Research on AI Digital Migration of Traditional Hand-drawn Comic Styles and Consistency of Dynamic Styles in Comic Dramas

Qisheng Liu[1]

[1] *Liaoning Communication University, Shenyang 110000, China*
[1] *Email: liuqisheng12321@126.com*

ABSTRACT
This article focuses on the digital transformation dilemma of traditional hand-drawn comics with the intervention of artificial intelligence, and discusses how its style can maintain the continuity of aesthetic core in static migration and dynamic deduction. Based on the visual grammar of hand-drawn cartoons, this article systematically analyzes the symbolic narrative system composed of lines, dots, composition and blank space. On this basis, the style deconstruction framework for AI modeling is constructed, and the mapping logic that transforms empirical aesthetic elements into computable semantic units is proposed. Further, the article extends to the dynamic media form of the comic drama, analyzes the new challenges to style consistency after the introduction of the time dimension, and then designs a multi-dimensional generation constraint mechanism covering time sequence continuity, shot scheduling and audio-visual collaboration. Only when the style is regarded as a semantic system with both structure and time sequence, rather than a set of static image features, can the real style continuity be realized in the algorithm generation, and digital duplication can be avoided from becoming a formal shell.

Keywords: *Hand-painted comic style, Visual grammar, AI style migration, Semantic mapping, Dynamic consistency of comic drama*

1. INTRODUCTION

In the contemporary context of the rapid evolution of digital media, traditional hand-drawn cartoons, as a visual narrative form bearing cultural memory and artistic expression, are facing unprecedented transformation pressure and regeneration opportunities [1]. Its unique line rhythm, ink color level, composition rhythm and character modeling system constitute a highly concise visual grammar, which is embedded with the aesthetic cognitive structure of a specific era and region [2]. With the deep involvement of artificial intelligence technology in the content production process, comic creation gradually moves from paper and pen to algorithm-driven generation paradigm [3]. The core problem is: how to maintain the aesthetic integrity of the original style in the process of digital migration? Especially when the static image is further developed into a drama with time dimension, the consistency of style is no longer only related to the degree of restoration of a single frame, but needs to continue to take effect in dynamic elements such as action cohesion, shot transition and rhythm control [4]. This challenge goes far beyond the simple technical adaptation category, but actually touches on the theoretical tension among the essence of style, transfer logic and dynamic expression.

At present, the research on the art of AI generation focuses on the engineering realization of general image synthesis or style transfer, but less on specific art categories [5], especially the hand-drawn comics with strong authorship and stylization, the ontology stability problem under the intervention of the algorithm. Traditional cartoon style is never an isolated visual representation, and there is a set of hidden rules behind it. This system is embodied in the symbolic use of dot texture, the narrative function of blank space, the proportional logic of exaggeration and deformation, and the coding method of line thickness and trend to

emotions [6]. These elements often rely on the creator's intuition and experience in manual drawing, but they must be explicit and structured in AI modeling, and then transformed into computable semantic units [7]. If there is no theoretical analysis of the internal structure of style, and only the pixel-level similarity or resistance loss is taken as the optimization goal, it will easily lead to the result of being like a god. These pictures seem to reproduce the original style, but they lose their narrative tension and emotional temperature.

When static cartoons are endowed with dynamic attributes to form comic dramas, style consistency faces the risk of secondary deconstruction. Dynamic not only introduces the time axis, but also superimposes multi-modal variables such as mirror movement, speed change, sound effect and interaction, and the stable boundary of the original static style is broken. In this context, style consistency should be understood as a cross-modal and cross-temporal generation contract, which requires the algorithm to actively maintain rather than passively copy the original aesthetic paradigm in the dynamic evolution. This article aims to construct a theoretical framework to analyze the continuation logic of traditional hand-drawn cartoon style in the process of AI digital migration and comic drama dynamics. Study and discuss the mapping principle of style deconstruction and reconstruction in AI modeling; finally, focus on the constraints of style consistency in dynamic context.

