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Practice and Exploration on the Application of Sound Reinforcement Technology in Outdoor Chorus

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Abstract

This paper discusses the application practice and challenges of sound reinforcement technology in outdoor chorus. Outdoor chorus faces complex acoustic environment, changeable meteorological conditions and background noise interference. Sound reinforcement technology can effectively compensate the attenuation of acoustic energy, improve sound clarity and layering through acoustic-electrical conversion, signal processing and electroacoustic reduction. This paper analyzes the selection and configuration of audio equipment in detail, including the reasonable layout and debugging of speakers, microphones and mixing consoles, and emphasizes the environmental adaptability and stability of the equipment. In addition, the paper also introduces the development trend of modern sound reinforcement technology, such as intelligent regulation, digital processing and network control, which improve the accuracy and adaptability of the system. Through the case of the Chorus of Nanchong Film Industry Vocational College, this paper shows how to apply sound reinforcement technology in actual performances to overcome environmental challenges and achieve high-quality sound effects. It is concluded that sound reinforcement technology is not only a technical operation, but also an important part of artistic expression. In the future, with the progress of technology, it will provide better technical support for outdoor chorus.

Keywords

Sound reinforcement technology, Outdoor chorus, Acoustic environment, Audio equipment

1. The Particularity of Outdoor Choir Singing

1.1 The Complexity of Acoustic Environment

Outdoor venues often lack fixed architectural acoustic structures, and sound energy propagation exhibits typical free field characteristics. Compared to indoor environments, sound energy cannot form effective reflections through building interfaces under outdoor conditions. During the propagation process, sound is mainly direct sound, and the lack of early reflected sound can lead to a decrease in the accuracy of sound image localization. Sound energy attenuation exhibits typical distance dependent characteristics. In addition, it may also cause spectral imbalance and affect the clarity and layering of

choir performances.

1.2 Interference from Environmental Factors

Outdoor choir faces complex and ever-changing environmental factors, and meteorological conditions have a significant impact on performance preparation, expression, and sound propagation. Wind disturbance may cause spatial distribution of sound energy and phase distortion of sound waves. The changes in temperature and humidity may lead to changes in sound velocity and increased high-frequency absorption, and the electroacoustic system may experience equipment parameter drift under extreme temperature and humidity conditions. The background noise of outdoor venues (such as traffic noise, crowd noise, etc.) can also interfere with the effectiveness of choir singing.

1.3 Uneven Propagation of Sound

In outdoor environments, the propagation of sound often exhibits non-uniformity. Especially in large open spaces, the distance between the audience and the stage varies greatly, resulting in significant differences in the loudness and clarity of the sound in different areas. Viewers closer to the stage may experience excessive sound pressure levels, while those farther away from the stage may not be able to hear the details of the choir clearly. Therefore, outdoor choir needs to use sound reinforcement technology to compensate for the unevenness of sound propagation and ensure that all audiences can have a good auditory experience as much as possible.

1.4 The important Role of Sound Reinforcement System

Due to the complexity and uncertainty of outdoor environments, the role of sound reinforcement systems in outdoor choir singing is more significant. Compared with indoor choir, outdoor choir cannot rely on architectural acoustic effects and requires sound equipment to enhance the loudness and clarity of the sound. It can also adjust the tone through mixing consoles, effectors, etc., which can add dynamic effects and spatial sense to choir performances, making the music more layered and infectious, thereby enhancing the overall viewing experience of the audience.

2. Interpretation of Sound Reinforcement Technology and Outdoor Chorus

As an important component of modern audio engineering, sound reinforcement technology can amplify and propagate sound signals through electronic means. In outdoor choir performances, this technology can not only compensate for the attenuation of natural sound energy, but also adjust and modify the sound of the choir performance through a multi-channel audio processing system. The application of sound reinforcement technology can make the choir's voice clearer and more balanced in complex outdoor environments, ensuring that the audience can have a better auditory experience.

2.1 Basic Principles of Sound Reinforcement Technology

The core process of sound reinforcement technology still follows three stages: acoustic electric conversion, signal processing, and electroacoustic restoration. After the microphone completes the sound source collection, it is mixed and balanced by the mixing console, and finally the sound field coverage is achieved through the speaker system. In outdoor choir singing, the sound reinforcement

system needs to be arranged reasonably according to the size and shape of the venue to ensure that the sound can evenly cover the entire audience area. As the core equipment of the sound amplification system, the mixing console can be responsible for mixing, balancing, and processing sound signals to ensure that the sound of each voice part can be accurately presented.

