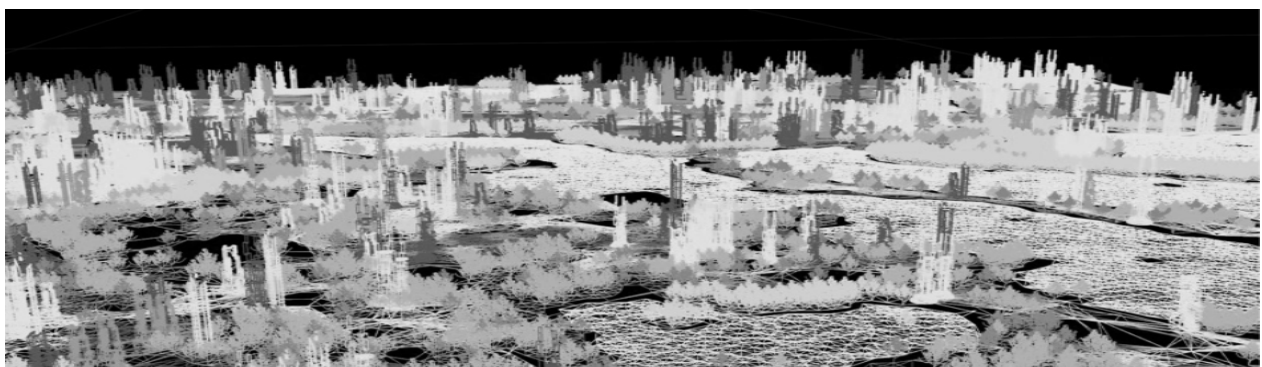


Figure 4. Algorithm generation process (© Zichen Xi).

In contrast, we employed an algorithm generation method to analyze the remote sensing satellite data provided by ImageSky Remote Sensing Technology. The quantity and data accuracy from these maps allowed for the automatic transformation of data into a two-dimensional vector graphic (Fig. 3), classified and graded according to the national Chinese land-use standard (Chen and Zhou, 2007). These encompass three categories of human-made land, vegetated land, and water bodies (Fig. 4). The utilization of Cellular Automata Algorithms enables a simulation the future trend of changes in natural vegetation due to human modification over time.

Finally, the fourth step consists of the visualization of these data points into a video format. We use multi-dimensional data visualization methods for the geographic data from the maps (Shneiderman, 1996), which include the parallel coordinate system method (Inselberg, 1985), RADVIZ method (Kandogan, 2001), scatter plot matrix method (Craig and Kennedy, 2003), and 2D icon-based visualization for historical geographic data. Here, data from different maps correspond to variations of icons, with variables such as "human settlement points", "water network lines", "Lake Boundary Lines", etc., that are represented by size, radius, location and color (Fig. 5). For the visualization of modern geo-data, 3D buildings are generated. The height and number of these buildings is based on records of changing land prices and population density. The 2D vector graphics from the previous step are used as the reference points for each building unit, supplemented by artistic embellishments such as particle effects and luminous effects.

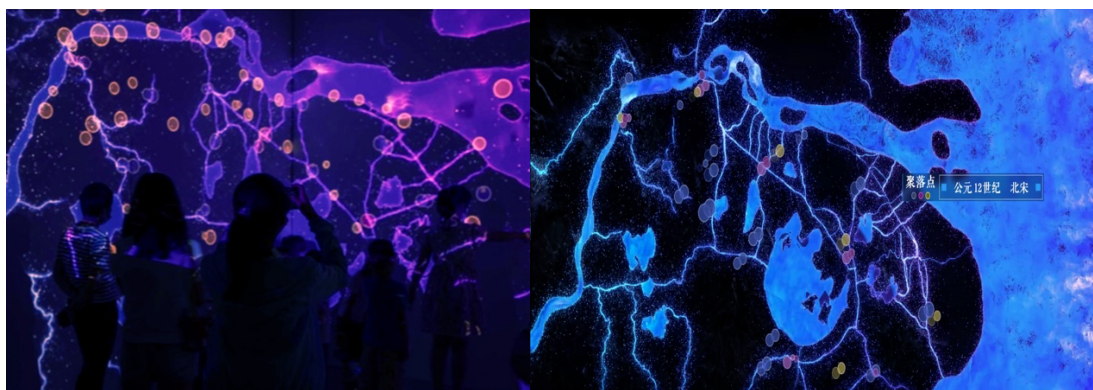


Figure 5. Exhibition Display. "Positive" correlation between the radius and number of human settlements-dots (© Yuan Zhang).

