

AI Empowers Sculpture Art: The Adaptation and Transformation of Handmade Sculpture in the Era of Intelligent Design

Jie Lu*

Graduate University of Mongolia, Ulaanbaatar, 11000, Mongolia

* Corresponding author: Jie Lu (Email: 385789750@qq.com)

Abstract: In the era of intelligent design, the rapid development of technologies such as artificial intelligence (AI), big data, virtual reality (VR), augmented reality (AR) and 3D modeling has promoted the innovation of sculpture art creation. AI not only optimizes the sculpture design process and improves the efficiency of creation, but also promotes the transformation of sculpture from traditional hand-carving to data-based and parametric directions. However, despite the empowerment of sculpture creation by AI, traditional hand-carved sculptures still have unique artistic value and cultural significance. In order to adapt to the changes in intelligent technology, hand-carved sculptures can explore new directions such as AI-assisted design, personalized customization, and immersive interaction through the integration of skills, innovative development, and reshaping of artistic values. In addition, the widespread application of AI is reshaping the sculpture education and market structure, and promoting the multi-dimensional development of sculpture art towards intelligence, virtualization, and commercialization. This study explores the profound impact of AI on sculpture art, and proposes the adaptation path of hand-carved sculptures in the era of intelligent design to achieve the integration and innovation of traditional skills and modern technology.

Keywords: Artificial Intelligence, Sculpture Art, Intelligent Design.

1. Introduction

In the era of intelligent design, the rapid development of technologies such as artificial intelligence (AI), big data, virtual reality (VR), augmented reality (AR) and 3D modeling has promoted the innovation of sculpture art creation. AI is not only widely used in art creation, industrial design, architectural modeling and product design, but also has a profound impact on the design process and expression of sculpture. The progress of deep learning and generative algorithms enables AI to analyze a large number of sculptures, extract artistic features of different styles, and automatically generate sculpture forms that meet specific aesthetic requirements, greatly expanding the creative boundaries of artists. At the same time, AI combined with 3D modeling technology makes sculpture design more efficient and accurate. Artists can quickly optimize the form and structure through intelligent algorithms to ensure the balance between aesthetics and function of the work. In addition, the application of computer vision and morphological recognition technology enables AI to analyze the surface texture of sculptures, identify carving defects, and provide intelligent optimization solutions to improve the accuracy and completion of sculptures. The advancement of 3D printing technology allows digital sculptures to be quickly materialized, breaking through the time and material limitations of traditional hand-made sculptures, making it possible to present complex structures and fine textures. At the same time, VR and AR technologies also play an important role in sculpture creation. Artists can perform three-dimensional sculptures directly in virtual space without relying on traditional physical materials, which greatly reduces creation costs and increases creative freedom.

In this technological context, sculpture art is developing in the direction of intelligence, parameterization and data-driven.

AI can automatically analyze the artist's creative style and provide intelligent auxiliary design solutions, so that sculpture can transform from traditional hand-carving to data-based design. The rise of parametric sculpture allows artists to quickly generate a variety of sculpture solutions by adjusting specific parameters such as height, curvature, texture, etc., further improving the flexibility and controllability of the design. At the same time, AI combined with big data analysis enables sculpture creation to accurately match market demand and provide the possibility for personalized customized sculptures, such as generating portrait sculptures based on the customer's facial features, or designing unique art installations based on specific spatial environments. In the era of intelligent design, AI not only empowers sculpture art creation, but also promotes the development of traditional sculpture creation mode in a more intelligent, precise and efficient direction.

Although AI and digital technology have brought unprecedented innovation opportunities in the field of sculpture, traditional hand-made sculptures still have irreplaceable artistic value. Hand-made sculptures carry a profound cultural heritage and embody the artist's unique creativity and personal expression. However, in the modern design environment, traditional sculptures face many challenges. First of all, the era of intelligent design emphasizes digital modeling and automated production, and traditional sculptures rely on manual skills. The adaptability of this creative method has become a reality that artists have to face. How to optimize the creative process with the help of AI and achieve innovative breakthroughs while maintaining the unique charm of hand-made sculptures is one of the key issues in the development of sculpture art. Secondly, the skill requirements of creators have also undergone profound changes. Sculptor artists not only need to be proficient in traditional carving techniques, but also need to master digital

tools such as 3D modeling and AI-assisted design to adapt to the industry's changing trends. This multi-dimensional skill demand has prompted the sculpture art education and training system to be adjusted accordingly to help the new generation of sculptors better integrate into the modern creation system.

