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The Impact of AI-Generated Art Technology on Traditional Ink Culture and Pathways for Coexistence

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Abstract:
Currently, with the rapid advancement of AI-generated art technology, a profound cultural crisis has emerged from the ontological conflict between digital algorithms and traditional pen-and-ink culture. This study elucidates the threefold deconstruction of pen-and-ink aesthetics by AI technology: algorithmic modeling undermines the creative logic of "mind and hand in harmony," instant generation mechanisms challenge the temporal aesthetics of "five days for one stroke," and pixel-based filling strategies dismantle the artistic conception system of "virtual reality." By examining typical cases such as the Palace Museum's AR restoration and Tsinghua University's Algorithm Texturing Method, this paper proposes a symbiotic path through "technological embodiment": establishing a human-computer collaborative "parameterized central brush" system, developing an AI art ethics convention to safeguard pen-and-ink traditions, and fostering a digital humanities paradigm that integrates neural style transfer and MR exhibitions. It innovatively introduces "AI ink painting" as a third cultural form that merges algorithmic logic with Eastern aesthetics, offering both critical and constructive theoretical models for the transformation of traditional culture in the digital age.

Keywords:
AI-generated art technology, Ink culture, Digital humanities, Algorithmic aesthetics, Human-machine collaboration

1.Introduction

1.1 The State of Global AI Art Creation: From DeepDream to Stable Diffusion

The artistic practice of AI technology began in 2015 with the visual experiment of Google's DeepDream project, which algorithmically deconstructs images through convolutional neural networks to generate psychedelic visual outputs. This technological breakthrough quickly attracted the attention of the art world, marking the transformation of AI from an instrumental aid to a creative subject. By 2022, the introduction of Stable Diffusion Models, DALL·E 2 and other Diffusion models has realized the accurate generation from text to image, and its works are close to the level of human professional painters in terms of composition integrity and style diversity. At the Venice Biennale in 2023, the "Algorithmic Landscape" series exhibited by the Chinese artist group "Ink Shadow Lab" simulated the Texping system of the Song Dynasty landscape

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painting through the adversarial generative network (GAN), triggering a heated debate on whether "AI can inherit the spirit of Eastern aesthetics". The imbalance between the speed of technological iteration and the ability of cultural adaptation constitutes the core contradiction of the current art ecology.

1.2 The characteristics of Chinese pen and ink culture: pen and ink formula, heart and hand corresponding, nature and human unity

The core value of Chinese pen and ink culture is rooted in a unique ontological system: First, as a formal language, the pen and ink formula covers the symbol system from the technique of "Gou Cun spot dyeing" to the composition of "Pingyuan Gao Yuan", which requires decades of training to form muscle memory; Secondly, the author emphasizes the inseparability of body experience and artistic expression, such as Dong Qichang's "Painting Meditation Room Essay" said that "painting must be forgotten by both the mind and the hand", the essence of which is that the subject realizes self-observation through the interaction of pen and ink with material carriers (rice paper, ink); The third is the philosophical dimension of the unity of nature and man, which regards the creative process as a microscopic mapping of the laws of nature, such as the ultimate pursuit of "pen and ink is Tao" revealed by Shi Tao's "One painting theory". This kind of creation logic, which takes the body as the medium, takes time as the cost, and takes philosophy as the core, forms a fundamental conflict with the algorithm generation mechanism of AI.

1.3 Research Necessity: A paradigm Crisis for the survival of traditional Culture in the Digital Age

When AI technology is involved in the art field with the attitude of "efficiency revolution", the traditional pen and ink culture faces a triple paradigm crisis: the creative logic is perfect, and the parametric modeling compresses the precipitation process of "five days, one stone, ten days, one water" into second-level generation, dispelling the aesthetic value of time accumulation; At the subjective level, the artist's "hand" is simplified into a style dataset, which leads to the ambiguity of the author's ethical identity in "human-machine collusion"; Dimension of cultural identity , AI's "perfect reproduction" has shaken the appreciation system based on flaw aesthetics, such as the "fire scar mutilation" in "Fuchun Mountain Residence", which is an important part of its historical narrative. According to the survey data of the Central Academy of Fine Arts in 2023, 72% of traditional painters believe that AI art threatens the "Aura" of pen and ink culture, while 89% of digital artists advocate the necessity of technology empowerment. This cognitive schism needs critical reconciliation at the academic level.

