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Research on the Application of CG Technology in Documentary Production (Postprint)

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Abstract

With the continuous advancement of science and technology in China, approaches to film and television production have become increasingly innovative and diversified. In pursuit of enhanced production quality, numerous film and television production companies have begun to innovate their techniques by integrating CG technology into the production process. The application of CG technology in documentaries not only serves to enhance their authenticity and strengthen audience immersion, but also promotes the development of documentary filmmaking in China, thus bearing considerable significance. Based on this foundation, this paper will proceed from an analysis of the connotation and primary functions of CG technology, as well as its impact on contemporary documentaries, to elaborate on the principles that should be observed in documentary production and the specific applications of CG technology.

Full Text

Research on the Application of CG Technology in Documentary Production

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Abstract: With the continuous advancement of science and technology in China, film and television production methods have become increasingly innovative and diverse. To achieve better production results, numerous film and television companies have begun to innovate their techniques by integrating CG technology into their workflows. The application of CG technology in documentaries not only enhances their authenticity and immerses audiences more deeply but also promotes the development of documentary filmmaking in China, making it profoundly significant. Based on this context, this paper analyzes the

connotation and primary functions of CG technology, examines its impact on contemporary documentaries, and elaborates on the principles and specific applications of CG technology in documentary production.

Keywords: CG technology; documentary; production; three-dimensional virtual scenes; digital matte painting technology

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CG technology, as a product of China's technological development, has played a significant role across numerous fields. Since its widespread application in film and television creation, it has consistently served an important function. Relying on computer graphics rendering and powerful image processing capabilities, CG technology seamlessly integrates virtual scenes with real footage, enhancing the realism, texture, and viewing experience of film and television works. When combined with audio-visual elements, scenes crafted through CG technology become even more spectacular. In documentary filmmaking, the deep reconstruction of historical scenes through CG technology substantially increases both the watchability and artistic quality of documentaries.

1. Overview and Primary Functions of CG Technology

1.1 Overview of CG Technology

CG is the abbreviation for Computer Graphics, referring to a technology that utilizes computer algorithms to simulate optical imaging mechanisms in real-world scenarios, thereby producing graphics and images nearly indistinguishable from reality. As early as the 1950s, computer graphics-related technologies emerged worldwide, with researchers beginning to explore the techniques and knowledge in this field. However, due to underdeveloped technology at the time, no significant breakthroughs were achieved. It was not until half a century later, with technological advancement, that CG technology became truly applicable. Presently, CG technology can accomplish numerous tasks through electronic computers, including digital painting and modeling. Leveraging its advantages, CG technology has been successfully applied in military, film and television, engineering, and other domains worldwide, becoming an indispensable component in the development of multiple fields [1].

1.2 Important Functions of CG Technology

CG technology plays a crucial role in various sectors in China, with its important functions primarily including the following aspects. First, CG technology enables image virtualization. In reality, every image possesses a certain degree of virtuality, as what people see through screens is merely a projection of the

objective world. Therefore, when applied to documentaries, CG technology amplifies this inherent digital characteristic, making the virtual nature of images more pronounced. Through diverse creative techniques, CG technology can deeply reconstruct the real world and make the stylistic features of images more prominent [2].

Second, CG technology enhances the authenticity of documentary documentation. Documentation constitutes the essence and defining characteristic of documentaries. Audiences expect to see more genuine and vivid images through documentaries. For scenes that cannot be reproduced or are difficult to reconstruct, CG technology becomes necessary for processing. Documentaries represent a reproduction of the objective world, and when confronting historical events that cannot be reenacted, CG technology is required to merge virtual and real images, restoring historical scenes as faithfully as possible. For instance, war scenes frequently appearing in documentaries demand CG technology for processing, thereby increasing documentary authenticity and providing audiences with a better viewing experience.

Third, CG technology enables the visual artistry of documentaries. The visual artistry of documentaries primarily refers to the impactful, shocking, and attractive sensations that documentary images evoke in audiences, encompassing not only color and composition but also narrative elements. Applying CG technology in documentary production can enhance visual effects, making documentaries more spectacular and influential, thereby increasing their artistic appeal. For example, CCTV's documentary *Discovery* employs CG technology, combined with advanced filming equipment and countless aesthetically stunning and shocking images, to fill the entire documentary with artistic charm and 震撼力. If only captured footage were used without subsequent environmental rendering and processing, the artistic and aesthetic qualities of the images would be difficult to present to audiences. Therefore, CG technology can enhance the artistic appeal and 震撼力 of documentaries through post-processing of images, attracting more viewers and making documentaries more high-quality and artistic.