At the same time, changes in market demand and aesthetic concepts have also posed new challenges to traditional sculptures. With the rise of AI art, interactive sculptures and digital sculptures, the audience's aesthetic standards and ways of experiencing sculptures are changing. Traditional sculptures are mainly in physical form, while modern sculptures tend to combine interactivity, immersive experience and digital display technology. How to keep traditional hand-made sculptures competitive in this trend has become a question that industry practitioners need to think about. Especially in the fields of public art, commercial installations, immersive exhibitions, etc., the audience is more inclined to choose works with a strong sense of technology and interactive participation. If hand-made sculptures do not actively embrace technological changes, they will be difficult to adapt to contemporary market needs.

Faced with the opportunities and challenges brought by the transformation of intelligent technology, it is of great practical significance to study how AI can empower sculpture art. AI can not only improve design efficiency and process accuracy in sculpture creation, but also provide artists with new creative ideas. For example, AI generation technology can quickly model complex morphological structures, allowing sculptors to focus more on artistic expression rather than cumbersome technical operations. At the same time, the combination of traditional hand-made sculptures and intelligent design technology is giving birth to new artistic creation models. AI-assisted design tools allow hand-made sculptures to obtain stronger technical support in the creative stage, thereby achieving more experimental and cross-border innovation breakthroughs on the basis of retaining traditional skills. In addition, the application of AI in sculpture teaching and art education also provides new possibilities for the inheritance and development of sculpture skills. For example, intelligent teaching systems can analyze sculptures through AI to provide students with personalized feedback, or use VR/AR technology to allow students to perform sculpture training in virtual space, thereby improving learning efficiency.

More importantly, AI-enabled sculptures are profoundly affecting the market structure and future development trends. AI technology not only expands the expression of sculpture art, but also affects the audience's aesthetic preferences. The rise of intelligent sculptures, dynamic sculptures and interactive sculptures has made sculptures no longer limited to static displays, but gradually developed towards intelligent interaction and immersive experience. This has not only changed the way sculpture art is disseminated, but also provided artists with a broader creative space. In this context, how to promote the integration of AI and hand-made sculptures and give traditional sculpture art new vitality in the era of intelligent design will become an important topic for future sculpture art research and practice.

This study aims to reveal the profound impact of AI technology on sculpture art, and explore how hand-made sculptures can adapt and change in the era of intelligent design to achieve the integration and innovation of traditional skills and modern technology.

2. The Adaptation Path of Hand-made Sculpture in the AI Era

Driven by AI technology, sculpture art is undergoing profound changes. How traditional hand-made sculptures adapt to the new creative environment in the era of intelligent design has become an important topic of common concern for sculptors and researchers. Although AI and digital technology have greatly improved the design and production efficiency of sculptures, hand-made sculptures still have unique artistic value and cultural depth. In this context, the adaptation path of hand-made sculptures is mainly reflected in the integration of skills, innovative development, and the reshaping of artistic value, that is, empowering sculpture creation through AI, improving creative efficiency and expressiveness, and exploring new development directions such as personalized customization and immersive experience to ensure the continuous innovation and inheritance of hand-made sculptures in the new era.

(1) The integration of traditional sculpture skills and AI

The introduction of AI technology has significantly changed the sculpture creation process. The combination of traditional sculpture skills and intelligent design methods provides sculpture artists with richer creative possibilities. First of all, AI can assist sculptors in preliminary morphological design. With the help of generative AI and deep learning algorithms, artists can input keywords, sketches or morphological features to let AI automatically generate a variety of sculpture schemes, providing a broader source of inspiration for creation. Compared with traditional hand-painted or clay model design, AI-driven morphology generation can not only iterate quickly, but also provide more innovative modeling languages, making sculpture design more modern and experimental.

