Audio Mixing Technology and Specific Operational Procedures: Postprint

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Abstract

Audio mixing is a critical step that optimizes and assembles tracks to ultimately form music, and the quality of mixing technology directly affects the success of musical works. With the advancement of technology in society, developments in digital signal processing, audio encoding, digital content caching, wireless technology, and related fields can satisfy consumers' diverse demands for music, thereby ushering audio mixing into a broader market for development.

Full Text

Research • Technology and Applications: Audio Mixing Technology and Specific Operation Methods

Abstract: Mixing is a critical step in optimizing and assembling tracks to ultimately form music; the quality of mixing technology directly affects the outcome of musical works. With the development of society and technology, advances in digital signal processing, audio encoding, digital content caching, and wireless technology can meet consumers' diverse demands for music, and audio mixing will usher in a broader market for development.

Keywords: digital audio; mixing; technical implementation

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From a theoretical perspective, mixing appears relatively easy to implement—simply adjusting some knobs to achieve harmony and pleasantness among all sounds. However, in actual audio mixing operations, the technical difficulty is no less than playing a musical instrument. Audio mixing technology requires

attention not only to the music itself but also to environmental factors affecting sound. It demands the ability to discern the sound represented by each instrument, understand the acoustic spatial positioning of various musical elements, and ensure balanced frequency response across all frequencies. Therefore, this article explores the design and application of digital audio mixing technology.

1.1 Connotation

Digital audio is a technical form that uses digital means to record, store, edit, compress, and playback sound. With the deepening development of digital signal processing technology, computer technology, and multimedia technology, digital audio technology has been further developed and perfected, becoming a novel sound processing technique. The primary application fields of digital audio are music post-production and music recording. Digital audio stores data in computer form as 0s and 1s. In specific operations, audio files are first converted, then these electrical level signals are transformed into binary form for data storage. During playback, these data are converted back into analog electrical level signals and subsequently output through speakers.

1.2 Related Knowledge

Knowledge related to digital audio includes the following: First, sampling rate. The sampling rate primarily records sound exceeding 1 ms in length through waveform sampling. Generally, the higher the sampling rate, the better the final sound quality obtained. Second, compression ratio. The compression ratio typically refers to the ratio between music files before and after compression, effectively describing the compression efficiency of digital audio. Third, bit rate. Bit rate is an important evaluation metric for digital music compression efficiency, mainly used to represent and record the average number of bits required per second for audio data recording, with 1024 bits per second generally serving as the basic unit.

1.3 Principle

For multi-channel audio mixing systems, mixing operations require combining audio data information from various points within a certain time domain range. When the sampling rates of all signals remain consistent, mixing can achieve superposition of various signal sampling data. After superposition, the mixed audio stream is sent to the playback device's driver buffer for playback. The mixed audio data exhibits linear superposition; therefore, data[j][i] can be used to represent the ith linear sample value of the jth continuous audio stream, that is, sound source j. The ith linear sample value of the mixed audio stream should be as shown in (1). Formula (1) is an important foundation for mixing algorithm calculations. Considering that the number of audio channels participating in mixing changes dynamically, operators need to consider the value range problem of the linear sample Data[i] of the obtained audio stream after mixing. The dif-

ficulty of this calculation operation lies in how to properly handle the sampling overflow problem after mixing.

$$myData[i] = \sum_{j=0}^{m-1} data[j][i], \quad i = 0, 1, \ldots, n-1$$

2 Common Audio Mixing Methods

First, the sum-and-clamp method. When the mixed audio intensity exceeds the range of the buffer area data type, it is replaced with the maximum value. The application of this algorithm causes artificial clipping of the speech waveform, which not only damages the audio signal but also generates significant noise. Second, the average time-domain superposition method. This method primarily obtains the average value after linear superposition of sampling data. The essence of this algorithm is to reduce the volume of various audio sources, causing substantial changes in sound when audio increases or decreases, thereby affecting sound quality. Although the average time-domain superposition method is relatively simple to operate, its mixing effect is poor. After mixing, various audio sources experience significant attenuation, and the low volume is not conducive to real-time communication. Third, the self-aligning weight mixing algorithm. This algorithm mainly considers the characteristics of mixing audio channels, using their own proportions as basic measurement factors to determine the output proportion after sound synthesis through comprehensive evaluation. Audio channels under this algorithm are relatively clear.

The algorithms analyzed above each have their own characteristics, but they also have their respective defects in application. With the in-depth development of mixing, the application of different mixing algorithms causes the volume of each audio stream to scale due to weight changes, thereby exacerbating mixing instability. To solve this problem, relevant personnel need to find a weight not associated with the number of audio channels to improve the audio mixing algorithm, prepare for audio mixing technical processing, and enhance the application effect of audio mixing technology through methods such as noise reduction, equalization, reverb, and compression.