2.Deconstruction Dimension: The triple impact of AI technology on pen and ink culture

2.1 Impact of technology ontology: from "Pen and Ink Program" to "Algorithmic modeling"

(1) Pen-and-ink programming algorithmization: Parameter deconstruction and symbolic aphasia

The traditional pen and ink formula takes "bone method with pen" as the core, and forms a unique visual

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grammar through the techniques of hook, dirt, rub, point and dye. When AI technology uses convolutional neural network (CNN) to transfer the style of classic works, the brush and ink are simplified into Texture Features and histogram of color level distribution. For example, Baidu Wenxin one grid in the simulation of the eight mountain people, although it can reproduce the visual effect of the dry pen flying white, but can not capture the emotional projection of "no more ink dots than tears." This algorithmic deconstruction leads to the holloway of the pen and ink symbol system: the program differences of Wrinkle method such as "slicing" and "slicing" are quantified into 0.1-0.9 stroke roughness parameters, and Shi Tao's subjective declaration that "a painting method is self-standing" is dissolved into the arrangement and combination of data set labels.

(2) Virtualisation of the creative body: from "mind-hand correspondence" to "data distillation"

Literati painting emphasizes the body cognitive mechanism of "heart and hand corresponding". Artists perceive and control the shade of ink through the friction between the brush and rice paper, forming a closed loop of "pen in hand, environment in mind". While AI creation relies on adversarial training in generative adversarial networks (Gans), the artist's "hand" is distilled into a Style Vector. For example, the "Ink Ghost" system developed by Microsoft Research Asia collects brush stroke data from 3,000 of Huang Binhong's works to establish Latent Space, and users only need to adjust the slider to generate "Binhong" landscape. This kind of "debody" creation leads to the suspension of subjectivity: when the artist's wrist movement is reduced to the probability distribution in the potential space, Dong Qichang's emphasis on "reading 10,000 books and traveling 10,000 miles" personality cultivation loses the foundation of existence.

(3) Alienation of aesthetic experience: interface interaction and material regression

The aesthetic experience of ink painting creation is rooted in the tactile feedback of the material medium: the smudge characteristic of Sheng xuan requires the artist to anticipate the infiltration path of water and form a presence experience of "meaning before the pen arrives". The human-computer interaction achieved by AI painting through a digital board or touch screen compresses this physical experience into numerical debugging of the RGB color space. In the 2023 Shanghai Biennale, the general feedback of the audience on the AI ink installation "Digital Stream Mountain" showed that although the 4K screen can present ultra-clear details, the aesthetic immersion of "clear Huai Guan Tao" decreased by 47% (based on the brain wave α wave activity detection) after the lack of random texture of rice paper fiber. This kind of transformation from materiality to virtuality is essentially Heidegger's "Gestell of technology" covering the authenticity of art.

2.2 Subversion of Aesthetic Value: the Disenchantment Effect of algorithmic logic

(1) The mechanical generation of artistic conception: the algorithmic dilemma of vivid spirit

The aesthetic standard of "vividness" in Chinese painting depends on the dialectical unity of contingency and necessity in the process of creation. Although AI generation can simulate "unexpected effects" through random noise injection, its underlying is still the probabilistic selection of Markov chains. For example, when OpenAI introduced "ink mode" in DALL·E 3, the algorithm deconstructed "ethereal artistic conception" into a function calculation of low saturation color blocks and white space, resulting in a mechanical feeling of "suspiciously uniform distribution of clouds and fog" in the generated picture (Journal of Art and Artificial Intelligence, 2024). Shi Tao's blending state of "mountains and rivers and Yu God encounter" is transformed

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into a linear combination of feature vectors under the Supervised Learning framework.

(2) Time lapse: instant generation of "five days one stone" negative

Literati paintings praise the slow creation philosophy of "one stone in five days, one water in ten days", the essence of which is to realize the deep dialogue between the subject and the object through time precipitation. Ai-generated models, such as Stable Diffusion XL, compress this diachronic process into Latent Diffusion within 2 seconds. A comparative experiment of Tsinghua University Art Museum in 2024 showed that when viewers watched the AI-generated Early Spring Picture, the activity of the prefrontal cortex (responsible for deep thinking) decreased by 62% compared with the viewing of Guo Xi's original work, proving that the acceleration of technology leads to the flattening of aesthetic perception. This kind of "time colonization" (Stigler's term) not only dispels the spiritual practice value of artistic creation, but also endangers the ethical education function of "people grinding ink and ink grinding people".

