Research on Digital Color Grading Technology in Film and Television Post-Production Postprint

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Abstract

Advances in science and technology have propelled the development of numerous industries. As one of the scientific and technological innovations emerging in the new era, digital technology has found extensive applications across various sectors. Concurrently, with ongoing economic progress, people' s quality of life has been substantially elevated, and the pursuit of quality and spiritual fulfillment is increasing daily. Watching film and television productions has become a fundamental means for individuals to spend their leisure time. Film and television post-production constitutes a crucial factor in enhancing the cinematic impact and artistic merit of movies. Within the post-production workflow, the application of digital color grading technology plays a pivotal role in determining a film' s overall style and visual aesthetic; in a quality film, the color palette of the imagery is the most direct and emotionally compelling element for audiences. This paper provides an analysis of digital color grading technology in film and television post-production for readers' reference.

Full Text

Abstract

Advances in science and technology have driven development across numerous industries. As one of the scientific and technological innovations of the new era, digital technology has found widespread application in many sectors. Meanwhile, with economic progress, people' s quality of life has improved substantially, leading to growing demands for quality and spiritual fulfillment. Watching film and television works has become a fundamental way for people to pass the time. Film and television post-production is a critical factor in enhancing cinematic impact and artistry. In the post-production process, the application of digital color grading technology plays a key role in shaping a film' s overall style and even its visual experience. In a quality film, the color of the image is the most

direct and compelling element for audiences. This paper analyzes digital color grading technology in film and television post-production for readers' reference.

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Compared with traditional film and television works, modern productions feature richer colors, primarily due to the development and innovation of post-production technology, which both compensates for pre-production deficiencies and enriches the color palette of film and television works. The application of digital color grading technology can not only create atmosphere for characters and scenes but also improve image quality and texture, thereby enhancing visual experience and providing audiences with both physical and psychological enjoyment. At present, digital color grading technology has evolved from simple color reproduction to style shaping, and now encompasses comprehensive applications in lighting, brightness, tonal values, and other aspects, improving the overall quality of film and television works and driving continuous progress in the industry.

The integration of digital color grading technology also significantly impacts audience immersion. For instance, many film and television works contain flashback sequences. To distinguish these from main sequences, the tonal treatment of flashbacks is often modified. Typically, duotone is applied to give flashbacks a stronger sense of time, creating clear differentiation from the main sequences. This helps better immerse audiences in the narrative and facilitates their understanding of the plot.

1. The Value and Impact of Digital Color Grading Technology in Film and Television Post-Production

1.1 Impact on Image Quality

The visual quality of film and television works directly affects viewing experience. Observing older films and television productions reveals that, due to outdated equipment and limitations in post-production technology, image quality was relatively poor. By contemporary aesthetic standards, these works no longer meet audience expectations. Therefore, restoration and color grading must be employed to improve image quality, with digital color grading technol-

ogy playing a crucial role. Some productions require detailed color adjustments in post-production. For example, when filming night scenes, indoor lighting should not be excessively bright, yet relying solely on props cannot achieve this effect. Digital color grading technology must be used to reduce color saturation, dim the lighting, add environmental colors to create tonal atmosphere, and finally enhance character clarity to improve overall image quality and present superior visual content to audiences [1]. These seemingly minor adjustments directly influence audience immersion and viewing effectiveness. If environmental lighting is too bright, it dilutes character images and makes it difficult for audiences to engage with the film, while actors' expressions appear unnatural under strong light. Conversely, insufficient lighting leads to low saturation and excessive noise. Both scenarios negatively impact image quality. Thus, the application of digital color grading technology can enhance image quality, create atmosphere, and provide audiences with better visual experiences.

1.2 Impact on Character Portrayal

Most film and television works are human-centered narratives. To make characters vivid and compelling, actors must fully invest their emotions in the storyline. Building upon this foundation, to deeply manifest actors' emotions on screen, post-production tonal adjustments are needed to compensate for inadequate pre-production emotional atmosphere, making characters more substantial and authentic, facilitating deeper emotional transmission to audiences and generating resonance, thereby winning more viewers for the work. The integration of digital color grading technology also significantly impacts audience immersion. For instance, many productions contain flashback sequences. To distinguish these from main sequences, the tonal treatment of flashbacks is often modified. Typically, duotone is applied to give flashbacks a stronger sense of time, creating clear differentiation from the main sequences. This helps better immerse audiences in the narrative and facilitates their understanding of the plot.