In addition to morphological design, the combination of AI and hand-carving tools has also greatly improved the sophistication and operability of sculpture creation. For example, AI-assisted equipment such as CNC engraving machines and intelligent engraving robots can accurately carve according to the sculptor's manuscripts or digital models, so that the works can achieve higher production accuracy while maintaining the artistic characteristics of hand-carved sculptures. This not only improves the artist's work efficiency, but also expands the expressiveness of sculptures to a certain extent, enabling them to cover more complex detail processing and structural innovation. In addition, the application of AI in material optimization and processing technology has also brought new possibilities for sculpture creation. Through intelligent algorithms to analyze the physical properties and environmental adaptability of materials, AI can recommend materials that are more suitable for sculpture creation, such as lightweight composite materials, intelligent deformation materials, environmentally friendly and degradable materials, etc., to help sculptors improve the durability and sustainability of their works while ensuring artistic beauty.

(2) Innovative development direction of hand-made sculptures

In the AI era, hand-made sculptures not only need to adapt to technological innovation, but also need to seek new breakthroughs in artistic expression and audience experience. Personalized customized sculptures are becoming one of the important development directions in the future. AI technology can automatically generate exclusive sculpture plans based on

individual facial features, emotional needs or personalized data, and achieve highly personalized art customization. This model shows great potential in the fields of art collection, commercial display, memorial sculpture, etc., providing more commercial and market possibilities for sculpture creation.

In addition, the combination of AI and virtual reality (VR)/augmented reality (AR) technology is also redefining the way sculptures are displayed and experienced. Traditional sculptures are limited to physical space, while VR technology allows viewers to freely explore sculptures in a virtual environment, allowing artists to break through the limitations of physical materials and create a more abstract and immersive sculpture experience. For example, in a VR sculpture exhibition, viewers can enter a digital sculpture space through interactive devices, observe the changes of the work from different angles, and even "enter" the sculpture to feel its structure and texture. AR technology can enable dynamic interaction of sculptures in the real world. Audiences can see the changes in the surface of the sculpture, the transformation of the shape, and even the effect of interaction with the environment by using mobile phones or AR glasses. This cross-media innovation gives sculptures a richer dimension of expression, making handmade sculptures still have a strong artistic appeal in the digital age.

The unique value of handmade sculptures in the era of intelligent design is reflected in its high control of materials, textures, craftsmanship, and emotional expression. Although AI can provide powerful auxiliary capabilities in form generation and production optimization, the personalized traces, emotional expression, and warmth of hand-carved sculptures given by sculptors in the creative process are difficult to completely replace by AI. Therefore, the future of sculpture art may develop in the direction of "AI assistance + hand-carved", that is, using AI for design optimization and technical support, while the final artistic expression still depends on the sculptor's manual skills and personal style. This combination can not only improve the efficiency of sculpture creation, but also ensure that handmade sculptures still maintain their unique artistic value and cultural significance in the era of intelligent design.

In general, the adaptation path of handmade sculptures in the AI era is not only the integration and innovation of technology, but also the upgrading and reshaping of artistic concepts. By empowering sculpture design with AI, improving creative efficiency, expanding sculpture materials and techniques, and exploring new possibilities for personalized customization and immersive experience, handmade sculptures can be revitalized in the intelligent era. In the future, driven by artificial intelligence, sculpture art will present a more diversified, intelligent and interactive development trend, and handmade sculptures, as the core form of sculpture art, will continue to occupy an important position in the wave of technological change with their unique artistic value.

3. The Impact of AI on the Ecology of Sculpture Art

The rapid development of AI technology has not only changed the way sculpture is created, but also profoundly affected the ecosystem of sculpture art, including education models, market structure, artist roles and other aspects. Under the background of AI empowerment, sculpture art is developing from a single physical creation to virtualization,

intelligence and commercialization. This change not only provides new opportunities for the innovation of sculpture art, but also poses new challenges to the education and market structure of traditional sculpture.

(1) Educational change of sculpture art

The application of AI technology is reshaping the sculpture education system, making sculpture learning move from traditional physical sculpture to digitalization and intelligence. Virtual Sculpture Lab has become an important teaching method for art schools. Students can use AI-driven 3D modeling software to build, modify and experiment with sculpture forms in virtual space, reducing material consumption while improving creation efficiency. This teaching model not only breaks through the dependence of traditional sculpture on sites and materials, but also analyzes the sculpture structure and provides instant optimization suggestions through AI algorithms, allowing students to master sculpture skills faster. In addition, the introduction of intelligent carving tools, such as AI-assisted carving robotic arms, can help beginners control the carving process more accurately and improve the quality of works, while reducing the threshold for technical learning and enabling more people to access the art of sculpture.