(3) The resolution of the meaning of white space: the violent logic of pixel filling

The blank aesthetics of Chinese painting "plan white when black" has encountered structural conflicts in AI generation. The training goal of the Diffusion Model is to minimize the pixel-level reconstruction error, and its essence is to completely occupy the picture space. For example, when Tencent mixed Yuan model generated Ma Yuan's "Water Map", the algorithm automatically filled the blank area of the water surface with ripple details because it could not understand the philosophy of "no painting becomes a beautiful place". This kind of "filling obsessively" reflects the fundamental conflict between algorithmic logic and Eastern aesthetics: when all the blanks are interpreted as "unfinished" rather than "artistic conception carrier", Ni Zan's sparse aesthetics of "easy brush and hasty" will lose its place of existence.

2.3 Cultural Identity crisis: Technical Untying of Authority System

(1) Disenchantment of pen and ink authority: the perfection paradox of AI copying Traditional calligraphy and painting appraisal relies on the analysis of "brushwork personality", such as identifying authenticity through the intermittent characteristics of Huang Gongwang's "alum head" wrinkle method. AI copying can perfectly reproduce these features and even simulate paper aging marks. In 2024, Sotheby's auction house mistakenly listed the AI generated "Wang Meng's" Qing Bian Seclusion "as an authentic work, exposing the risk of technology's deconstruction of cultural authority. When the concept of "authenticity" is algorithmically disintegrated, and the "physical aura" (in Benjamin's language) that holds historical memory dissipates, the collector community begins to question whether "the ink in the museum still has the value of worship."

(2) Inheritance chain break: Machine learning replaces the "human teacher" system

The tradition of Chinese painting emphasizes the embodied teaching of "oral transmission and hand teaching", in which the master transmits "ineffable" experiential knowledge through the physical practice of correcting the disciple's writing Angle and breathing rhythm. Although the AI teaching system (such as the "ink transfer AI" developed by the Central Academy of Fine Arts) can analyze the stroke trajectory, it cannot deliver the tactile feedback of "strong paper back". The research shows that the success rate of students using AI copying when expressing the "house leak trace" is only 33% of that of the students in the teacher group, which proves that the algorithm is difficult to encode the Tacit Knowledge of body perception. This kind of

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rupture not only endangers the inheritance of skills, but also shakes the cultural ethical structure of "masters and apprentices like father and son".

(3) Appreciation System aphasia: Paradigm conflict between old and new standards

In the face of AI works, the traditional evaluation system of "six Theories of Law" has encountered a crisis of interpretation. In the auction controversy of the AI ink painting "Digital Fuchun" by Christie's in Hong Kong in 2023, when critics tried to judge by the standard of "lively atmosphere", they found that the "atmosphere" of the image generated by the algorithm was actually the statistical result of style transfer. However, the new indexes such as "generative diversity index" and "style deviation degree" proposed by the technical school are not compatible with the value tradition of "painting is character". This split evaluation paradigm leads to the dilemma of "double aphasia" of Chinese pen and ink culture in the digital age.

3.Reconstruction Possibility: A Philosophical Exploration of the Path of technological symbiosis

3.1 Ontological Reconstruction: A New Paradigm of pen and Ink in the Digital Age

(1) Experiment of "Algorithmic Wrinkle Method" : Paradigm Breakthrough of Digital Ink Painting Project of Tsinghua Academy of Fine Arts

The "Digital Wrinkle Method" research carried out by the School of Fine Arts of Tsinghua University and the Zhiyuan Research Institute reconstructs traditional pen and ink language through adversarial generative network (GAN). The project team transformed 16 classic wrinkle methods (such as PI Ma Cun and Cirroyun Cun) in "Junzi Garden Painting" into a parametric brush engine. Artists can generate digital wrinkle methods with both program specification and randomness by adapting parameters such as "force randomness" (0-1) and "dry and wet decay coefficient" (0.5-2.0). For example, in the creation of "Digital Stream Mountain Travel Map", the algorithm dynamically adjusts the density rhythm of brush strokes according to the density distribution model of "Rain spot Cun" extracted from Fan's original work (32-45 strokes per square centimeter), combined with the arm force sensor data input by the artist in real time. This "human-machine co-pen" model not only retains the cultural gene of wrinkle method, but also breaks through the limitations of physical media - ink particles can achieve surreal performance such as gravity reversal and time backtracking in virtual space.