2.2 Visual Transformation

The visual output of the artwork involves transforming the geographical data into a video format, with water and silk serving as recurring motifs. We employed various multi-dimensional visualization softwares, including Houdini, Blender, Procreate, Adobe AE, PS, AI and PR, to showcase the graphics that resulted from the previous step. By relying on water as a narrative design element, the image sequences relay information on the city's development through a temporal division of four chronological sections:

- Water and continent - the formation of impact plains;
- Water and agriculture - the transformation of the natural environment;
- Water and commerce - prosperous urban development;
- Information Future - a new future blueprint for innovative Suzhou.

The video commences with an animation of the formation of the middle and lower Yangtze River plains through a visualization of the interactive nature between water and land (Fig. 6). It progresses to showcase the emergence of human civilization, represented by latitudinal and longitudinal locations of fire relics, early human rice relics, and the waterway irrigation. This information relay points out the close relationship between water, environmental and agricultural change, the development of human society, as well as the abundance of these water resources and its role in managing of the development of agriculture, fisheries and hunting.

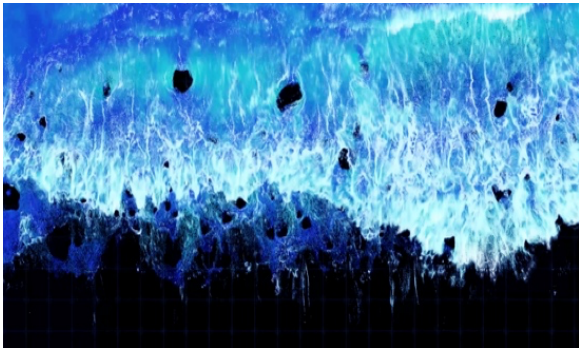


Figure 7. Lower Yangtze River Visualization
(© Ruitao Guo).



Figure 8. Lower Yangtze River and Tai Lake Visualization
(© Shunni Feng).

The relationship between water and commerce is based on the information collected from the *Pingjiang map* and other historical materials. Using artistic processing to interpret the cityscape of ancient Suzhou, we restored the appearance of the Suzhou night market during the first peak of the city's development in the Song Dynasty (Fig. 9). We used particle effects to accentuate the movement patterns of the busy crowd within the night market, the spatial distribution of commercial districts and commercial waterways, as well as the positionings of the main road network and other infrastructure elements. This particular video segment displays Suzhou's distinctive “water town” feature through a double checkerboard pattern that represents the interplay between land and water.

The final segment of the video uses the city's historical patterns of water, land distribution and architecture to interpret Suzhou's past and future urban development. In the final moments, the video concludes by revisiting the geographic coordinates (longitude: 120.54620735298157, latitude: 31.293915174794172) of Suzhou Museum West, providing viewers with a tangible reference point to comprehend their current position in relation to the potential future urban landscape of Suzhou (Fig. 10). This serves to establish a sense of connection between the present reality and the envisioned future, allowing viewers to envision the city's prospective transformations.