2. Impact of CG Technology on Contemporary Documentaries

2.1 Creating Virtual Characters and Building Virtual Scenes

In numerous cultural and nature documentaries, scenes of natural destruction and species extinction frequently appear. As protagonists of documentaries, these creatures must be sufficiently realistic to move audiences. For a long time, Chinese documentary producers, lacking authentic visual materials, have resorted to specimens and models to portray these characters. However, using models and specimens as documentary protagonists clearly lacks persuasiveness without vivid imagery. The application of CG technology in documentaries can solve this problem. Through three-dimensional animation modeling and virtual

camera movements, CG technology can reproduce characters and scenes. For example, the BBC documentary *Walking with Dinosaurs* extensively employed CG technology to deeply reconstruct the life and extinction process of dinosaurs, creating a truly spectacular effect.

Beyond virtual character creation, CG technology also excels at reconstructing virtual scenes. Archival footage of modern warfare events is extremely scarce. To deeply reconstruct these events and make documentaries more persuasive and authentic, CG technology is required to produce and restore scenes. In summary, CG technology can create virtual characters and deeply reconstruct scenes, exerting a significant influence on contemporary documentary production [3].

2.2 Providing Unique Perspectives and Flexible Visual Fields

Beyond creating virtual characters and reconstructing scenes, CG technology can provide unique viewpoints and flexible visual perspectives during scene reconstruction. In terms of shot scale, CG-generated images are not constrained by spatial limitations and can examine entire events from multiple flexible angles—whether from the audience’s perspective or the producer’s perspective. CG technology can traverse multiple different scenes or even entire spaces. For instance, while ordinary people cannot see the entire universe, CG technology makes this possible. CG images can display scenes from multiple perspectives, satisfying audience curiosity and enhancing documentary appeal to some extent. CG images possess an all-encompassing viewpoint characteristic, primarily derived from virtual cameras in CG technology. These virtual cameras enable omnidirectional filming, making images more dynamic and attractive. Under CG processing, numerous science documentaries often captivate audiences through their magical and rich imagery. In conclusion, the application of CG technology in documentary production delivers impact and 震撼力 to audiences by creating virtual characters and building virtual scenes, providing novel perspectives and richer imagery.

3. Principles for Applying CG Technology in Documentary Production

3.1 Principle of Objective Authenticity

For documentary production, adhering to the principle of objective authenticity regarding content is a crucial component. Authenticity constitutes the essence of documentaries and the foundation of documentary production. The so-called objective authenticity of documentaries is generally reflected in the authentic and objective nature of filmed images, the objective authenticity of described events, and the gradual revelation of facts. The purpose of documentaries is to record facts, expose truths, and inspire continuous reflection and contemplation among audiences regarding social, life, and natural phenomena presented in the documentaries. Upholding the principle of objective authenticity inherent to

documentaries, those employing CG technology must also consistently follow this principle and strictly practice it. For instance, in historical documentaries produced by domestic institutions, when scenes involve architecture or daily life from specific dynasties, production teams must utilize CG technology alongside historical materials and expert team research to restore historical situations to audiences to the greatest extent possible, showcasing the charm of historical culture. Therefore, when producers maintain the principle of objective authenticity throughout production and employ CG technology accordingly, the result will not deviate from facts. The application of CG technology can not only better interpret content authenticity but also enhance image expressiveness and audience experience [4].

3.2 Principle of Moderate Feasibility

CG technology serves to deepen image content and achieve specific visual effects. Therefore, its application in documentaries must ensure moderate feasibility. CG technology should only be employed to achieve particular visual effects when traditional visual methods cannot accomplish the desired results. In many renowned nature documentaries, CG technology supplements footage that cannot be captured due to temporal or spatial limitations, providing audiences with authentic visual experiences. However, CG technology must be used cautiously in documentaries. To ensure objective authenticity, it should not be overused. Application must be 适可而止, avoiding deviation from documentary themes in pursuit of visual effects. Additionally, CG technology involves high costs, necessitating rational application based on creative requirements, budget constraints, and objective conditions. Overall, CG technology is merely a tool for television art creation. Its rational application can maximize aesthetic effects, reveal objective reality, and provide audiences with an additional perspective for observing the world. Documentary success depends largely not on artistic effects but on thematic content. Employing technology to make images more exquisite and artistic without deviating from the theme constitutes the purpose of CG technology application. Documentary directors and teams should uphold documentary authenticity, safeguard its aesthetic essence, and innovatively apply CG technology to better exert creativity and produce artistic documentaries [5].