2.2 The Role of Sound Reinforcement Technology in Outdoor Choir Singing

1. Sound pressure level compensation

In response to the attenuation characteristics of sound energy in open spaces, achieving sound pressure balance in different audience areas through partitioned volume control helps ensure consistency in sound perception.

2. Improve the clarity of sound

Through reasonable equipment configuration and debugging, sound reinforcement technology can reduce the interference of environmental noise, improve the clarity and hierarchy of sound, and accurately present each part of the choir.

3. Adjust the tone and sound effects

Sound amplification technology can not only enhance the volume of sound, but also adjust the tone through the effect device. In addition, the application of digital effects to construct a virtual acoustic environment can compensate for the lack of natural reflected sound in outdoor venues by adjusting reverberation parameters, enhance the spatial fusion of choir voices, and make the sound more full and three-dimensional.

2.3 The Combination of Sound Reinforcement Technology and Choir Art

The application of sound reinforcement technology in outdoor choir is not just about simple volume amplification, but also a combination of technology and art. The sound engineer needs to adjust the parameters of the sound equipment reasonably according to the artistic needs of the choir, ensuring the balance, loudness, and clarity of the sound. At the same time, the choir also needs to adapt to the application of sound reinforcement technology, adjust the singing style and voice distribution to achieve the best sound effect. For example, in large outdoor venues, choirs may need to adjust the balance of their vocal parts to ensure a coordinated ratio of bass and treble, avoiding certain parts being obscured.

3.4 Challenges and Solutions of Sound Reinforcement Technology

In outdoor choir, the main challenges faced by sound reinforcement technology include environmental noise interference, uneven sound field coverage, and system operation stability. To address these technical challenges, optimization can be achieved through the following strategies:

1. Reasonable layout of audio equipment

Based on the geometric and acoustic characteristics of the venue, optimize the spatial layout and configuration of speakers and microphones, and achieve uniform sound energy distribution in the audience area through directional control.

2. Choose professional grade sound reinforcement equipment

Adopting professional equipment with anti-interference circuit design and windproof noise structure, effectively suppressing the impact of environmental noise on the quality of audio signal transmission.

3. Real time adjustment of equipment parameters

Adjust the parameters of the audio equipment in real time according to the changes on site to maintain the stability and consistency of the sound output.

The application of sound reinforcement technology in outdoor choir has important practical significance. Through reasonable equipment configuration and technical means, sound reinforcement technology can significantly improve the performance quality of outdoor choir. With the continuous innovation of modern sound reinforcement technology, more precise environmental adaptability will be achieved in the future, creating a more immersive aesthetic experience for the audience.

3. Selection and Configuration of Audio Equipment

3.1 Selection of Audio Equipment

1. Speaker (speaker)

Speakers are the core components of sound reinforcement systems, responsible for converting electrical signals into sound energy radiation. In outdoor choir singing, the selection of speakers should consider the following factors:

(1) Power matching and coverage range: Based on the geometric dimensions of the venue and audience capacity, select speaker units with appropriate power reserves to ensure effective sound pressure level coverage of the target area.

(2) Directional characteristics and sound field uniformity: In outdoor environments, selecting speakers with good directionality can achieve precise sound energy delivery by adjusting the vertical radiation angle, reducing ineffective spatial diffusion.

(3) Environmental adaptability: The outdoor environment is constantly changing, and the protection level of the equipment casing should meet certain standards, with moisture-proof and dust-proof structural design to cope with sudden weather changes.

2. Microphone (microphone)

The microphone is used to pick up the sound signal of the choir, and its selection should be reasonably configured according to the size and voice distribution of the choir:

(1) Type selection: In outdoor choir performances, dynamic microphones are more suitable for dealing with complex outdoor conditions, especially for choir parts with large dynamic ranges, due to their high durability, resistance to environmental interference (such as wind noise), and high tolerance for high sound pressure levels; Capacitive microphones, on the other hand, are known for their high sensitivity, wide frequency response, and delicate sound quality. They can accurately capture the details and levels of human voices, but rely on phantom power supply and are more sensitive to environmental noise. They are suitable for delicate choir scenes that require stable power supply and high fidelity sound

pickup.

(2) Quantity and layout: Reasonably allocate the number of microphones according to the distribution of choir voices. Usually, each voice part is equipped with at least one microphone to ensure that the sound of each voice part can be accurately captured.