2. VISUAL GRAMMAR AND AESTHETIC FEATURES OF HAND-DRAWN CARTOONS

The visual grammar of hand-drawn cartoons is not a simple formal decoration, but a highly systematic symbol system with embedded narrative function. Its core lies in carrying complex semantics with minimalist lines, and realizing emotional transmission and plot advancement through deformation, exaggeration and rhythm control [8]. The line itself is expressive-the rough outline suggests strength or tension, while the slender and smooth auxiliary line creates a light or melancholy atmosphere; the shade of ink not only distinguishes between light and dark, but also bears the function of emotional coding. Large-scale blank space is often used to express loneliness or suspension, while dense dots strengthen depression or movement. This aesthetic strategy of controlling more with less enables hand-drawn comics to convey high-density information in a limited picture.

On the composition level, traditional comics generally adopt non-perspective spatial organization, relying on frame rhythm and line-of-sight guidance to construct reading logic, as shown in Figure 1. The size, shape and arrangement of compartments directly control the narrative speed: narrow and long vertical compartments create a sense of urgency, wide horizontal compartments extend the meditation time, and irregular compartments are used for climax mutation. Character modeling follows the stylized but not rigid proportional law, such as enlarging eyes to enhance emotional projection and simplifying limbs to highlight action intention. This kind of de-realism is not a technical limitation, but an active choice of visual rhetoric, aiming at strengthening the character and drama tension.



Figure 1 Composition of Traditional Comics

Hand-painted traces themselves constitute an inseparable part of style. The texture of paper, the faint residue of pencil draft and the accidental boundary of ink smudge, these imperfect elements jointly construct the materiality of the work and the author's sense of presence [9]. They resist the common excessive smoothness and mechanical symmetry in digital generation, and give the picture a sense of breathing and time thickness. Therefore, the aesthetic characteristics of hand-drawn cartoons are essentially a kind of temperature order-keeping improvisation and trembling of human nature within a strict grammatical framework. This characteristic makes it difficult to reduce it to low-order visual features such as color distribution or edge detection, but it is necessary to understand its deep structure as a complete narrative medium from the perspective of semiotics and perceptual psychology.

3. STYLE DECONSTRUCTION AND SEMANTIC MAPPING LOGIC IN AI MODELING

In the process of migrating the traditional hand-drawn cartoon style to the artificial intelligence generation framework, the core challenge is not the pixel imitation at the image level, but how to structurally deconstruct the style and establish the mapping logic between it and the operational semantic units of the algorithm. The traditional cartoon style is embedded in a highly concise visual grammar, which contains both explicit elements and implicit rules. If AI modeling only relies on the end-to-end image conversion network, and the original input and output digital images are regarded as black-box mapping, it is easy to lose the semantic intention behind the style, resulting in the lack of narrative coherence and emotional resonance although the generated results have superficial similarity. Therefore, style must be regarded as a semantic system that can be decomposed, reorganized and reasoned, rather than a static visual template.

The first step of style deconstruction is to identify its constituent levels. From the bottom visual features to the middle structural units, and then to the high-level narrative components, each level carries specific functions. AI models should be modeled at different granularity, and the overall consistency should be maintained through cross-layer constraint mechanism. On this basis, the establishment of semantic mapping logic becomes the key. The so-called mapping is not a simple one-to-one correspondence, but a non-parametric and empirical expression in hand-drawn style is transformed into a structured instruction that can be understood by neural networks. This mapping must be interpretable and controllable to avoid falling into the misunderstanding that style is noise, that is, mistaking random texture for the essence of style.

Table 1. Hand-Drawn Comic Style Elements and AI Mapping Strategies

Style Element	Visual Function	Layer	AI Mapping Strategy	Control Parameters
Jittery Lines	Convey emotions and the sense of the artist's handwriting	Stroke Layer	Bezier perturbation modulated by emotions	Emotion intensity, rhythm
Non-Uniform Halftone Dots	Express light, shadow, and psychological stress	Texture Layer	Dynamic generation by cGAN	Light direction, emotion labels
Blank Areas	Create suspense or highlight the main subject	Composition Layer	Retention guided by semantic masking	Focus weight, tension index
Exaggerated Proportions	Strengthen character personalities	Shape Layer	Embedded driving deformation vector field	Character prototype, scene type
Hand-Drawn Panel Boundaries	Enhance the human feel of reading rhythm	Layout Layer	Laplacian noise perturbation	Entropy value, panel density
Ink Color Transitions	Build volume and atmosphere	Tone Layer	Multi-scale diffusion kernel simulation	Contrast, emotional tone
Start/End Strokes	Reflect drawing force and rhythm	Stroke Layer	Endpoint enhancement network	Drawing speed estimation, emotional urgency

