

Innovative Approaches to Generative AI in CG Animation Production

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Abstract. Generative AI is a technology based on algorithms and models that generates content such as text, images, sound, video, and code. Unlike traditional AI's analytical functions, generative AI can learn and produce new content with logical coherence. In CG animation production, animators undertake extensive creative image work. Theoretically, integrating generative AI into CG animation by leveraging its characteristics can enhance traditional production efficiency. Therefore, this paper uses 2D CG animation as an example to explore the potential integration of generative AI across three phases: pre-production, mid-production, and post-production.

Keywords: CG Animation; Generative AI; Animation Production.

1. Generative AI and CG Animation

1.1 Generative Artificial Intelligence

Generative AI represents a significant branch within the field of artificial intelligence. It is a technology that employs algorithms and models to generate content such as text, images, sound, video, and code. Unlike traditional AI's analytical functions, generative AI can learn and produce new content with logical coherence. The core characteristic of generative AI lies in its role as a creative output tool. It can achieve human-like creative logic by analyzing themes, extracting key information, searching for similar materials, and ultimately generating entirely new content. Moreover, generative AI can be trained on massive datasets, progressively generating higher-quality content that better meets user needs through deep learning, analysis, and information organization. [1-2]

Currently, an increasing number of creative projects are embracing AI-generated content, while creative professionals actively explore integrating various generative AI tools into their workflows. This trend stems not only from the tools' creative capabilities but also their high output rate and minute-level mass production speed, which significantly boosts workflow efficiency. Therefore, monitoring the development of generative AI is essential for the advancement of creative industries like CG animation.

1.2 CG Animation

In recent years, with the continuous refinement of digital media technology, CG animation has been widely applied in film, television, gaming, advertising, and other industries, while its commercial value continues to rise. CG animation refers to digitally created visual works produced using computer technology, encompassing both 2D and 3D formats. It serves not only as a presentation medium but also as a design tool. By integrating computer science, art, film, and music knowledge with industry-specific software, creators produce CG animations for promotion, exhibition, or entertainment. Even traditional stop-motion animation has gradually adopted digital tools in its production process with technological advancements. The emergence of AIGC technology has drawn significant attention from animation researchers, who have experimented with its application in short film production. Several AI-animated shorts, such as "Dragon Gate," have garnered international awards. Therefore, within the contemporary AI landscape, exploring how to better integrate generative AI technology into CG animation production warrants further research.

2. Application Prospects of Generative AI in Animation Creation

2.1 Pre-Production Work in Animation

Pre-production primarily encompasses story development, screenplay creation, concept design, character design, set and prop design, storyboarding, and dynamic shot composition. During story development, the core theme, world-building, and basic plot outline are established. Based on this outline, a screenplay is crafted to translate narrative into animated sequences, specifying each shot's setting, composition, character dialogue, and actions. Visual symbols are then extracted from the textual settings to create mood boards, followed by detailed character and environment illustrations to establish the overall artistic style. Finally, storyboards are produced to visualize the script, designing specific shot compositions and camera movements. Only after completing these design tasks can an animation's fundamental narrative framework, visual art style, and basic cinematic storytelling be finalized. [3-4]

All these tasks require animation design teams to handle extensive textual and visual processing work. Leveraging generative AI capabilities to integrate AI into pre-production can significantly accelerate designers' workflows. For instance, in story development, key themes, characters, and world-building concepts can be converted into keywords. Text-to-image tools like ChatGPT or Deepseek can then generate initial story drafts. Animators or screenwriters can refine these drafts to ensure logical progression and thematic coherence. Similarly, character design—a creative visual task—can leverage text-to-image tools like Midjourney or Stable Diffusion to generate initial concept sketches. Animation character designers then refine these designs based on character specifications and shot requirements, crafting detailed character illustrations.

2.2 Keyframe Handling in Animation Mid-Production

The mid-production workflow differs significantly between 2D and 3D animation. For 2D animation, mid-production is the "from nothing to something" art of drawing, while for 3D animation, it is the "from model to performance" art of manipulation. These tool and process differences shape their distinct aesthetics, yet the shared pursuit of keyframe design and deep understanding of movement principles form the foundation of all outstanding animation works.

In 2D animation's mid-production phase, keyframes must capture the action's start, end, and all pivotal transition points. These frames define the movement's extreme positions, rhythm, and the essence of the character's performance. By incorporating preparatory actions, ease-outs, and other performance elements, the dynamic portrayal of 2D characters becomes richer. This demands that key animators possess exceptional dynamic modeling skills and a keen sense of performance, capable of conveying a character's emotion and power through a single frame. Middle animators then refine the transitional frames within each shot. Today, many 2D CG animations are created using digital tools like tablets and software, following a workflow similar to traditional 2D animation but with different tools.

In 3D animation, the mid-production phase prioritizes creating digital assets like character models and textures before animating movement. Both approaches share the need to design keyframes for fluid motion. Animators can directly input descriptive prompts to AI (e.g., "A character runs into the frame from the left and abruptly stops at the center"). Tools like Runway can rapidly generate one or more video options. This significantly accelerates the transition from pre-production to mid-production, allowing teams to visually evaluate shot composition and motion pacing without committing extensive modeling and rigging resources. Today, the integration of generative AI serves as a powerful auxiliary tool, injecting new efficiency into both workflows at the levels of dynamic pre-visualization and motion reference.