(3) Environmental noise suppression: In outdoor environments, equipping microphones with windproof covers and shock-absorbing bracket components can effectively reduce airflow noise interference.

3. Mixing Console

The mixing console is the control center of the sound amplification system, responsible for mixing, equalization, and effect processing of sound signals:

(1) Number of channels: Based on the size of the choir and the complexity of the sound system, a mixing console with sufficient number of channels should be selected to ensure that each voice and instrument can be independently controlled.

(2) Function and Effect: The mixing console should have basic functions such as equalizer, compressor, and reverb effects to adjust the sound quality and effects.

(3) Mobile adaptation design: In outdoor activities, the mixing console should have a certain degree of portability, convenient for transportation and on-site installation.

4. Power amplifier (power amplifier)

An amplifier is used to amplify the low-power signal output from the mixing console and drive the speakers to produce sound

(1) Impedance matching: The rated impedance of the amplifier should maintain a reasonable matching range with the nominal value of the speaker.

(2) Stability: In outdoor environments, power amplifiers should have good heat dissipation and stability to ensure long-term reliability.

5. Audio Effects Processor

The audio effect processor is used to further optimize the sound and improve the sound quality:

(1) Reverberation effect device: used to simulate the acoustic effects of indoor environments, making the sound fuller and more three-dimensional.

(2) Equalizer: Used to adjust the frequency response of sound to ensure balance among different parts.

(3) Feedback suppressor: used to prevent the occurrence of whistling (feedback) phenomenon and ensure the clarity of sound.

3.2 Configuration of Audio Equipment

1. Speaker layout plan

The layout of speakers should be designed reasonably according to the shape of the venue and the distribution of the audience:

(1) Main sound reinforcement array: usually symmetrically arranged on both sides of the performance area, with the radiation axis pointing towards the center of the audience seat to ensure that the sound can cover most of the audience.

(2) Auxiliary sound compensation unit: In large venues, delayed sound compensation speakers can be installed in the middle and rear of the audience area to compensate for the natural attenuation of sound energy.

(3) Stage monitoring system: configurable multi zone adjustable feedback system, providing sound monitoring for performance teams.

2. Principles for microphone layout

The layout of the microphone should be reasonably configured according to the distribution of vocal parts in the choir:

(1) Main microphone: used to capture the overall choir sound, usually placed in front of the choir.

(2) Voice part microphone: Each voice part is equipped with a separate microphone to ensure that the sound of each voice part can be accurately captured.

(3) Solo microphone: If there is a solo section, a separate microphone must be configured for the soloist.

3. Configuration of mixing console and amplifier

The mixing console should be placed in the monitoring area on the side of the stage, in the center or behind the audience seat, to ensure that the sound engineer can clearly monitor the live sound field and observe the situation in real time. The amplifier equipment can be installed near the mixing console or speaker group to shorten the signal transmission path.

3.3 Precautions for Equipment Configuration

1. Equipment compatibility

Ensure compatibility between all audio equipment to avoid sound effects issues caused by equipment mismatch.

2. Power and Cable Management

In outdoor activities, power supply and cable management are key. Ensure stable power supply, reasonable cable layout, and avoid interruptions caused by power issues or cable failures.

3. Environmental adaptability

The outdoor environment is constantly changing, and audio equipment should have certain waterproof, dustproof, and anti-interference capabilities to ensure stable operation in various environments.

The selection and configuration of audio equipment for outdoor choir activities are important factors in ensuring sound quality. By selecting speakers, microphones, mixing consoles and other equipment reasonably, and conducting scientific layout and debugging, the sound performance of outdoor choir can be effectively improved, bringing high-quality auditory experience to the audience. Meanwhile, the stability and environmental adaptability of the equipment are also important factors that cannot be ignored and need to be fully considered during the configuration process.

4. On Site Operation and Debugging of Sound Reinforcement Equipment

In outdoor choir activities, on-site control and debugging of sound reinforcement equipment is a key step in ensuring sound quality. Due to the complexity and uncertainty of outdoor environments, sound engineers need to adjust equipment parameters in real time according to the on-site situation to ensure the clarity, balance, and stability of sound. The following is a detailed analysis of on-site operation and debugging of sound reinforcement equipment in outdoor choir activities:

4.1 Basic Principles of on-site Operation and Debugging

1. Real time monitoring and dynamic adjustment

The sound engineer needs to monitor the mixed signal in real time and adjust the equipment parameters according to the changes on site. Through headphones or monitoring speakers, sound engineers should assess the quality of the sound, promptly identify issues, and make adjustments.