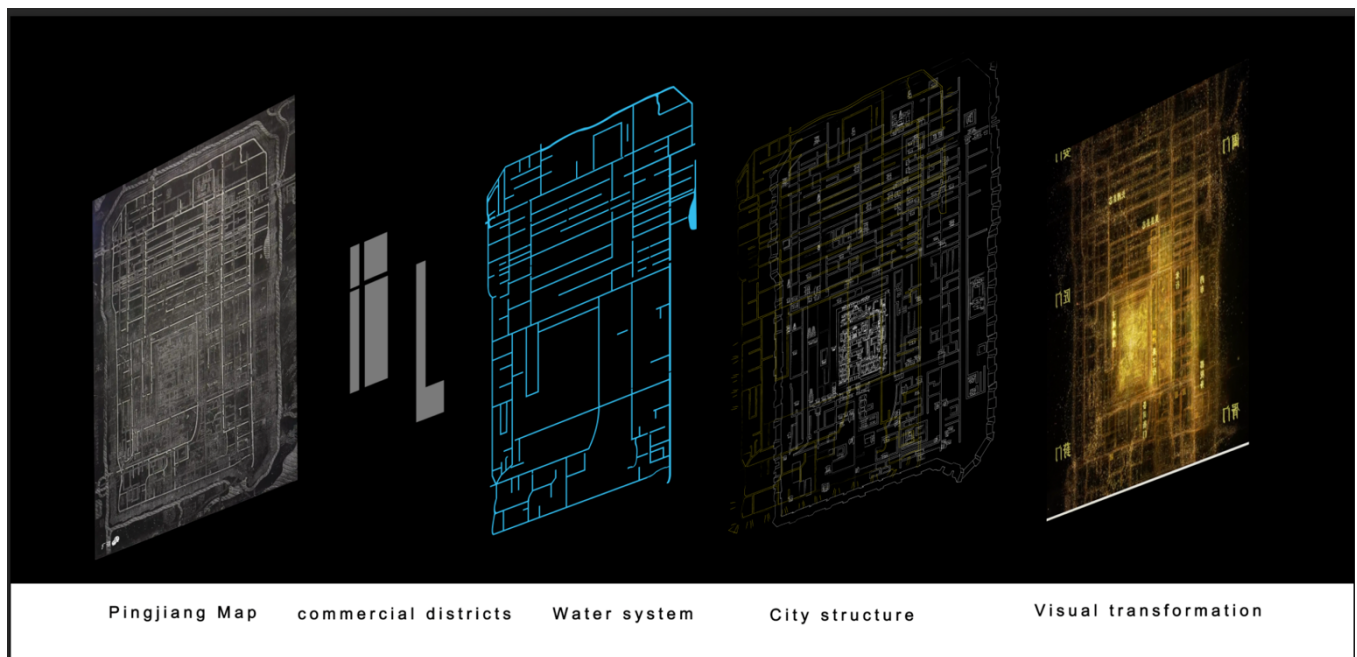


Figure 9. Rendering the Night Market of Suzhou during the Song Dynasty (© Yuan Zhang).



Figure 10. The Future Urban Landscape of Suzhou (© Zichen Xi).

2.3 Spatial Transformation

Longitude and Latitude completes the final transformation of data-content-space (Figs. 11, 12, 13) by expanding the exhibition space through video projection and specular reflection, creating an immersive experience.

Our approach to designing the exhibition display for *Longitude and Latitude* aims to substitute conventional exhibition methods of showcasing geographical information through material objects. Instead, we utilized new media technology to present the narrative of cultural history in a digital dimension within a physical space. By doing so, we intended to achieve a quantitative representation of extensive geographical data and bridge ancient history and intangible future development. By combining physical space, virtual space, video content, and mirror reflection, the artwork attempts to break the spatial limitations of the physical exhibition environment and expand the scale of the entire artwork itself in the space, where the audience is able to envision geographic information from all angles, both from the physical space to get a wrap-around sensory experience, and from the virtual space to gain knowledge on Suzhou from ancient times to the present day. In addition to the physical and temporal location of the artwork, the virtual space serves to let visitors perceive various layers of immersion, exploring the transformative aspects of the city through a transformation of the exhibition space itself. This virtual realm – established through video projection and extended through mirror installations – supports the physical exhibition space by transcending the limitations of "material presence" and instead offering an experience imbued with an "auratic" sensation, which goes beyond the interaction between viewers and physical objects.

Our immersive exhibition design thus explores the fluidity of integrating the exhibition space with the artwork to provide visitors with a holistic viewing experience.



Figure 12. Mirror installation (© Yuan Zhang).