However, the popularization of AI technology has also brought challenges to the inheritance of traditional sculpture skills. Many classic sculpture techniques rely on the accumulation of manual experience, and AI's automated creation may lead to the marginalization of traditional skills. Therefore, future sculpture education needs to find a balance between intelligent technology and manual skills, so that students can not only master AI tools, but also deeply understand the artistic essence of sculpture. For example, by combining AI analysis and manual practice teaching mode, students can understand key factors such as texture, knife skills, and material characteristics during the creation process, thereby ensuring that the skills of traditional sculpture are not forgotten, but can be further developed and innovated with the assistance of new technologies.

(2) Market changes in the sculpture industry

The application of AI technology has not only affected the education model of sculpture, but also reshaped the market structure of the sculpture industry. The traditional sculpture market mainly relies on the sales and exhibitions of physical works, while driven by AI, digital sculpture has become a new business model. NFT (non-fungible token) technology enables digital sculptures to be uniquely authenticated through blockchain, giving them collection value and enabling artists to sell virtual sculptures directly through online trading platforms. This model breaks the geographical limitations of the traditional sculpture market, making sculpture art more global and attracting the attention of a large number of young collectors and investors. In addition, driven by the concept of the metaverse, virtual sculptures have also become an important element of the digital world. Artists can use AI to generate dynamic and interactive sculptures, which can be applied to virtual reality (VR) exhibitions, digital museums, and even games and social platforms to expand the boundaries of sculpture art.

At the same time, AI technology is changing the way artists and designers collaborate. In the past, sculpture creation mainly relied on the manual labor of individual artists, but now AI can serve as an intelligent assistant to help artists quickly generate sculpture plans, optimize structural designs, simulate the visual effects of different materials, and even

predict market trends through data analysis, thereby improving the market competitiveness of works. AI-enabled sculpture creation teams are also emerging. Sculptors, programmers, interactive designers, and data scientists work together to create interdisciplinary and multi-dimensional intelligent sculptures, allowing sculpture art to break through the limitations of traditional media and enter a broader digital art ecosystem.

In terms of changes in market demand, the development of AI technology has made standardized and mass-produced sculpture production more efficient, which may lead to a smaller share of handmade sculptures in the commercial market. However, the uniqueness, emotional expression and artistic value of artificial sculptures are still difficult for AI to replace. Therefore, the sculpture market in the future may be more polarized: on the one hand, AI-generated sculptures will meet the needs of commercialization and personalized customization, such as smart home decoration, interactive public art, etc.; on the other hand, the high-end art market will prefer handmade sculptures, emphasizing the artist's personal style and the uniqueness of handcraftsmanship. For handmade sculptors, the key to maintaining their competitiveness in the AI era is to optimize the creative process by combining intelligent technology, while highlighting the unique value of handmade sculptures, so that they still have irreplaceable artistic charm in the wave of digitalization.

In summary, AI is profoundly affecting the ecology of sculpture art, and is undergoing unprecedented changes from education methods to market models, from creative tools to artistic experiences. In the future, sculpture art will show a trend of intelligent, diversified and digital development, and traditional handmade sculptures need to find a new position in this change, and achieve their own sustainable development through technological integration and artistic innovation.

4. Conclusion

This study explores the profound impact of artificial intelligence on sculpture art creation, education and market, and analyzes the adaptation path and development direction of handmade sculpture in the era of intelligent design. First of all, the application of AI technology in sculpture art not only improves the efficiency of creation, but also provides artists with new creative tools. Through deep learning, computer vision, 3D modeling and printing and other technologies, AI can assist artists in morphological generation, structural optimization and material simulation, and promote the development of sculpture art in the direction of intelligence and parameterization. In addition, in the field of sculpture teaching, the integration of AI-driven virtual sculpture laboratories, intelligent carving tools and VR/AR technology makes sculpture learning more efficient and intuitive, and also provides new possibilities for the inheritance of traditional sculpture skills.