2. Spectrum balance and voice balance

In choir singing, the sound engineer needs to ensure the balance and hierarchy of each voice part. By using an equalizer, the sound engineer can balance the volume of each voice part, avoiding certain voices from being obscured or overly prominent. Multiple parametric equalizers can also be used to finely compensate for the frequency of each voice part, such as enhancing the fundamental frequency band of the bass voice part and moderately attenuating the high-frequency tooth frequency band of the soprano voice part.

3. Clarity and loudness adjustment

In outdoor environments, sound is easily disturbed by external factors. Sound engineers need to adjust the gain of the microphone and the volume of the speaker to ensure the clarity and loudness of the sound, so that the audience can hear every detail of the choir clearly. Dynamic range control can also be achieved through compressors to ensure that strong voice parts are not overloaded and weak voice parts are not distorted, maintaining overall loudness consistency.

4. Prevent acoustic feedback (whistling)

Sound feedback (whistling) is a common problem in sound reinforcement systems. Sound engineers need to set the positions of microphones and speakers reasonably, while avoiding signal transmission errors and preventing the occurrence of whistling.

4.2 Specific Steps for on-site Operation and Debugging

1. System initialization calibration

Before the event begins, the sound engineer needs to inspect all equipment to ensure that it is working properly.

2. Microphone debugging

(1) Gain architecture optimization: Sound engineers need to set the gain of each microphone reasonably based on the actual sound signal. First, set the microphone preamplifier to the optimal signal-to-noise ratio, and then balance the mixing ratio through channel multipliers.

(2) Directional adaptation: Adjust the polarity mode of the microphone according to the position of the voice part. For dense voice parts, use a supercardioid direction, while for dispersed voice parts, use a wide heart-shaped direction.

3. Debugging of Speakers

The sound engineer needs to adjust the volume and directionality of the main and auxiliary speakers according to the size of the venue and the distribution of the audience, ensuring that the sound can evenly cover the entire audience area. The real-time analyzer (RTA) can be used to detect the frequency response curve of the audience area, adjust the tilt angle and delay parameters of the speaker array. The gradient volume attenuation strategy can be used for the main sound amplification area and the delayed supplementary sound area to achieve a smooth transition of sound pressure level.

4. Application of effectors

(1) Reverberation effect: By using a reverberation effect device, simulate the acoustic effect of indoor environment, making the sound more full and three-dimensional. The parameters of the reverberator should be adjusted according to the acoustic characteristics of the site to avoid excessive reverberation causing sound blur. The reverberation time should be controlled within an appropriate range to maintain a balance between sound clarity and spatial perception

(2) Dynamic processor: Compressors and limiters can be used to control the dynamic range of sound, avoiding excessive or insufficient volume and ensuring sound stability. But it is necessary to adjust the parameters reasonably and preserve the dynamic performance of the music.

4.3 Debugging Strategies for Addressing Environmental Factors

1. Wind noise suppression

Wind noise is a common issue in outdoor environments. Sound engineers can reduce wind noise interference by taking the following measures:

Equip the microphone with a windproof cover to reduce the capture of wind noise; Adjust the position of the microphone to avoid direct exposure to the wind.

2. Temperature and humidity compensation

Changes in temperature and humidity may cause fluctuations in the performance of audio equipment. In special circumstances, sound engineers need to preheat, heat, and dissipate equipment in advance to ensure stability during the activity.

3. Background management

The background noise of outdoor venues (such as traffic noise, crowd noise, etc.) can affect the performance effect of choir. Sound engineers can reduce noise interference by taking the following measures:

Use highly directional microphones to reduce the capture of background noise; Reduce the gain of noise frequency bands through the equalizer of the mixing console; Adaptive noise reduction can also be achieved by analyzing and locking the characteristic frequency bands of interference noise, and applying dynamic equalizers.

4.4 Common Problems and Solutions in Debugging

1. Wave clipping distortion phenomenon

Common reasons: The input signal exceeds the linear operating range of the device, which is commonly caused by high pre gain of the microphone or impedance mismatch of the power amplifier load.

Solution: Refactor the gain architecture and follow the principle of "fixed noise floor for the front-end gain and balanced control for the back-end thruster"; Insert a compressor or limiter, set appropriate thresholds and startup times, and maintain dynamic integrity; Replace equipment with appropriate specifications and parameters.