In order to systematize this process, a style semantic element comparison table can be introduced to clarify the hand-drawn features and their functional expression in AI modeling. Table 1 lists some typical elements and their corresponding algorithm processing strategies.

4. THE STYLE CONTINUITY AND GENERATION CONSTRAINTS IN THE TEMPORAL INTERPRETATION OF ANIME DRAMAS

When static hand-drawn cartoons are transformed into time-dimensional romances, the problem of style consistency expands from the fidelity of a single frame image to the dynamic continuity challenge of cross-frame and cross-modality. Manju does not simply play the picture

frame by frame, but reconstructs the narrative flow by means of lens movement, role micro-movement, rhythm change and sound-picture coordination. In this process, if the traditional hand-drawn style is embedded only by static transfer, it is easy to have style drift in dynamic interpretation, that is, although adjacent frames are in line with the original style, they are visually fractured or emotionally dislocated due to lack of time sequence constraints. Therefore, it is necessary to establish a style continuation mechanism oriented to time series generation and impose multi-dimensional generation constraints to ensure the internal unity of styles in the dynamic context.

The core of style continuity lies in transforming static style elements into generation rules with time continuity. It is reasonable to model jitter as a low-frequency time series signal, and its phase and amplitude are smoothly interpolated between key frames, thus maintaining visual stability. Similarly, if the density change of dot texture is adjusted with the emotional fluctuation of the character, it is necessary to introduce the time series of emotional state as a global control signal to avoid local mutation leading to style out of focus. This processing requires the AI system not only to understand the single frame style, but also to master the evolution logic of the style on the time axis.

The lens language in the comic play itself also constitutes a part of the style. Traditional comics guide readers' line of sight rhythm through frame size, visual angle switching and blank layout, while comic plays translate this into mirror speed, zoom ratio and transition mode. If the lens motion generated by AI is too mechanical, even if the picture style is highly restored, the overall look and feel will still deviate from the original temperament. Therefore, it is necessary to decode the reading rhythm of the original into the viewing rhythm and encode it as the constraint condition of shot scheduling.

Table 2. Dynamic Constraint Mechanisms for Comic Drama Styles

Dynamic Dimension	Continuation Goal	Related Static Element	Generation Mechanism	Constraint Method	Evaluation Method
Line Jitter Consistency	Avoid flickering and retain the hand-drawn feel	Jittery Lines	Temporal interference perturbation field	Phase and frequency smoothing control	Temporal visual fidelity
Halftone Dot Emotion Synchronization	Texture echoes narrative tension	Non-Uniform Halftone Dots	Emotion-driven dynamic generation	Density changes in coordination with emotions and light/shadow	Texture-emotion matching degree
Panel Rhythm to Camera Shots	Restore the reading rhythm of the original work	Panel Layout	Rhythm mapping to shot duration	Shot duration adjusted according to panel density	Rhythm restoration accuracy
Hand-Drawn Feel of Camera Movement	Avoid mechanical camera movements	Panel Boundaries	Stroke rhythm mapping to camera movement acceleration	Movement fluctuations simulate hand-drawn rhythm	Naturalness score of camera movement
Audio-Visual Emotion Coupling	Sound does not disrupt the visual tone	Ink Color Transitions	Audio-visual emotion alignment	Sound emotions consistent with the picture atmosphere	Subjective evaluation of audio-visual coordination
Micro-Expression Smoothness	Natural evolution of expressions	Exaggerated Proportions	Key point trajectory interpolation	Continuous and jump-free expression changes	Perception of expression smoothness
Cross-Frame Blank Continuity	Stable spatial narrative	Blank Areas	Negative space temporal propagation	Stable position and proportion of blank areas	Judgment of spatial continuity

In order to systematize this kind of constraint, we can construct the key constraint dimensions of the dynamic style continuation of the comic drama and its generation and realization mechanism (see Table 2), and clarify the mapping relationship

between different dynamic elements and style continuation.