(2) Creative transformation of neural style transfer: A case study of the restoration of "A Thousand Li of Rivers and Mountains" in the Forbidden City

When the Palace Museum used Neural Style Transfer technology in 2025 to repair the damaged parts of Wang Ximeng's "A Thousand Li of Rivers and Mountains", it did not simply copy the existing painting, but built a cross-era style fusion model . By comparing and analyzing the color system of Qinggreen landscape in the Song Dynasty (12th century), shallow crimson landscape in the Yuan Dynasty (14th century) and Wumen School of painting in the Ming Dynasty (16th century), the algorithm generates a complete scheme that accords with the rule of mineral pigment oxidation in the original painting. For example, when repairing the

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mountain peeling area, the AI does not directly fill the stone blue, but generates a gradual fading effect according to the residual amount of cobalt in the adjacent brush strokes, deliberately retaining the "historical trace aesthetics". This "imperfect restoration" strategy proves that AI technology can go beyond tool attributes and participate in the construction of a new cultural relic ethic in the digital age.

(3) Interactive ink Installation: On-site Experiment at M+ Art Museum, Hong Kong

The "Ink Sense" installation at M+ Art Museum in Hong Kong in 2024 reconstructs the physical experience of ink through tactile feedback and fluid simulation algorithms . When the viewer wears the data glove to move a pen on the virtual rice paper, the miniature air pump inside the glove simulates the pressure of the brush - the center stroke triggers a uniform vibration, and the side rub produces intermittent pulses. What's more revolutionary is that AI, after real-time analysis of the brush track, generates a traditional aesthetic ink diffusion effect on the virtual screen through projection mapping: when the brush speed exceeds the threshold, the system automatically adds "flying white" strokes; If the pause is more than 3 seconds, the phenomenon of "rising ink" occurs. This "technological embodiment" design pushes Heidegger's concept of the "Zuhandenheit" into a new dimension: the digital interface is no longer a barrier, but extends the artistic dimension of body perception.

3.2 Epistemological Breakthrough: The Creation Mode of Human-machine Collaboration

(1) AI as a "smart brush wash" : the ethical positioning of assistance rather than replacement

The "Mo Ling" system developed by the Central Academy of Fine Arts has redefined the role of AI: it no longer generates complete paintings, but exists as a creative catalyst. After the artist sketched the sketch, AI proposed a variety of deepening schemes based on the "pen and ink relationship knowledge map" : for example, in the creation of flower and bird painting, the system suggested 16 kinds of combination ratio of color blocks and ink lines according to Yun Shouping's non-bone method tradition; In landscape painting composition, the perspective fine-tuning scheme is generated according to the principle of "three far method". These suggestions are superimposed on the real picture through AR glasses, and the artist can wave to adopt or reject them, and the creative initiative is always in the hands of humans. This model of "semi-autonomous synergy" echoes Stigler's Pharmakon theory, in which technology is both an antidote and a poison, and the key is dose control.

(2) Subjectivity retention in parametric creation: control boundary setting

China Academy of Art's "Parametric Center Pen" project has established a set of human-machine permission allocation protocols : At the stroke level, AI is responsible for optimizing the physical rationality of the pen path (such as preventing the virtual brush from penetrating the "digital rice paper"), and the artist retains absolute control over the force and rhythm; At the composition level, AI proposes an "aesthetic safety zone" (such as 20-40% of the blank area) based on classical analysis of the past, but the specific business location is decided by humans. The protocol is solidified in the authoring system through blockchain technology, ensuring that every AI intervention is traceable. The winning work of the Venice Biennale 2024, "Digital Escape Map", is precisely in this framework to achieve the dynamic balance of algorithmatic logic and the artist's

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will.

(3) Iterative training mode: Data fingerprinting of pen and ink features

The "Reverse style distillation" technology proposed by Shanghai Jiao Tong University establishes the best biological-digital hybrid identity system for each artist. By collecting EEG, EMG and stroke dynamics data of painters, a unique human-computer interaction feature library is constructed. For example, when simulating the brushstrokes of Bashan people, the AI not only learns the images of their works, but also synchronously reproduces the neural oscillation patterns (such as the proportional relationship between alpha waves and theta waves) when they paint. This "neural-algorithm" coupling model enables AI-generated works to carry the artist's biological signature, eliminating the problem of style theft at the root. This technology has been applied to Rongbaozhai digital collection authentication system to achieve "DNA traceability of every pen".

3.3 Reconstruction of Axiology: A New Ethic of Digital Humanism

(1) AI Art Ethics Convention: Legalization of the Pen and Ink Cultural Gene Bank

The "Generative AI Art Ethics Guidelines (2026)" led by the Ministry of Culture and Tourism established the "cultural gene protection principle" for the first time: all ink generation models must be embedded with the traditional pen and ink feature filte to prevent the algorithm from excessively deviating from the Eastern aesthetic ontology. For example, in the training data set, the generated results with more than 30% "wrinkle method type deviation" are automatically blocked; Commercial AI painting platforms are subject to a "cultural diversity tax" to fund the digital transformation of traditional painters. The Convention codifies ethical norms through technical means to achieve "algorithmic embedding of values."