2. Excessive echo or reverb sound

Common reasons: The acoustic characteristics of the venue result in excessive sound reflection or incorrect parameter settings of the effects device.

Solution: Adjust the parameters of the effector; Adjust the position of the speaker; Install mobile sound absorbers on the main reflective surface.

3. Unbalanced voice parts

Common reasons: The volume of different voices is too high or too low. The frequency spectrum overlap between voice parts is too high, and the dynamic range is not controlled.

Solution: Multi band dynamic equalization, implementing dynamic enhancement for easily masked mid low frequency parts (such as bass); Sound image localization control, using stereo technology to place different voice parts in specific positions in the virtual sound field; Implement evasion processing for the lead singer as the trigger source; Frequency band separation, dividing the dominant frequency band of voice parts through cross filtering, etc.

The precise control of the sound reinforcement system in outdoor choir requires the establishment of a systematic debugging process: in the early stage, the sound propagation characteristics of the venue are analyzed through on-site testing, in the middle stage, audio processing technology is used to optimize the sound effect targetedly, and finally, real-time monitoring is carried out during the performance and flexible adjustments are made according to the on-site situation. Although modern smart devices have achieved parameter adaptive adjustment, artistic fine-tuning still requires sound engineers to combine subjective listening experience and achieve the best balance between technical specifications and aesthetic expression.

5. Addressing the Challenges Posed by Environmental Factors

The environmental factors faced by outdoor choir activities are complex and varied, including wind, rain, temperature, humidity, background noise, etc. These factors not only affect the performance of audio equipment, but also have adverse effects on the propagation of sound and the auditory experience of the audience. In order to ensure the smooth progress of outdoor choir activities, effective measures must be taken to address the challenges posed by these environmental factors. The following are

specific coping strategies:

5.1 Dealing with the Impact of Wind

1. Use windproof equipment

Equipping the microphone with a professional windproof cover can effectively reduce the interference of wind noise and ensure the clarity of the sound.

2. Adjust the device position

Microphone position: Place the microphone in a leeward position to avoid direct wind and reduce the capture of wind noise.

Speaker position: Adjust the angle and height of the speaker to ensure that the direction of sound propagation is not affected by wind.

3. Use directional microphones

Choosing a microphone with strong directionality (such as a heart-shaped directional microphone) can reduce the pickup of wind noise and enhance the pickup of choir sounds.

5.2 Dealing with the Impact of Rain

1. Waterproof equipment

Choose audio equipment with certain waterproof performance to ensure normal operation even in rainy weather. Build waterproof covers or tents for audio equipment to prevent rainwater from directly contacting the equipment.

2. Equipment protection

Protect cables with waterproof tape or conduit to prevent rainwater from seeping in and causing short circuits or equipment damage. Replace copper cables with fiber optic transmission and install surge protectors.

3. Emergency plan

Develop an emergency plan for rainy days before the event, such as preparing backup equipment, building temporary shelters, etc., to ensure that the event can still proceed smoothly on rainy days.

5.3 Dealing with the Effects of Temperature and Humidity

1. Special temperature

In extremely hot and cold weather or situations with large temperature differences, avoid equipment overheating and sudden cooling and heating. If necessary, preheat the machine in advance and use insulation boxes for transportation to transition temperature differences.

2. Equipment heat dissipation

Provide good heat dissipation conditions for amplifiers, mixing consoles, and other equipment to avoid performance degradation or damage caused by high temperatures. Reasonably arrange the spacing between equipment, ensure air circulation, and avoid equipment overheating. The ventilation and temperature of the working environment need to be controlled.

3. Humidity control

In high humidity environments, use moisture-proof measures such as moisture-proof boxes or

desiccants to protect equipment from moisture. Regularly check the connection wires and interfaces of the equipment to prevent poor contact caused by humidity.

According to changes in temperature and humidity, device parameters can be adjusted in real-time to ensure sound stability.

5.4 Dealing with Interference from Background Noise

1. Choose a low-noise venue

Try to choose a site that is far away from traffic arteries, construction sites, and other noise sources to reduce the interference of background noise.

2. Use directional microphones

Choosing a microphone with strong directionality can reduce the capture of background noise and enhance the pickup of choir sounds.

3. Noise reduction technology

Equalizer adjustment: By using the equalizer on the mixing console, the gain of the noise frequency band is reduced and the impact of background noise is minimized.

Noise Gate: Using noise gate technology to shield sounds below a set threshold and reduce background noise interference.