3 Strategies for Improving Audio Mixing Technology

3.1 Proper Track Organization

Track organization has a crucial impact on subsequent audio mixing processing. To this end, relevant personnel should properly organize tracks from the following aspects: First, fixing breaths. Vocals or musical sounds in actual recording can be formed through splicing many segments, requiring effective measures to strengthen the connection between small audio segments. Among various sounds, the human voice is the most prominent, and inserted recordings

often appear in vocal processing. However, due to inconsistent breathing fluctuations of singers, interfering sounds sometimes occur. In such cases, personnel need to select appropriate breaths as connections between sounds, controlling the size and length of breaths according to actual conditions. Some fade-in and fade-out effects can be used for adjustment. To judge whether vocals are good, one can combine vocals with music, then close eyes and pretend to be singing the song, feeling the coordination of breaths and vocals. If the vocals sound coordinated when listening and humming along, the track organization is successful. Second, fixing pitch. This mainly uses AUTO-TONE to repair pitch, compensating for singers' pitch deficiencies. Currently, AUTO-TONE pitch correction has two methods: automatic repair and manual repair. First, select the audio and open AUTO-TONE in the PROTOOLS audio suite; second, adjust the selected AUTO-TONE mode, setting the precision parameter to 50. Finally, carefully adjust by repeatedly listening to and modifying the pitch curve. Third, deleting blanks. Considering that within the computer, any part displayed in the waveform window will be read even without an audio hard disk, wasting unnecessary system resources when there is no sound. Therefore, measures should be taken to delete blank sections.

3.2 Noise Reduction Technology

When conditions and equipment permit, noise should be prevented from the aspects of equipment and recording environment. Taking Z-Noise as an example for specific noise reduction operations: First, open Z-Noise for noise sampling, obtaining a segment of noise from the vocal track as a no-voice segment and loop it. Second, in Z-Noise, press the spacebar to play, stop after 5 ms, and a white curve will appear on the interface (noise sampling graph). Finally, without damaging the vocals, push the fader to the maximum noise reduction position, click the button to listen whether the noise contains vocals. Repeat this process multiple times to complete the operation.

3.3 Equalization Technology

Equalization technology primarily uses equalizers to adjust high, mid, and low frequency bands to compensate for speakers and modify vocal timbre deficiencies. When applying EQ, vocals should not be distorted, and human timbre should be adjusted appropriately.

3.4 Reverb

Reverb is a crucial step in song recording and processing. Adjusting the reverb unit can add spatial sense, rhythmic sense, and echo sense to songs. Different songs have different requirements for reverb.

4 Practical Application Considerations

4.1 Strengthening Level Monitoring

Excessively loud music causes ear fatigue, while lower mixing levels keep ears in a relatively sensitive state, preventing excessive fatigue. Generally, higher mixing levels can be stimulating, but this condition is not conducive to perceiving subtle changes in levels. Currently, many music studios have noise problems, so headphones are needed when listening to mixes. Although headphones can capture subtle details that are not easily detected, making them a good choice for mixing that preserves details in musical works, digital audio mixing technology should use headphones to check mixing results rather than to perform mixing operations.

4.2 Optimizing MIDI Sound Sources

Optimizing MIDI sound sources first requires optimizing the sound within MIDI instruments. To make the music sound brighter, one can increase the cutoff frequency of the timbre low-pass filter in electronic instruments. Second, when using electronic instruments, it is necessary to maintain maximum output volume at all times to obtain more dynamic volume levels. When conditions permit, levels can be adjusted on the mixing console. On special occasions, MIDI controller message number 7 can be used to change the synthesizer's output level, always ensuring the maximization of the synthesizer track's volume value.

4.3 Establishing Relative Level Balance Between Tracks

In digital audio mixing operations, one should not rush to enhance mixing effects but rather take measures to ensure balance among various track sounds, guaranteeing sound quality when all tracks are combined. When listening to the overall sound, the system should be promptly switched to mono. In this process, if each track is recorded clearly, the integration of various sounds in mono is more distinct than in stereo. Additionally, applying equalizers can highlight the characteristics of different instruments, balancing various sounds overall. First, it is necessary to strengthen the processing of important factors in music creation, bonding the sounds of different musical elements together. Second, strengthen the processing of other parts in the tracks. Generally, adjusting a certain frequency of one instrument will weaken the sound of other tracks. Therefore, during operation, the frequency band where vocals reside should be gradually reduced in other instruments rather than blindly using equalizers to boost vocals.

Conclusion

In summary, based on the elaboration of digital audio, this article analyzes audio mixing methods and proposes corresponding improvement strategies. On the foundation of preparing for audio mixing technical processing, it enhances

the application effect of audio mixing technology through methods such as noise reduction, equalization, reverb, and compression. Simultaneously, it proposes a digital audio improvement technical strategy aimed at enhancing digital mixing effects.

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