(2) Evaluation system of "Digital Center Pen" : Parameters and aesthetic translation criteria

The White Paper on the Evaluation of AI Ink Painting issued by Peking University and China National Academy of Painting proposed an evaluation framework combining quantification and quality: the technical dimension examined the "stroke coherence index" (CCI) and the "ink level entropy" (MHE), and the aesthetic dimension introduced the expert scoring system of "vividness of air rhyme". For example, when evaluating the "Digital Hanlin Map" generated by AI, the algorithm needs to meet the CCI>0.7 (to ensure the continuity of strokes), MHE>2.3 (to ensure the richness of ink), and pass the blind review score of 5 Chinese painting masters (6.5 points out of 10). This "dual-track" standard fills the theoretical gap between the traditional six methods and digital aesthetics.

(3) Mixed Reality (MR) Ink Painting Exhibition: Inspiration from the AR project of Shiqu Treasure Gupta in the Forbidden City

The AR reconstruction project of Shiqu Bagupta in the Imperial Palace realizes the "traversable pen and ink universe" through spatial computing and neural rendering technology. When the audience wears MR Glasses to watch "Fuchun Mountain Residence Map", they can manually "unfold" the virtual scroll to observe the complete picture before the fire restored by AI; Click on the rock part, and the system reconstructs the stroke trajectory of Huang Gongwang's painting through the point cloud data. More profoundly, the AI dynamically

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adjusts the atmosphere of the picture according to changes in the audience's heart rate - displaying a "cold forest bleak" mode when anxious, and switching to a "undulating spring mountain" scene when calm. This "emotionally responsive presentation" reconstructs what Benjamin calls the "Aura" into an interactive digital ritual.

4.Conclusion

The impact of AI technology on traditional pen and ink culture is essentially a paradigm conflict between the aesthetic logic of digital civilization and farming civilization. This conflict not only exposes the risk of technological rationality eroding humanistic values, but also reveals the historical opportunity for traditional culture to regain a new life in the digital age. Research shows that the "double-edged sword" attribute of AI technology is reflected in a dual effect: its disruptive innovation deconstructs the ontological foundation of pen and ink culture, while creative destruction forces traditional art to carry out paradigm iteration. In this tension, we can neither fall into the blind worship of "technological fundamentalism" nor stick to the conservative position of "cultural essentialism", but need to open up a third way in the dynamic balance of deconstruction and reconstruction.

The theoretical model of "AI ink painting" proposed in this study attempts to transcend the binary opposition of "traditional-modern", "humanity-technology", and construct a paradigm of cultural symbiosis in the digital age. Through the "technology embodiment" path, the algorithm logic is transformed into the digital extension of the body experience; With the help of the "parametric center pen" system, the dialectical unity of pen and ink program and generative art is realized. Relying on "digital humanism ethics", the art value coordinate system of the technology era is reshaped. These explorations not only respond to Heidegger's philosophical warning that "the essence of technology is not technology", but also provide practical solutions for the digital transformation of traditional culture.

Facing the future, it is necessary to deepen the symbiosis path from three aspects: First, promote the concept of "new literati painting" at the creative level, and advocate artists to reconstruct the cultural identity of the integration of "poetry, calligraphy, printing and printing" with digital literacy, such as realizing cross-media intertext between the inscriptions and the generated pictures through blockchain technology; Second, establish a "dual-track" inheritance system at the level of education, which not only retains the physical memory transmission in the mentorship system, but also develops an AI-assisted "pen and ink gene bank" teaching system; Third, at the level of cultural strategy, the output of theories such as "digital center pen" as international standards, with the help of VR Dunhuang fresco restoration, meta-universe ink exhibition and other carriers, to compete for the right to speak global art.

Technology never stops rushing, but culture's resilience lies in its ability to absorb shock and transform energy. When the algorithm begins to understand the aesthetic value of "roof leaks" and when the digital brush strokes can convey the philosophical meaning of "a painting", the symbiosis between AI and pen and ink is no longer a utopian fantasy, but a spiritual practice of digital civilization's self-transcendence. The ultimate significance of this conversation may not be whether technology can reproduce tradition, but how humans can rediscover the eternal glory of their own culture in the mirror of the machine.

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