4. Speaker layout

Reasonably arrange speakers to ensure that sound can cover the audience area while reducing the propagation of sound to noise sources.

5.5 Addressing the Challenges Posed by the Acoustic Characteristics of the Site

1. Equalizer adjustment

Adjust the frequency response of the sound through the equalizer on the mixing console to ensure clarity and depth of the sound.

2. Reverberation effect device

Simulate the acoustic effects of indoor environments using a reverberation effect device to make the sound fuller and more three-dimensional, but avoid excessive reverberation that can cause the sound to become blurry.

5.6 Challenges in Responding to Unexpected Events

1. Backup equipment

Prepare backup audio equipment (such as microphones, speakers, mixing consoles, etc.) to ensure timely replacement in case of equipment failure.

2. Emergency plan

Develop detailed emergency plans, including measures for handling equipment failures, sudden weather changes, and other situations, to ensure the smooth progress of activities.

3. Technical Support Team

Establish a professional technical support team responsible for the installation, debugging, and maintenance of equipment to ensure stable operation during the activity process.

The environmental factors faced by outdoor choir activities are complex and varied, but these challenges can be effectively overcome through reasonable equipment selection, scientific debugging, and effective response measures. Every measure, from windproof and waterproof to noise reduction and heat dissipation, is crucial. Only with sufficient preparation and scientific response can the sound quality of outdoor choir activities and the auditory experience of the audience be ensured, bringing an artistic feast to the audience.

6. The Development Trend of Modern Sound Amplification Technology

With the continuous advancement of technology, current sound reinforcement technology is advancing towards precision and adaptability through the integration of intelligent perception and digital technology. Technological innovation not only ensures sound quality, but also simplifies equipment operation, enhances system stability and adaptability. The following are the development trends of modern sound reinforcement technology in outdoor choir singing:

6.1 Intelligent Control System

1. Automatic tuning technology

Modern sound reinforcement systems are gradually introducing artificial intelligence (AI) technology, which can perceive real-time changes in sound signal parameters and dynamically adjust volume and tone balance through built-in algorithms. For example, the system can automatically compensate for the identified mid to high frequency loss and maintain the brightness of the choir voice.

2. Feedback suppression optimization

Traditional feedback suppressors require manual adjustment, while the new generation of intelligent systems can quickly identify and eliminate howling signals, avoiding the damage to sound quality caused by traditional technology during the processing, ensuring the clarity of the sound, and reducing the workload of sound engineers.

3. Dynamic adaptation of sound field

By analyzing the acoustic characteristics of the site, the system can automatically optimize the working mode of the speaker group. If the sound pressure on both sides is automatically enhanced in the fan-shaped audience area, the sound and image clarity of the rear audience will be similar to that of the front row.

6.2 Digital Sound Reinforcement Technology

1. Digitization of the entire chain

Digital signal processing technology is widely used in modern sound reinforcement systems. The full process of digital processing from sound pickup to amplification ensures the complete preservation of sound details. Digital mixing consoles have replaced traditional analog mixing consoles with higher flexibility and functionality. The digital mixing console can not only store and call preset parameters, but also be remotely controlled through the network, greatly simplifying the operation process for sound engineers.

2. Wireless system innovation

The popularization of wireless transmission technology has made the layout of audio equipment more flexible. By using wireless microphones and speakers, sound engineers can break free from the limitations of cables, flexibly adjust equipment positions according to on-site needs, and enhance the adaptability and convenience of the system. The breakthrough of wireless devices in transmission stability and anti-interference ability allows singers to move freely without being bound by cables. Distributed wireless speaker networking technology supports rapid construction of sound field coverage in special venues.

3. Remote collaborative control

A remote monitoring system based on a network platform allows multiple engineers to synchronously adjust the sound field parameters in different areas. This technology can ensure even distribution of sound pressure in areas with tens of thousands of spectators during large-scale outdoor music festivals.

6.3 Networked Sound Reinforcement System

1. Networked control and management

Modern sound reinforcement systems are gradually developing towards networking, achieving interconnectivity between devices through Ethernet or wireless networks. Sound engineers can remotely monitor and control the sound reinforcement system through computers or mobile devices, adjust equipment parameters in real time, and improve the convenience and efficiency of operation.

2. Elastic sound field deployment

Adopting a modular distributed architecture, it supports flexible configuration of speaker nodes based on site characteristics. Connect multiple speaker nodes through the network to form a unified sound reinforcement network. Each node can independently adjust the volume and other parameters as needed to ensure a uniform distribution of sound throughout the entire venue. For example, in ancient architectural sites, uniform coverage of sound energy can be achieved through concealed node layout.