At the level of the sculpture market, AI-enabled digital sculptures and NFT artworks have gradually emerged, changing the trading methods of traditional sculptures and expanding the market boundaries of sculpture art. However, handmade sculptures still have unique artistic value in the AI era. Their unique personality, the warmth of handmade skills and the deep expression of culture and emotion make them still occupy an important position in the high-end art market and cultural inheritance. Therefore, the adaptation path of

hand-made sculpture lies in the integration and innovation with AI, such as using intelligent tools to assist creation, combining interdisciplinary technologies to expand the form of expression, and finding new development models in education and the market. In the future, sculpture art will show a trend of synergistic coexistence between artificial intelligence and handcraft skills, which will not only retain the artistic essence of traditional sculpture, but also enhance its creativity and influence with the help of intelligent technology.

The further development of AI technology will have a more far-reaching impact on sculpture art. From a technical point of view, AI may achieve more accurate form generation, more intelligent creation assistance, richer material optimization, and even enable artists to directly transform their ideas into digital sculptures through cutting-edge technologies such as brain-computer interfaces. In addition, AI-driven dynamic sculptures and interactive sculptures may become important forms of public art and digital exhibitions, providing audiences with immersive and personalized art experiences.

However, while artificial intelligence continues to make breakthroughs, the value of traditional hand-made sculptures cannot be ignored. In the future, the coexistence and development of hand-made sculptures and AI may unfold in various forms, such as improving the accuracy of hand-made carving through intelligent tools, optimizing sculpture teaching and skill inheritance with the help of AI, and even establishing a closer interactive relationship between digital sculptures and physical sculptures. For example, AI-generated sculpture schemes can serve as a source of inspiration for hand-made sculptures, while the texture, texture and craftsmanship details of hand-made sculptures can reversely affect the aesthetic expression of AI sculptures. This complementary relationship will become a key direction for the development of sculpture art in the future.

In terms of future research, it is also necessary to pay attention to the ethical issues of AI and sculpture art, such as the copyright ownership of AI-generated sculptures and the impact of AI-assisted creation on the originality of artists. In addition, the AI sculpture aesthetic evaluation system is also an area worthy of in-depth discussion. How to evaluate the artistic value of sculptures generated by AI? Can AI understand and create sculptures with real emotional depth? These issues require artists, technical experts and sociologists to discuss together to promote the healthy development of AI technology in the field of sculpture.

In general, the rise of AI has brought unprecedented opportunities and challenges to sculpture art. In the future, sculpture art will continue to innovate under the impetus of intelligent technology, but it is also necessary to think about how to find a balance between technological development and the essence of art, so that hand-made sculptures and AI sculptures can jointly promote the diversified development of art and open up a broader space for the future of sculpture art.

References

- [1] Xu Duan. Innovative application and exploration of traditional lacquer art in sculpture creation[J]. Literature and Art Weekly, 2024(20):76-79.
- [2] Li Bing. The theory of "Xinjiang statue" in traditional sculpture[J]. Sculpture, 2024(5):40-45.
- [3] He Liuyang. The relationship between traditional architecture and ceramic sculpture and its inspiration for creation[J]. Ceramics, 2024(10):129-131.

- [4] Chi Di. The value reconstruction of traditional sculpture form design under the influence of contemporary material technology[J]. Shoe Crafts and Design, 2024, 4(19):11-13.
- [5] Xie Jinggui. An analysis of the aesthetic culture of “clumsiness” in traditional Chinese sculpture art[J]. Artist, 2024(8):132-134.
- [6] Wu Yun. The communication and expression of sense of gravity in sculpture[J]. Art Panorama, 2024 (24): 101-103.
- [7] Chen Wenfeng. Fusion of tradition and modernity in ceramic sculpture creation [J]. Foshan Ceramics, 2024, 34 (8): 119-121.
- [8] Sun Jing. Historical generation and "participation" aesthetics of artificial intelligence art [J]. Contemporary Literature, 2022 (06): 183-189.DOI: 10.19290/j.cnki.51-1076/i.2022.06.031.
- [9] Fang Xin. "Inevitability" - Technology drives the future of sculpture [J]. Sculpture, 2020 (02): 14-19.