Postprint: Application of Surround Sound Technology in Video Programs

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Abstract

With the continuous development of modern science and technology, humanity has entered the high-definition era, wherein high-definition television enables the viewing of various high-quality images and videos. However, how may high-definition be achieved in the auditory domain? While international audio standards for high-definition television have been established, our country has not incorporated surround sound into the standardization efforts for high-definition television audio, leading to an imbalance between audio and visual development in high-definition television programs. This article analyzes the advantages of surround sound, explores its specific applications in diverse video programs including sports, music, film, and television, and proposes several reasonable measures, with the aim of providing reference for the formulation of surround sound evaluation standards for high-definition television in our country.

Full Text

Application of Surround Sound Technology in Video Programs

Abstract: As modern science and technology continue to advance, we have entered the high-definition era, where we can view various high-quality images and videos through HDTV. However, how can we achieve "high-definition" in audio? International standards for HDTV audio have been established, but since China has not yet incorporated surround sound into its HDTV audio standards, this has led to an imbalance between audio and visual development in high-definition television programs. This paper analyzes the advantages of surround sound, explores its specific applications in various video programs including sports, music, and film/television, and proposes reasonable measures to inform the development of surround sound evaluation standards for high-definition television in China.

Keywords: HDTV; program types; surround sound application; audio standards

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Sports events are among the most popular programs, and they have fully embraced surround sound technology. The combination of high-definition visuals and surround sound creates an experience that transports viewers directly to the venue, delivering intense impact and allowing audiences to be infected by the atmosphere of the live event. For high-definition television programs, clear images must be complemented by high-definition audio to create a truly stunning audio-visual experience. Therefore, studying the application scenarios and techniques of surround sound technology in video programs is of great significance for enhancing program quality and audience experience.

Science and technology continue to develop, and high-definition television is profoundly changing our lives. HDTV uses digital technology to deliver high-quality audio and video to audiences. In HDTV audio systems, support for Dolby 5.1 channel transmission provides audiences with a cinematic auditory experience.

1. Characteristics of Mono, Stereo, and Multi-Channel Surround Sound

As the name suggests, mono sound typically features only a single sound source, resulting in a very monotonous audio experience. Stereo sound, by contrast, demonstrates spatial depth and creates a three-dimensional sense of presence. Surround sound, based on the listener' s on-site experience, creates a sound space that more closely approximates real-world effects. Stereo allows the sound imaging effects of multiple sound sources to be distributed across a relatively wide spatial range, with significantly stronger masking effects between sound elements than in mono. This makes volume balancing among various parts easier to handle and brings the results closer to actual live sound effects.

Multi-channel surround sound technology builds upon stereo by enabling realistic sound sources to be individually grouped and output according to their actual positions and directions in the sound field, then integrated with traditional stereo signals to create an enveloping sound space. This technology allows listeners to experience an immersive, on-site auditory sensation that better restores the authenticity of the scene. Based on these advantages, surround sound technology has been widely applied in the production of broadcast television and online video programs. Currently, many countries internationally have adopted Dolby 5.1 surround sound technology as the primary standard for audio encoding in television programs. As technology continues to evolve, exploration of more advanced holographic surround sound technologies has never ceased.

2.1 Surround Sound Technology in Sports Broadcasting

Sports events are particularly popular programs that have fully leveraged surround sound technology. The combination of highly clear picture quality and surround sound creates an experience that makes audiences feel as if they have arrived at the competition venue, delivering strong impact and allowing viewers to be infected by the atmosphere of the scene. In Japan' s HDTV development process, the influence of hosting large-scale sporting events accelerated the rapid development of the country' s HDTV broadcasting. China' s HDTV development started relatively late, but after the successful hosting of the 2008 Beijing Olympics, it not only promoted national economic and social development but also advanced China' s high-definition television industry. China' s sports channel officially began live broadcasting in 2013, airing sports events in full high-definition 24 hours a day.

During the broadcasting of large-scale sports events, the international standard employs multi-channel surround sound for audio accompaniment across various sports. Only by ensuring both visual high-definition and high-quality audio can audiences be provided with an extraordinary experience. Large-scale sports events represent an important source of content for HDTV surround sound. Surround sound technology allows us to experience the intense atmosphere of live ball games and the passion of fans, as if we were physically present at the venue.

However, during surround sound recording, because players move and pass balls at extremely high speeds while commentators deliver passionate narration, television audiences sometimes cannot follow what they hear. For example, in table tennis matches, because the ball moves so rapidly, it is very difficult for the ears to keep up with the sound of the paddle hitting the ball. If the surround sound reproduction system is not properly configured in such cases, an obvious "ping-pong effect" can occur, creating an uncomfortable experience for the audience.