3. Cloud storage and sharing

Modern sound reinforcement systems support cloud storage and sharing functions. Sound engineers can store tuning parameters and presets in the cloud, making it easy to quickly call and share between different venues and devices, while ensuring the continuity of artistic style and reducing on-site debugging time. Improve work efficiency.

6.4 Improvement of Sound Quality

1. Detail restoration technology

By improving signal sampling accuracy and transmission bandwidth, new audio technologies can capture and restore more sound details, enhancing overall sound quality.

2. Stereo and surround sound technology

Adopting multi-dimensional sound field design and creating a three-dimensional listening experience through sound image localization technology. By using a multi-channel speaker system, a three-dimensional sound effect is created, allowing the audience to feel the spatial and hierarchical

sense of the sound. This technology has broad application prospects in large-scale outdoor choir activities. Immersive sound technology uses surround sound and spatial sound field processing to make the audience feel as if they are in a choir, providing a more stunning auditory experience.

3. Environmental integration technology

Intelligent analysis of the background noise spectrum of the venue, dynamically adjusting the frequency response curve of the sound reinforcement system. For example, in noisy environments such as squares, it can enhance the penetration power in the mid frequency range without disrupting the overall sound balance, ensuring the clarity and comprehensibility of the sound.

6.5 Integrated and Modular Design

1. Integrated system

Modern sound reinforcement systems are gradually developing towards integration, integrating equipment such as mixing consoles, amplifiers, and effectors into one system, simplifying equipment layout and operation processes, and improving system stability and reliability.

2. Modular design

Modular design allows the sound reinforcement system to be flexibly configured and expanded according to actual needs. Scalable architecture provides flexible configuration solutions from portable single box systems to multi cabinet arrays. Sound engineers can flexibly choose different combinations based on the size of the venue and the scale of the choir; For specific scenarios, different modules can be quickly loaded to enhance the adaptability and cost-effectiveness of the system.

The application of modern sound reinforcement technology in outdoor choir is developing towards intelligence, digitization, networking, and other directions. These new technologies not only improve the quality of sound signals, but also simplify device operation, enhance system stability and adaptability. In the future, with the further development of artificial intelligence, big data, and the Internet of Things technology, sound reinforcement technology will become more intelligent and personalized, providing better technical support for outdoor choir activities and bringing audiences a more stunning artistic experience.

7. Outdoor Choral Practice Case

Taking the outdoor practice singing of the choir of Nanchong Film Industry Vocational College in the spring of 2025 as an example, the performance venue was selected as the courtyard square on the first floor of the No.11 circular teaching building on campus. The venue has a closed circular structure, surrounded by teaching buildings forming acoustic reflection surfaces, providing a unique spatial resonance effect for choir singing. The choir adopts a "square circular" standing position - nearly 60 students surround the central piano accompaniment and conductor arrangement, forming a layout of concentric radiation in the sound field.

Based on the characteristics of the venue, utilizing the existing equipment in the school, the sound reinforcement system adopts the strategies of "light intervention" and "precise sound supplementation".

The main sound amplification system uses a speaker LA110 full frequency line array combined with a 110S low-frequency expansion unit, placed in the middle floor circular corridor, covering the main audience area through a preset downward tilt angle, and using the vertical directionality of the line array to control the concentrated sound energy. The supplementary sound system uses ZSOUND M12 feedback speakers to be discreetly deployed near the audience area, combined with the main amplification system to form a uniform sound field coverage. The delay function of the MIDAS M32 digital mixing console is used to calibrate the sound image localization. Signal processing integrates all audio sources through the MIDAS DL32 interface box, relying on the multi segment dynamic equalization optimization frequency response characteristics of the M32 mixing console to achieve low distortion transmission in the system.

In the design of the pickup system, the choir part adopts SHURE SLXD24/SM58 digital wireless microphone combination, which can be flexibly set according to the distribution of parts, and the vocal group feeling can be uniformly controlled through the mixing console grouping control. The piano sound source is achieved through two Newman KM184 heart-shaped condenser microphones, which are installed diagonally above the piano resonator plate in a near-field pickup manner to accurately capture the dynamics and overtones of the piano keys.