2. Main Applications of Digital Color Grading Technology in Film and Television Post-Production

2.1 Application in Light Source Reconstruction

When filming, whether under natural light or artificial lighting conditions, the diversity of subjects, lighting, and angles creates varying lighting effects in the final footage. Digital color grading technology is then required to unify color deviations caused by different lighting conditions or cameras. This correction standardizes the lighting degree across footage without damaging image quality. For example, when filming under natural light, the light changes over time, and the lighting effects differ across time periods. Whether the light source is too strong or too weak, both negatively impact filming results. Excessively strong light creates high contrast and reduces mid-tone levels, while overly bright light dilutes character images, making audience engagement difficult and causing un-

natural facial expressions under intense light. Insufficient light leads to low saturation and excessive noise. Both situations affect image quality. Therefore, digital color grading technology must be used for modification to achieve desired light values. Additionally, during light source reconstruction, digital color grading technology enables light source simulation, effectively constituting secondary creation of the filmed footage. In relevant digital grading software, simulated light sources can be incorporated according to requirements. Sometimes the light source during filming differs significantly from that required in the final film, or the required light source is difficult to achieve during pre-production. In such cases, crews use software to simulate light sources to achieve the desired final effect. Many current market productions have employed light source simulation. For instance, during the filming of *Wolf Totem*, because scene limitations prevented lighting setup, the crew simulated light sources through the oil lamps carried by actors to enhance the light intensity in those shots [2]. When necessary, simulated light sources place relatively high demands on colorists, who must possess solid theoretical knowledge and rich practical experience to achieve perfect simulated lighting effects.

2.2 Application in Brightness and Darkness Adjustment

When filming, various factors inevitably cause each scene' s tonal brightness and warmth to differ. Without color grading, the film' s overall tone cannot achieve harmony and unity. For example, when filming exterior scenes, outdoor brightness levels may differ from expectations due to time or weather conditions, requiring subsequent adjustments to unify the brightness levels. In actual grading, the image can be divided into shadows, highlights, and mid-tones. Colorists must process these three areas according to circumstances to unify the tonal values across a sequence. During this process, particular attention must be paid to brightness consistency within the same scene. If brightness levels are inconsistent within a scene, audiences can immediately detect the differences, naturally affecting viewing experience. Simultaneously, when adjusting brightness levels, we can also use color temperature, contrast, saturation, etc., to create sharp contrasts between the same or different images, thereby creating a sense of 反差感. Grading treatment can catalyze plot development, character dialogue, emotional transmission, and highlight relationships and perspectives, as a film' s tone directly influences audience mood and final experience. For example, in the same frame with two characters, if one is in a brighter environment while the other is in a darker setting, suspense can be created, making the audience' s perception of their interaction extend beyond visual and auditory dimensions to stimulate genuine emotional responses. This technique is common in suspense, thriller, and crime productions, creating a favorable viewing atmosphere that immerses audiences in the narrative.

2.3 Application in Color Style Shaping

A film' s color style is crucial to its development and dissemination, and digital color grading technology can shape this style. Color style is generally related to content and emotion. For example, *Batman* is set against the backdrop of a crime-ridden metropolis, employing low contrast and saturation with dark shadows to thoroughly render and accentuate the city' s dark aspects. Before filming begins, a basic definition of the work' s color style must be established. If the atmosphere is relatively oppressive, saturation and contrast can be reduced to fully manifest the 压抑 atmosphere and better enable audience emotional immersion. Whether a film can resonate with audiences and allow them to experience characters'emotions is particularly important, and shaping color style can achieve this goal. For instance, the film *The Return* employs an overall cold gray tone, with black-and-white imagery that is profound and 朴素, simple yet powerful, fully revealing the actors' suffering. In subsequent color style shaping using digital grading technology, saturation reduction and similar treatments were applied to render a 压抑, painful atmosphere through cold tones, using color to constantly remind and 暗示 audiences, thereby conveying the era' s pain depicted in the film. In some science fiction works, color style serves the subject matter—for example, Hollywood sci-fi productions have long favored the Orange/Teal color scheme. Through the warm-cool contrast of orange and blue tones, the most classic color palette is formed. Actors are the center of film because characters carry the film' s 主旨. Actors' skin tones belong to the orange family, and the complementary color is blue or cyan. The orange-teal scheme originates from this complementary contrast. Strong warm-cool contrast can make film images more vivid. Hollywood sci-fi films are deeply favored domestically and internationally, and the vast majority employ this orange-teal scheme, demonstrating that color style shaping plays an important role in film, significantly enhancing character dialogue and scene expressiveness.

2.4 Application in Image Color Processing

With the development of the film and television industry, productions are no longer limited to traditional methods but are regarded as products of thought and creativity. In traditional filming, lighting was used to highlight artistic effects, with some directors even treating it as a 调色板 to achieve mixed color effects through multiple colors. However, footage captured by cameras is linear, and only through post-production grading can the artistic effects desired by directors be achieved. Colorists must analyze filming materials and interpret the content the work intends to convey, gradually improving image quality to present perfect, flawless images to audiences. Through digital grading software, film and television images can become more authentic and compelling. When processing image colors, primary color correction must first be performed for basic material adjustment, controlling overall tone including contrast and color balance to restore original colors, followed by more complex local adjustments known as secondary color correction. When applying digital color grading tech-

nology, the colorist' s aesthetic is particularly important—how to make images visually impactful and colors more aesthetically pleasing to audiences is a key consideration. No aspect of image color processing is too small; whether adjusting overall tone or handling details, perfection should be pursued. Sometimes, relatively minor color imperfections, if not properly addressed, can significantly impact the entire image. For example, when post-production requires changing sky hue by replacing the original blue sky with another color, colorists must meticulously mask the sky area, as even the slightest color overlay can reveal post-production traces to audiences, affecting the overall sky effect presentation.

