Exploration and Practice of Television Audio Recording Technology: Postprint

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Date: 2023-10-08T00:00:00+00:00

Abstract

With the development of the media industry, audiences watching television programs on traditional TV platforms expect not only novel program content, brilliant colors, and composition, but also a superior audio-visual experience. Delivering a quality program requires high-level coordination among departments including planning, directing, stage design, lighting, camera operation, directing, video, audio, and post-production editing, wherein sound holds a position of significant importance and function. This paper expounds upon television audio recording technology from the aspects of sound recording standards, recording methodologies, sound reinforcement techniques, and recording practices.

Full Text

Exploration and Practice of TV Audio Recording Technology

Abstract: With the development of the media industry, television audiences increasingly demand not only novel program content with vivid colors and composition, but also enhanced audio-visual experiences. Producing high-quality programs requires seamless coordination among multiple departments—including planning, directing, stage design, lighting, camera operations, broadcasting, video, audio, and post-production editing—where sound plays a crucial role. This paper examines television audio recording technology from the perspectives of recording standards, methodologies, sound reinforcement techniques, and practical recording applications.

Keywords: television; audio; recording; quality; technology
CLC number: TN948.13
Document code: A
Article ID: 1671-0134(2018)12-057-02

DOI: 10.19483/j.cnki.11-4653/n.2018.12.022
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With the development of the media industry, television audiences increasingly expect not only novel program content with vivid colors and composition, but also superior audio-visual experiences. Producing an excellent program requires high-quality collaboration among planning, directing, stage design, lighting, camera operations, broadcasting, video, audio, and post-production editing departments. Sound holds a particularly important position and function in this process. This paper explores television audio recording technology from three main aspects.

1. Television Audio Recording Standards and Methods

In program evaluation competitions, audio quality is assessed based on three criteria: sound volume, sound quality, and balanced audio mixing. The overall program volume must remain within standard level ranges, with natural transitions between audio segments free from distortion or noise, and proper balance between vocals and background music or sound effects.

1.1 Audio Calibration Signals

The audio calibration signal is a 1000Hz sine wave at a reference level of -20dBFS. For monaural recording, all four channels receive identical continuous calibration signals. For stereo recording, channels CH2 and CH4 receive identical continuous calibration signals, while CH1 and CH3 receive intermittent calibration signals with identical phase that pause for approximately 0.25 seconds every 3 seconds. This standardized calibration procedure also defines the lead tape format: 15 seconds of silent black, followed by 60 seconds of color bars with audio calibration tone, then 30 seconds of silent black before program content begins. The tape tail after the program must contain at least 30 seconds of silent black, with timecode running continuously from the color bars through to the end of the tape tail. In daily studio recording or OB van field production, specific requirements may vary—for instance, some events may require sending a -20dB 1000Hz signal on the left channel and a -20dB 400Hz or 500Hz signal on the right channel for calibration. Alternatively, after initial level calibration, the right channel may be attenuated by 10dB to verify channel separation and prevent misrouting or assignment errors.

1.2 Recording Levels versus Perceived Loudness

A common misconception among some directors is that levels exceeding -20dB are "too high." In reality, the -20dB reference level serves only as a calibration benchmark for verifying audio channel integrity—not as an average or peak level standard. Since audio has a wide dynamic range, actual recording levels typically run 8–10dB higher than the calibration level. Program peaks

should be controlled at -9dB, with instantaneous maximums not exceeding -6dB, and speech levels never surpassing -12dB. Furthermore, normal program audio should not remain below -20dB for extended periods. Maintaining appropriate dynamic range while achieving overall volume balance is therefore essential during recording.

However, displayed level values do not always correspond to perceived loudness. Audio may sound loud without registering high levels, or conversely, may sound quiet despite high meter readings. This discrepancy arises because human hearing exhibits varying sensitivity across different frequency ranges. This explains why sound effects sometimes appear louder than presenters at identical levels, or why television commercials seem louder than program content despite broadcast levels being standardized. To ensure consistent listening experiences, loudness meters are indispensable in audio systems, enabling production of programs with stable, uniform perceived volume rather than erratic fluctuations. In systems lacking loudness meters, experienced audio engineers must rely on both level meters and headphone monitoring to adjust and evaluate sound levels, frequency response, distortion, and signal-to-noise ratio.

1.3 Preventing Audio Distortion

A common phenomenon in OB van field production involves receiving audio signals from local venues where, despite proper level calibration and well-controlled recording levels on the van, the monitored sound remains distorted. Generally, distortion results from excessive signal levels. When hosts or guests become emotionally expressive with wide dynamic vocal ranges, the signal may exceed the microphone preamplifier's dynamic range, causing saturation distortion. Attenuating the input fader or master output after preamplifier distortion occurs reduces volume and meter levels but cannot eliminate the distortion. Therefore, preamp gain must be set according to source level characteristics, with adequate safety headroom reserved.