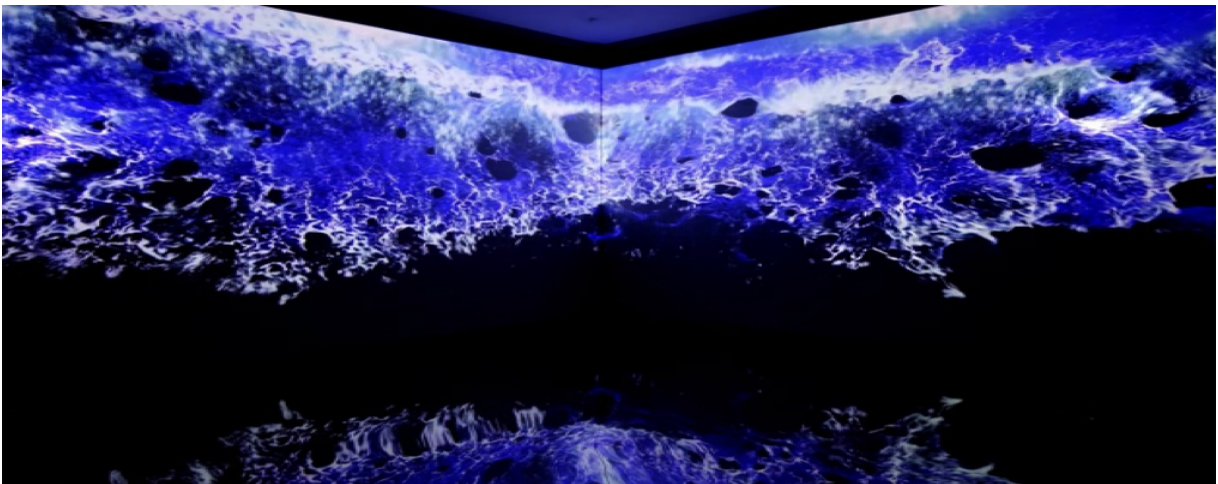


Figure 11. Exhibition site (© Ruitao Guo).



Figure 12. Mirror installation (© Yuan Zhang).

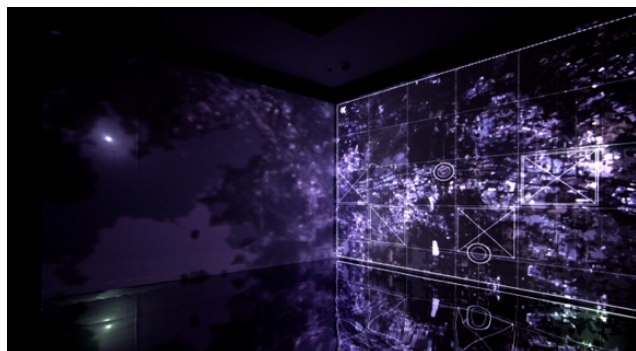


Figure 13. Exhibition site (© Shunni Feng).

3. Implications

We aimed to create *Longitude and Latitude* as an illustration of the departure from traditional exhibition methods by establishing an immersive environment within the context of the Suzhou West Museum. By reconstructing the past of the city, the primary focus during the design process involves translating data gained from ancient and remote sensing maps into a format that could be understood and absorbed by the audience without the presence of original artefacts. Through the integration of the limited physical exhibition space and immersive display techniques, the inherent quantity of data can be showcased through the expansion of the physical space through the different layers of data transformation.

As a more recent evolution in the history of exhibition practices, Martin Hall interprets this type of immersive exhibition mode brought about by new media as an "experiential complex" (Hall, 2006). Hall bases this model on the ideas of Joseph Pine and James Gilmore, who argue that "experience" has unique qualities compared to "commodities" and "services" – while commodities and services are external to individuals, experiences have the ability to touch people's inner selves and profoundly impact them (Pine and Gilmore, 2020).

While Pine and Gilmore argue that immersive experiences touch upon four domains – entertainment, education, escapism, and aesthetics – Hall provides further insights by emphasizing that education requires active engagement, while escapism necessitates immersion in the experience rather than passive observation associated with entertainment. Within this particular context, the gallery space assumes the role of an educational conduit, facilitating an environment that encourages active engagement and deep absorption. Consequently, it serves as an extension of the traditional method of exhibition display. Our immersive approach to *Longitude and Latitude* takes two essential features of immersive exhibitions into consideration: the absence of material objects and the expansion of physical space.

In fact, one major concern regarding immersive exhibitions is the emphasis on "aesthetic adaptation" rather than "authentic presentation" (Huang, 2023). This issue arises when comparing the traditional exhibition complexes filled with "real objects," with the often "object-less" immersive experiences. Linking this viewpoint to Walter Benjamin's notion of the decline of traditional "aura-based art" and the rise of modern "reproductive art" (Benjamin, 2018), we can observe a shift in the aesthetic experience of spectators – from a state of "focused" attention to one of distraction. This transformation is equally applicable to immersive exhibitions, which can be seen as a contemporary form of art reproduction. According to Kim West, this phenomenon not only enables reproduction but also allows for the mobility, recontextualization, comparison, and combination of art (West, 2017)—a notion reminiscent of André Malraux's "Imaginary Museum," in which art "loses its object quality" and is "confined to a material experience" (Grasskamp, 2014). Malraux considers the "Imaginary Museum" as an "auratic museum" rather than a substitute for physical museums. The key element of this type of experience is the exhibition design itself. According to Pine and Gilmore, this "experience design is determined not only by the exhibit's instructions on how to use the space but also by the absence of functions that adhere to established uses" (Pine and Gilmore, 2020).