5. CONCLUSION

This study reveals the deep contradiction faced by the traditional hand-drawn cartoon style in the process of AI digital migration and comic drama dynamics, that is, the tension between technical efficiency and aesthetic integrity. Through the theoretical dismantling of visual grammar, this article confirms that the style essence of hand-drawn cartoons is not an isolated visual representation, but a set of compound symbol system which integrates narrative function, emotional coding and the author's will. On the basis of this cognition, the AI modeling path with semantic mapping as the core is proposed, which emphasizes the transformation of jitter lines, non-uniform dots, rhythmic white space and other elements into controlled generated variables, rather than relying on end-to-end image fitting. This path effectively avoids the generation trap that looks like a trance, and makes the algorithm output have interpretable style logic.

After entering the comic context, the study further points out that style consistency must cross the boundary of a single frame and establish continuity constraints on the time axis. By constructing the mapping function between the lens rhythm and the original frame density, introducing the dynamic adjustment mechanism of emotion-driven dots, and setting the emotional coupling threshold of sound and picture, the system can maintain the internal unity of the original style in dynamic deduction. The research emphasizes that hand-drawn feeling should not be simplified as random noise, but should be modeled as a generated signal with time series phase and semantic orientation. Future work can explore the ability of cross-author style generalization, user interactive style modulation, and the immersive comic experience in VR/AR environment.

REFERENCES

[1] Sun Tianpeng, Zhou Ningning, Huang Guofang. A New GAN-based Local Photorealistic Comic Image Style Transfer[J]. Computer Engineering and Applications, 2022, 58(14): 167-176. DOI: 10.3778/j.issn.1002-8331.2104-0083.

[2] Li Ning, He Luoshan. Technological Innovation and Aesthetic Evolution in Contemporary Chinese Digital Ink-wash Animation[J]. Movie Literature, 2023, (15): 25-31. DOI: 10.3969/j.issn.0495-5692.2023.15.005.

[3] Guo Yan, Wu Zhiqiang, He Yanhui. A Two-stage Automatic Coloring Model for Comics[J]. Mini-Micro Systems, 2020, 41(11): 2308-2313.

[4] Deng Xu, Zhao Lianjun, Huan Jing. Digital Recognition and Classification of Master Paintings Based on Transfer Learning[J]. Computer Engineering and Design, 2021, 42(03): 840-845. DOI: 10.16208/j.issn1000-7024.2021.03.034.

[5] Gu Meng'en, Fan Wei, Wu Yang, et al. Research on Digital Design Innovation Based on Patterns of Xiangxi Miao Embroidery[J]. Packaging Engineering, 2023, 44(18): 258-264. DOI: 10.19554/j.cnki.1001-3563.2023.18.029.

[6] Xu Chanchan, Huang Xinyuan, Fei Guangzheng. Research on Visual Communication Design in Film Animation and Virtual Simulation[J]. Movie Literature, 2022, (20): 81-88. DOI: 10.3969/j.issn.0495-5692.2022.20.018.

[7] Xu Xin. Research on the Promotion of Traditional Cultural Elements in Animation Art Design Performance in the Digital Era[J]. Movie Literature, 2024, (16): 83-87.

[8] Guo Jianwei, Shen Hui, Nie Kaiwei. Inheritance of Song Brocade Weaving Techniques Based on 3D Technology[J]. Journal of Silk, 2020, 57(09): 78-83. DOI: CNKI:SUN:SICO.0.2020-09-014.

[9] Wu Ting. Mining and Analysis of Typical Opinions in Animated Film Reviews in the Context of Big Data[J]. Movie Review, 2022, (20): 11-16. DOI: 10.16583/j.cnki.52-1014/j.2022.20.011.