1.4 Vocal Microphone Technique and Music Balance

For vocal pickup, microphones should be positioned to capture clear, high signal-to-noise ratio sound. Placement too close to the mouth risks capturing breath noise, while excessive distance introduces interference and coloration. Lapel or headset microphones must be securely fastened with proper orientation to ensure clarity. In sports broadcasting, wired lavalier microphones are typically mounted on table tennis nets and under tables, while basketball backboards also carry microphones to capture sound. Microphone capsules must avoid contact with metal surfaces and be firmly secured to prevent vibration and friction noise. Windscreens are essential when clipping microphones to soccer goal nets. These details may seem simple but prove critically important.

Regarding the balance between voice and effects, poetry recitation with musical accompaniment provides a representative example. Music should fade in

and out naturally and harmoniously, typically with a slight level increase at the recitation' s conclusion, held for several seconds before gradually fading out. This allows both the reciter and audience to remain immersed in the emotional atmosphere. Similar subtle level increases during song interludes, along with deliberate subjective processing of vocal and musical elements at recitation beginnings and endings, convey a sense of creative intention to listeners.

Having covered recording standards and microphone applications, we now turn to another crucial component of studio audio systems: sound reinforcement.

2. Sound Reinforcement Systems

The conventional sound reinforcement configuration comprises main PA speakers, monitor speakers, and fill speakers. Main PA speakers typically employ line array suspension, offering controlled coverage angles and distance while conserving floor space and facilitating stage design. Monitor speakers generally use compact, lightweight enclosures, while fill speakers must also be easily movable. After positioning speakers according to performance and audience areas, levels are adjusted sequentially—main PA first, followed by stage monitors. The optimal balance ensures performers hear primarily through monitor speakers while audience members receive sound predominantly from the main PA. Additional fill speakers may supplement coverage gaps in main PA and monitor systems or adjust sound localization. Special programs such as live bands require different instruments in each musician' s monitor mix, necessitating customized monitor feeds based on specific performance requirements. This selective routing of different audio signals to individual monitor speakers is common in studio productions. For programs using numerous lapel and headset microphones with performers arranged in multiple stage groups, each performer should hear other groups' microphones through their own monitor speaker while sending their group' s microphones to other groups' monitors. This approach ensures clear audibility for all performers while reducing feedback.

2.2 In-Ear Monitor Applications

In contemporary program production, stage monitoring has traditionally relied on monitor speakers. However, the cabling complexity and visual obstruction of monitor speakers often concern directors and camera operators. Consequently, wireless in-ear monitors are increasingly adopted across various production contexts. In-ear monitors offer numerous advantages: convenient setup and operation, reduced feedback potential, and improved stage aesthetics. Performers particularly prefer them in large outdoor venues like stadiums to minimize reflected sound. Current practice typically combines monitor speakers with in-ear monitor systems.

3. Program Recording Practice

3.1 Microphone Placement for Conference Programs

Conference program recording involves fewer microphone types and quantities than variety shows, requiring fewer adjustment points but tolerating zero errors. Live conference productions demand advance preparation, early arrival, pre-positioning, and thorough testing. Dual-path redundancy and signal backup are mandatory. Appropriate pickup patterns, cable routing, recorder types and quantities, and system interconnections must be selected. Wired gooseneck microphones are preferred over wireless for reliability, with dual microphones at each speaking position feeding separate primary and backup console paths. Camera-mounted microphones should also be installed to capture audience and ambient sound via camera cables to the main console. Additional backup signals may be obtained from venue audio systems or other sources. After system connection, audio paths must be tested and calibrated with recording, satellite transmission, and broadcast control systems using previously described methods, followed by input gain setting, level adjustment, and backup signal verification.

3.2 Emergency Handling

During normal operation, the OB van' s main console receives both the venue console' s mixed signal and vehicle-mounted microphone signals, selecting the higher quality output. Microphones connected to the van feed both primary and backup consoles, with a switcher enabling backup console takeover if the main console fails.

While conference program systems are simpler than variety show setups, the production process cannot afford any errors. Therefore, comprehensive preventive measures are essential, including thorough verification of all links, clear understanding of technical requirements for each position, and mastery of emergency procedures. Before live transmission, monitor levels throughout the OB van must be adjusted to provide appropriate listening levels for all crew positions, with headphone monitoring used when necessary to detect whispers or other subtle sounds before the conference begins. Throughout the conference, content must be continuously monitored, with special situations promptly reported and appropriately addressed.

Amidst the convergence of traditional and new media, television professionals are pursuing innovation and development through high-quality programs that deliver novel experiences to audiences. Moving forward, traditional television producers will continue learning and advancing within this integrated media environment.

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