3.3 Principle of Artistic Interest

Documentaries must maintain their artistic quality as works of art. During creation, artistic interest must be expressed through thematic selection, camera techniques, editing methods, and even musical scoring. Documentaries are not fictional artistic works; their greatest appeal lies in discovery, realism, and reflection of real-world truths. Their artistry involves using techniques to display past and present objective events or things that audiences cannot or rarely have opportunities to see. In this process, CG technology application can restore the majesty and grandeur of historical scenes, achieving organic integration of

reality and art. For instance, in some historical documentaries, modern on-site filming cannot reflect past scenes. Supported by CG technology, scenes from that time and place can be displayed, allowing audiences to immerse themselves with interest and engagement. The application of CG technology serves documentary thematic needs, and such expressive techniques can achieve unity between reality and art.

4. Specific Applications of CG Technology in Documentary Production

4.1 Application of Fully 3D Virtual Scenes

Fully 3D virtual scenes are virtual reality technologies for real scenes based on panoramic images, designed and processed using cameras and computer technology to generate interactive 360° viewing experiences. This technology is frequently used as part of CG technology. The general workflow for fully 3D virtual scenes involves first capturing images, then using computer 3D software for model construction while adding details such as lighting and material textures, followed by setting up camera animation and other processes, and finally completing production through special effects rendering. For example, virtual science museums can be established using fully 3D virtual scene technology, allowing students to visit various exhibition halls via computers, with each viewpoint observable within a 360° spatial range, and even enabling them to pick up and examine artworks of interest.

Fully 3D virtual scene technology plays a crucial role in documentaries, primarily utilized to express historical, natural, or cultural landscapes—such as vanished ancient famous buildings or extinct flora and fauna. This technology can also present detailed representations of existing scenes or visualize conceptual objects. For instance, CCTV's documentary *Old Summer Palace* documents the story of the famous imperial garden that inherited 3,000 years of Chinese essence and was built by four generations of emperors before its decline. Since the Old Summer Palace was destroyed by foreign invaders in the late Qing Dynasty, its internal structure and excellent landscapes must be reconstructed using fully 3D virtual scene technology, allowing audiences to appreciate its authentic charm.

4.2 Application of Camera Tracking Technology

Documentary production relies on excellent cinematography. Using CG technology to combine live-action photography with 3D animation has become a major direction for documentaries. Compared with traditional live-action filming, this combined image processing method makes documentary expression more diverse and richer [6]. Camera tracking technology involves analyzing the motion trajectory of already-filmed live-action footage through software programs, calculating the camera movement data during actual filming, and finally importing this motion trajectory data into a 3D processing system. This technology serves as a crucial link between live-action photography and 3D virtual scenes. It not only

enables seamless integration of virtual and real images but also makes synthesized images more realistic with higher fidelity. For instance, in documentaries about extinct species, some footage consists of real natural environments captured on location, while other portions require combining virtual species created through CG technology. In such cases, camera tracking technology is needed to match the motion trajectories of live-action and virtual footage, presenting the most realistic and convincing images and enhancing audience visual experience.

4.3 Application of Digital Matte Painting Technology

Digital matte painting, also known as scenic painting, refers to a technique that creates required landscapes, scenes, or distant environments through painting when physical construction would be too expensive or difficult to capture on film, or that paints over existing scenes. This technology holds significant importance in enriching scene content and enhancing image expressiveness. For example, Beijing Satellite TV's variety program *China in Calligraphy and Painting* utilized digital matte painting technology to reconstruct the grand scene of Emperor Qianlong celebrating the 70th birthday of Empress Dowager Chongqing for "Zhen Huan," creating a lively and bustling atmosphere. Therefore, the rational application of digital matte painting technology in documentaries can make image content more vivid and expressive.

4.4 Application of Motion Graphics Design

Motion graphics design is a language of film and graphic design, a visual expression form designed based on the flow of time. This technology creates movement in originally static images. Compared with previous static and rigid images, motion graphics design makes images more dynamic, explanatory, intuitive, and provides better audience experience. The general workflow of motion graphics design involves first creating static two-dimensional graphic images, then using animation software to assign motion trajectory elements to these images, and finally presenting dynamic graphics with animated effects. This technology is primarily applied in historical documentaries, as historical themes often present audiences with relatively dry historical documents and materials. Motion graphics design can transform these materials into vivid and dynamic visual representations, enabling more comprehensive interpretation of historical content while enhancing image effects and audience experience [7].

Against the backdrop of rapid technological development, documentaries must keep pace with the times and employ advanced production methods to gain greater audience appreciation, and CG technology represents a highly beneficial documentary production technique. Although CG technology differs from documentaries in creative philosophy, its application always adheres to principles of authenticity and objectivity, maintaining unity with documentary values. To scientifically and rationally apply CG technology in documentary production, relevant personnel must follow the principles of objective authenticity, moderate feasibility, and artistic interest, and master application strategies including

fully 3D virtual scenes, camera tracking technology, digital matte painting, and motion graphics design. Only then can the final documentary images achieve greater watchability and artistry.

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Note: Figure translations are in progress. See original paper for figures.

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