2.3 Post-Production Rendering and Compositing AI

Whether for feature-length animations or shorts, 2D or 3D, the post-production workflow remains largely consistent, primarily divided into two aspects: (Sound Processing) and (Visual Processing) .

For visual processing, editors first assemble the composited assets produced during mid-production according to the storyboard sequence. The animation director then reviews the edited footage until the final shots for narrative presentation are confirmed. Additionally, post-production involves color grading, particularly for special scenes required by specific story elements. To enhance scene ambiance, further color adjustments and corrections are applied during post-production. Continuous advancements in generative AI have driven breakthroughs in both areas: tools like AutoClip's intelligent video slicing can rapidly generate rough cuts for large-scale projects, while Colourlab AI handles extensive color grading tasks. Though AI cannot perfectly control every design detail, it significantly assists designers in managing voluminous post-production adjustments.

In post-production sound design for animation, sound effect creation is a delicate art. Beyond character dialogue relying on live voice actors and some materials sourced through field recordings, a vast array of intricate and lifelike sounds are crafted through the traditional craft of foley. In traditional production workflows, sound designers function as behind-the-scenes magicians. Within specialized foley booths, they intently watch on-screen footage while manipulating an array of bizarre props—kneading cornstarch-filled cloth bags to mimic footsteps, twisting old keys to produce metallic groans, or swirling water in sinks to create swirling currents. Through meticulous synchronization and performance, they infuse the virtual animated world with a tangible, lifelike sonic soul. [5-6]

However, this creation method—highly dependent on experience, physical space, and tangible props—is undergoing a revolutionary shift with the rise of generative AI technology. Today, powerful AI sound generation tools like AIVA, Soundraw, and Mubert provide sound designers with unprecedented "digital sound stages." Creators are no longer constrained by physical props at hand. Simply describe the desired sound effect in natural language—for instance, inputting "the sticky echo of a slime jumping on metal pipes" or "the electromagnetic hum of a futuristic hovercar gliding lightly"—and these intelligent systems instantly generate multiple high-quality sound effect options that meet the requirements, based on their understanding of vast sound databases.

This not only liberates creation from geographical and physical constraints, expanding sound design's boundaries from the real world to the limits of imagination, but more crucially, it enables "non-linear and exploratory" sound creation. Designers can rapidly generate diverse sound styles for comparison and blending, or issue "reverse prompts" to refined outputs (e.g., "Reduce metallic quality, amplify aerodynamic characteristics"). This efficient human-machine dialogue precisely captures the most expressive "perfect sound." AI's intervention is transforming sound creation from a craft reliant on manual replication into a collaborative creative process that sparks infinite possibilities. [7-8]

3. Conclusion

In summary, the penetration of generative AI into CG animation production represents far more than a simple tool iteration—it signifies a profound paradigm shift in production relationships and creative aesthetics. AI technology now permeates every stage from concept design to final rendering. Its value lies not only in astonishing efficiency gains and cost optimization but also in dismantling the linear barriers of traditional workflows, unlocking near-limitless imaginative space for artists. However, we must also recognize that behind this technological disruption lies a fundamental reexamination of art's essence. At present, generative AI outputs still exhibit randomness, limited controllability, and sensitivity to data biases. Yet this is not the technology's endpoint, but rather our starting point. Future challenges will extend beyond making AI more "intelligent" to enabling artists to master AI with greater "wisdom." This demands innovation in animation education systems to cultivate a new generation of creators who are proficient in traditional aesthetics, adept at conversing with AI through "prompts," and equipped with algorithmic thinking.

References

- [1] Cao Xinyan. Animation Film Creation Driven by AIGC Technology [J]. China Film Market, 2025, (10): 34-37+47.
- [2] Qiao Ru, Sun Jing. Transformation of Film and Television Creation in the AIGC Context [J]. Media and Art Research, 2025, (02): 98-104.
- [3] Li Zhen. "AI+Animation" Charts New Future for Industry [N]. People's Daily Overseas Edition, 2025-08-22(008). DOI:10.28656/n.cnki.nrmrh.2025.005319.
- [4] Xu Zhengyu. Research on AIGC-Empowered Innovative Character Design [J]. Toy World, 2025, (07): 72-74.
- [5] Gao Chaomeng, Qu Shiwen. Application of AIGC Technology in Traditional Chinese Art Style Animation [J]. Da Guan (Forum), 2025, (06): 93-95.
- [6] Yang Yuhao. Application of AIGC Technology in Animation Creation [J]. Toy World, 2025, (06): 52-54.
- [7] Sun Hongyu, Li ZeCong, Bao Yining. Innovation in Animation Creation Models Empowered by AI Technology [J]. Toy World, 2025, (07): 63-65.
- [8] Song Jiawei. Application of AI Technology in Animation Storyboard Design [J]. Home Theater Technology, 2025, (10): 42-45.