The sound field control is carried out through layered reverberation processing, and the built-in effect device in the mixing console loads reverberation for the piano and low voice parts to enhance the sense of space, while retaining the natural environmental reflection characteristics of the mid to high frequency parts. In terms of dynamic balance control, selective compression processing is implemented for the male bass section, and progressive gain control is adopted for the female treble section to maintain dynamic balance between sections.

When performing the adapted work "The World Gave Me", the technical team achieved triple artistic expression through equipment collaboration: the precise coverage of the sound line array makes the choir sound field present centripetal cohesion, and the M12 sound supplement speaker effectively fills the weak areas of sound energy; The KM184 microphone captures piano overtones delicately and combines with the natural reverberation of the circular field to create a three-dimensional spatial wrapping effect; The dynamic processing of the MIDAS mixing console creates distinct layers for each voice part, with warm vocals and clear piano sounds naturally blending in the architectural reflection surface.

This case study verifies the feasibility of optimizing building acoustic characteristics through line array angle control, balancing the relationship between electroacoustic enhancement and natural sound field through layered reverberation strategy, and balancing operational flexibility and sound quality restoration through wireless microphone and condenser microphone combination in a semi open venue through the organic integration of equipment and technology. It provides a practical paradigm of "adapting building acoustics to equipment characteristics" for sound reinforcement design in similar venues, achieving maximum artistic expression under limited equipment conditions.

8. Summary

Through the practical application and exploration of sound reinforcement technology in outdoor choir, combined with the actual case of Nanchong Film Industry Vocational College Chorus performing outdoors in the spring of 2025, we can draw the following conclusions:

8.1 The Importance of Sound Reinforcement Technology in Outdoor Chorus

Outdoor choir activities face complex and ever-changing environments, and sound amplification technology is not only a tool for amplifying sound, but also a key factor in ensuring sound clarity, balance, and spatial sense. The performance case of the choir of Nanchong Film Industry Vocational College shows that reasonable sound reinforcement system design and debugging can effectively compensate for the shortcomings of outdoor acoustic environment and enhance the auditory experience of the audience.

8.2 The Scientificity of Equipment Selection and Configuration

In the performance at Nanchong Film Industry Vocational College, professional equipment such as the Shengyang LA110 line array speaker, ZSOUND M12 feedback speaker, and MIDAS M32 digital mixing console were selected, and precise layout was carried out based on the characteristics of the venue, successfully achieving uniform sound coverage and optimized sound image localization. This case demonstrates that the selection and configuration of equipment must be combined with the acoustic characteristics of the venue and the actual needs of the choir in order to achieve optimal results.

8.3 Balance between on-site Debugging and Artistic Expression

During the performance, the sound engineer ensured the balance and hierarchy of each voice part through real-time monitoring and dynamic adjustment. Especially in the performance of "The World Gave Me", the perfect fusion of human voice and piano sound was successfully achieved through layered reverberation processing and dynamic balance control, demonstrating the organic combination of technology and art. This process demonstrates that the application of sound reinforcement technology is not only a technical operation, but also a part of artistic expression.

8.4 Flexibility in Responding to Environmental Factors

Outdoor choir activities are inevitably affected by environmental factors such as wind, rain, temperature, and humidity. In the case of Nanchong Film Industry Vocational College, the acoustic challenge of a semi open venue was successfully addressed through reasonable equipment layout and debugging strategies. This indicates that in outdoor environments, the design and debugging of sound reinforcement systems must have a high degree of flexibility and adaptability to cope with various unexpected situations.

8.5 The Development Trend of Modern Sound Amplification Technology

With the continuous development of intelligent, digital, and networked technologies, the application of sound reinforcement technology in outdoor choir will become more precise and efficient. In the case of Nanchong Film Industry Vocational College, the application of digital mixing consoles and wireless

microphones demonstrates the advantages of modern sound reinforcement technology in improving sound quality and operational convenience. In the future, with the further popularization of artificial intelligence and Internet of Things technology, the sound reinforcement system will become more intelligent, able to automatically adjust parameters according to environmental changes, further improving the sound quality of outdoor choir.

In summary, the application of sound reinforcement technology in outdoor choir not only requires scientific technical support, but also needs to be closely integrated with artistic expression. The performance case of the choir of Nanchong Film Industry Vocational College provides us with a successful practical example, demonstrating how to achieve high-quality sound effects in complex outdoor environments through reasonable equipment selection, scientific debugging, and flexible response strategies. In the future, with the continuous advancement of technology, sound reinforcement technology will provide better technical support for outdoor choir activities, bringing audiences a more stunning artistic experience.

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