We thus aimed to transform the physical exhibition space by offering an immersive encounter that effectively embodies the distinctive qualities of Malraux's concept of the "auratic museum," all the while remaining firmly grounded in the physical realm. The amalgamation and recontextualization of historical data in its present setting enable immersive experiences to deliver the same range of entertainment, education, escapism, and aesthetics as emphasized by Pine and Gilmore. The physical exhibition space itself assumes a pivotal role in effectively conveying these messages – and further indicates that immersive exhibitions may not only be seen as a "transformation" of tradition but rather an expansion and modern adaption of the exhibitionary complex as previously described by Tony Bennett (Bennett, 2019).

In immersive exhibitions, the relationship between the audience and the artwork depends on the viewer's interpretation of the presented objects. According to John Hannigan, immersive reconstructions are not

intended to make visitors believe they are experiencing a real environment, on the contrary, part of the enjoyment comes from being aware of the immersive technology and admiring the simulation of realism in animation. Hannigan describes the pleasure derived from a "suspension of disbelief" from the paradoxical coexistence of recognizing a technological illusion while simultaneously experiencing an authentic sense of immersion through the interplay of exhibition design, space and the artwork itself (Hannigan, 2005). As a result, the exhibition space is no longer merely a vessel for objects but an integral part of the art itself. In fact, the physical architecture of the exhibition room does not serve as a limiter for the exhibition experience. Ross Parry and Andrew Sawyer point out that architectural space "frees us from the limitations of the web page". By merging the physical space with the virtual, a new spatial narrative produces a new kind of relationship between art, space, and people (Parry and Sawyer, 2005).

Guided by the above-mentioned principle that immersive media regards the exhibition space as an intrinsic component of the artwork, our design for *Longitude and Latitude* involved spatial configurations achieved by deliberately selecting and arranging various display elements. These included the strategic placement of video projection, the incorporation of reflective surfaces, sound design, and lighting techniques.

Longitude and Latitude thus intends to provide an alternative sensory experience for interpreting the history and future of a city by interconnecting ancient data with modern technology through an object-less display, forming a chronology of the city's temporal dimensions without relying on a preprogrammed, "ritualistic" museum route (Duncan and Wallach, 1980).

The final, spatial transformation of our project thus allows visitors to experience the development of Suzhou through a "Spatial Narrative" that uses the scale and volume of space rather than the spatial sequences of exhibition settings to produce a narrative.

4. Conclusion

Within the context of museums, immersive experiences have the potential to fundamentally change the interaction between visitors, artworks, and exhibition spaces. Everett Ellin, referring to new electronic technologies as the "dominant medium of our time", suggests that these technologies teach people to interpret the world through multiple simultaneous sensory experiences (Ellin, 1967). On the one hand, this requires various stimuli to complement the artworks themselves, and on the other hand, it demands that museums break away from traditional exhibition models to enhance the visitor experience. Ellin believes that the emergence of these technologies creates an environment of "all-at-onceness" that enables individuals to constantly engage with one another and experience multiple forms of communication, ultimately altering our perception and modes of thinking, and giving rise to a new mode of subjectivity. The emerging immersive technologies not only complement but also enhance traditional practices by providing additional dimensions for exhibition experiences.

By triggering the audience's imagination and utilizing media and technology, exhibition venues can create immersive experiences that go beyond observation, allowing visitors to actively engage, escape from reality, and appreciate aesthetics. The interpretation and involvement in immersive exhibitions ultimately lie in the agency of individual viewers, and the level of immersion depends on the curator's and artists' ability to create suspense and the art itself.

Through *Longitude and Latitude*, we aimed to achieve this effect by transforming the historical display of the cityscape, as well as the exhibition space itself into a coherent spatial narrative as an integral part of the artwork. During the design process of the artwork, the three modes of transformation – data transformation, visualization, and spatial transformation – serve to provide the audience with a multi-layered immersive experience to educate on the city's historical and future development. The transformative aspects of our design aim to establish a display system that uses new media technology to allow the creation of spatial narratives that go beyond the limitations of physical objects, enhancing the viewer's experience and creating a sense of collective immersion.

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