2.2 Surround Sound Technology in Music Video Programs

Music programs are also popular among audiences. Compared with general television programs, music programs place greater emphasis on emotion and expressiveness. The use of harmonious sound in music programs can immerse audiences in corresponding situations, allowing them to experience feelings of sadness or joy without requiring much conscious thought, and enabling them to resonate with the producers through association and psychological activity.

Music is a form of symbolism that does not require conceptual representation; audiences only need to focus on experiencing the connotation of music at its own pace, thereby stimulating their emotions. For the same piece of music, different people will have different feelings, as music perception is a behavior built upon past experience. When listening to free and powerful music, we can not only experience that music expresses better than language, but also become immersed

in its narrative. Unlike literary expression, which excels at representing the material world, music emphasizes the representation of the spiritual world. For high-definition music programs to attract audiences and quickly immerse them in the mood created by the music, the use of surround sound technology can achieve twice the result with half the effort, and different types of surround sound mixing techniques can produce different effects for audiences. Using a direct sound simulation model can make audiences feel as if they are at the center of the band, while the combination of direct and reverberant sounds can create the feeling of being at a live concert hall.

For example, the music talent show *The Voice of China* has been beloved by television audiences since its first season, with ratings far exceeding other similar singing competition programs during the same time slot. In addition to its strong directorial team and excellent amateur singers from all walks of life, *The Voice of China* was also the first singing competition program in China to be produced using Dolby 5.1 surround sound technology. To successfully produce this program, Zhejiang Radio and Television Group conducted in-depth research, engaged in extensive exchanges with foreign surround sound production companies, comprehensively updated the surround sound acquisition and production equipment at the recording site, and conducted multiple trials and refinements in other programs, laying a solid foundation for the program' s broadcast and successful promotion.

Based on the advantages and characteristics of surround sound, *The Voice of China* implemented a more scientific design for audio acquisition across various channels. The front center channel captured the singers' vocals and the mentors' spoken evaluations to enhance sound stability. The front left and right channels captured musical accompaniment and harmonies to enhance the live atmosphere. The left and right rear surround channels allowed audiences to experience spatial envelopment and realism, making them feel as if they were sitting at the center of the stage at the recording site, listening to the contestants' performances.

2.3 Surround Sound Technology in Film and Television Works

In film and television dramas, sound composition is extremely complex, encompassing music, dialogue, sound effects, and environmental spatial elements. In daily life, people' s experiences are limited by visual images—audiences can hear sounds not represented in the picture, but they cannot accept situations where they see visual activity without corresponding audio. Therefore, the sound production process in film and television places high demands on production staff. The audio must not only satisfy the requirement that what audiences hear matches what they see, but also possess a unique structure that makes the sound attractive and allows audiences to be artistically infected by it.

In film and television works, sound is more about expressiveness than documentary realism, and this expressive sound is built upon audiences' auditory

perception and experience. Through arrangement and combination, sound designers can resonate with audiences' emotions. Consequently, in film and television works, surround sound technology emphasizes the design relationships between multi-channel surround sounds, demonstrating strong creativity in the expansion and shaping of cinematic spatial perception.

For example, the Oscar-winning film *The Silence of the Lambs* leveraged the advantages of surround sound to construct the film' s spatial audio landscape. During the scene where the female agent searches for the serial killer in the basement, the narrative method relies on meticulously arranged sound elements. Based on the female agent' s perspective, the audience' s emotions are gradually guided and transformed. The entire visual perspective during the basement search is limited to the female agent' s viewpoint. However, what cannot be seen in time and space during the narrative is effectively expressed by the director through background music and ambient sound that reveal the basement's spatial acoustics. As the female agent moves through the limited basement space, the reverberation of the music gradually decreases then increases again. When she follows the sound to the sewing room, the reverberation becomes increasingly faint, and when the door opens, the reverberation suddenly disappears, creating intense tension for the audience. When the female agent leaves the sewing room and enters the next contiguous space, the direct sound of the music once again diminishes while the reverberation increases.

In this film, the music demonstrates not only a rhythmic thread but also reflects the spatial environment of the basement to the audience. Using this method, the director does not need to use visual shots to explain the basement' s space. At the moment when the lights suddenly go out, the killer puts on his glasses to watch the female agent' s movements. The female agent, groping in the dark, is positioned at the center of a green-tinted frame. At this point, his breathing sound is sealed in the center speaker, aligning the audience' s visual and auditory perspectives. Then, the killer' s breathing sound is placed in the surround channels, making the audience' s listening position consistent with the female agent' s objective listening position, giving viewers an immersive experience.

Conclusion

As high-definition television technology continues to develop and audience demands for audio quality increase, the rational use of surround sound technology in television programs can provide audiences with unique experiences, making them feel as if they are present at the program site and thereby enhancing the expressiveness of television programs.

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