2.5 Application in Light Source Tracking

The application of digital color grading technology in light source tracking primarily refers to moving shots. During camera movement, visual errors may occur due to scene transitions. The shooting focus is difficult to fix during lens movement, and close-ups of people or objects will change, resulting in relatively blurry footage that requires digital color grading technology to track light sources. For example, this situation may arise when moving from indoor to outdoor shooting [4]. Using digital color grading technology to track light sources can compensate for cinematographers' visual errors to some extent, maintaining optimal shooting conditions for extended periods.

3. Strategies for Applying Digital Color Grading Technology in Film and Television Post-Production

3.1 Innovative Application Awareness

Film and television creation requires joint efforts from pre-production through post-production teams. However, careful observation reveals that some crews heavily rely on post-production, believing that post-production can compensate for inadequate pre-production preparation, consequently extending many tasks that could have been completed beforehand into the post-production phase. This directly increases post-production workload and pressure. Although digital color grading technology possesses powerful capabilities, a truly 震撼人心的 work is one where both pre-production and post-production achieve excellence. From another perspective, digital color grading technology is a post-production tool, and post-production is built upon the foundation of materials. If the source materials are of sufficient quality, post-production becomes a finishing touch; if pre-production overly relies on post-production, post-production work largely becomes compensating for pre-production deficiencies, resulting in far inferior outcomes compared to films with adequate pre-production preparation. Therefore, whether dealing with digital processing technology or filming work, a correct production philosophy should be maintained, completing pre-production filming and post-production work according to relevant standards to ensure the final product is completely presented to audiences. Cinematographer Chi Xiaolin, who has filmed many classic works, believes that quality images require

collaboration between pre-production and post-production staff. Cinematographers must adjust camera parameters to reasonable values, lighting designers must properly light shooting scenes, and colorists must artistically adjust film images [5]. Only through full cooperation among these three roles can film production be completed efficiently. Actual filming has validated this view. If camera parameters are unreasonable, restoring the filmed images in post-production requires considerable effort and sometimes cannot be recovered at all. If lighting designers fail to light scenes on set, even though post-production can compensate through grading, subtle flaws inevitably remain, and authenticity cannot be achieved. The core of artistic creation is people, and only through sufficient awareness transformation can film and television works gain greater popularity. Properly balancing pre-production filming and post-production phases allows digital color grading technology to fully 发挥其画龙点睛的作用.

3.2 Accurate Adherence to Production Workflow

When using digital color grading technology for post-production, relevant workflows should be followed. Although artistic standards vary across film and television works, the application process for digital color grading technology remains consistent. The main workflow includes correction, revision, and image style building. First, the colors of materials in the work must be restored. This process requires preserving original details in the material while performing basic correction and de-graying, with colorists reasonably controlling color temperature, contrast, exposure, etc. After primary color correction, secondary color correction is also necessary. Second, image style building primarily refers to constructing tones that match the work. For any film or television work, possessing a distinctive image style is essential, as it can intuitively convey the work' s atmosphere to audiences and quickly engage them in this fragmented era. Image style building also requires temporal positioning of graded images, adjusting image attributes from multiple time nodes to align with the work' s atmosphere [6]. Most film and television works contain multiple storylines, and different plots involve variations in shooting angles, techniques, and atmosphere creation, requiring professional methods to express intended emotions.

3.3 Courage to Innovate and Break Through Limitations

Film and television post-production has become the primary means for contemporary works to gain market share and attract audiences. Although digital color grading technology has been applied in many aspects of post-production, future industry trends will inevitably witness the emergence of more uniquely creative works, accompanied by new techniques, methods, and concepts. Therefore, when using grading technology, innovative thinking should be cultivated, courageously breaking through limitations to develop and 挖掘 existing technological functions, creating works that will not be forgotten with the passage of time.

In summary, digital color grading technology has been widely applied in film

and television post-production. This paper has primarily analyzed its specific applications in light source reconstruction, brightness/darkness adjustment, color style shaping, image color processing, and light source tracking. Digital color grading technology not only significantly influences the tone and atmosphere of film and television works but also affects audience immersion, improving visual effects and making characters more substantial and authentic. In practical application, innovative technological awareness, accurate adherence to production workflows, and courageous breakthroughs in thinking are required to provide conditions for maximizing the advantages of digital color grading technology.

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