

An exploration of the application of psychoacoustics to sound recording

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Abstract: At present, psychoacoustics mainly studies the relationship between human and sound in subjective hearing perception, which is one of the important construction contents of modern acoustics. With the continuous updating and upgrading of recording technology, psychoacoustics has been widely used in the field of recording, and more and more people begin to study how to effectively apply psychoacoustics to recording, and promote the sustainable development of the field of recording. In this regard, this paper explores the application of psychoacoustics in recording, in order to provide some references for relevant researchers.

Key words: Psychoacoustics; Recording; Application; Explore; Recording techniques; Recording art

Psychoacoustics is the study of the interrelationship between sound and the human mind. In the field of sound recording, psychoacoustics helps us to better understand the listener's feelings, so that we can adjust recording techniques and audio processing to achieve a better hearing experience. Through the application of psychoacoustics, recording creators can better grasp the perceptual, cognitive and emotional aspects of sound, resulting in more engaging and infectious works. At the same time, it helps to solve some technical difficulties in recording, such as the balance of audio quality, sound positioning and clarity. The application of psychoacoustics in recording is a field worthy of further study and exploration, which will have a profound impact on the development of recording technology.

I. Analysis of the relationship between psychoacoustics and recording technology

With the progress and development of China's science and technology, the scope of psychoacoustics research is also expanding. The concept of psychoacoustics covers the two main fields of psychology and acoustics, but because of their respective characteristics, it is closely related to the subjectivity of "human", and the research content is constantly changing. However, as research continues to deepen, people are gradually finding unique research methods, that is, based on the study of psychoacoustic phenomena, combined with other fields, so as to ensure greater progress at the research level.

In psychoacoustics, the general concern is the hearing threshold, masking effect, critical frequency band, hearing threshold, auditory resolution of sound pressure level changes and frequency changes, auditory orientation, loudness, timbral, auditory hallucination effect, nonlinearity, etc. Therefore, the important problem of psychoacoustics is: to judge whether there is a signal, to clarify the type and attribute of the signal, to distinguish the difference and measurement between the signals, through these three concepts can fully reflect the different characteristics of individual auditory behavior. Therefore, the study of auditory psychological phenomenon is inseparable from the physiological structure and mechanism, but also from the basic theory of psychoacoustics. At present, the application achievements of psychoacoustics are as follows:

1. The performance of psychoacoustics in audio systems

Audio coding algorithm and digital audio compression technology are all audio technologies generated by relying on psychoacoustics, and the model is of great significance to the design of audio systems. Under normal circumstances, when the source is compressed and encoded, the psychoacoustic model is first used to denoise it, and then the appropriate digital signal processor is selected to optimize the hardware system, so as to reduce the input noise to below the hearing threshold, so as to effectively improve the audio quality. The experimental and mathematical model can describe the relationship between the various elements in the auditory system. The electronic hearing analyst uses a comprehensive approach to combine psychoacoustics with different fields of study. It can combine psychoacoustics with multiple disciplines, enabling the research results to be applied to fields such as linguistics, music acoustics, and noise analysis, and as the mental model is refined, the recording quality will continue to improve.

2. The performance of psychoacoustics in replay systems

In different replay systems, different types of replay modes (speakers, headphones) are used, and the characteristics of hearing perception are significantly different. At present, the replay system at home and abroad is mainly for multi-channel surround sound technology, but in practical applications, it is often played through headphones, so as to achieve better listening effects. At present, the loudspeaker-based surround sound replay system has been widely used in cinema, home audio and other fields. When using loudspeakers to play surround sound, we should not only consider the sound performance of the playback environment (indoor sound quality), but also consider the sound characteristics generated by the loudspeaker itself during reproduction, but also be closely related to psychoacoustics and auditory aesthetics. There are obvious differences between the cinema and the home replay environment, and it is necessary to adopt a variety of technical methods to meet the playback needs in different replay environments, of which psychoacoustics is particularly important.

Digital audio watermarking technology based on quantification and auditory perception. The technology can effectively avoid the appearance of anti-counterfeiting in audio products. The application of psychoacoustic technology in audio recording is the focus of the current speech system, and further study of psychoacoustics is of great significance for realizing and reproducing the desired sound effect. Whether it is the "psychoacoustic mode" which is widely used at present, or the direct guidance of the audio system from people's sensory

psychology, finally achieve the “perfect” recording effect.

3. The performance of psychoacoustics in pickup technology

The research on stereo sound in China began in the 1990s, and psychoacoustics is still in the preliminary stage of independent research. Starting with binaural effect, the characteristics of stereo sound have been explored, but there are few related studies. This is mainly because our research in this area is still in the initial state, only stay on the basis of the introduction of foreign research results, and reflect on some research results.

With the development of surround sound in the world, after the 21st century, China has gradually transferred from stereo to surround sound technology. Under the guidance of this theory, research has been carried out on the spatial sense and surround sense generated by sound, and rich research results have been obtained in many disciplines such as physiological acoustics and hearing, which has laid a solid theoretical foundation for the study of psychoacoustics in pickup technology. The surround sound is to compensate the stereo sound environment information caused by a variety of different surround sound picking standards. Virtual environment: In the virtual environment, psychoacoustics plays a very key role. Although virtual surround sound technology can make recording simple, its impact, as well as its differences and associations with multiple channels, needs to be studied in depth. However, it is still under development and has not yet built a relatively complete system.

II. Analysis of the relationship between psychoacoustics and recording art

Recording is a technology that can create sounds with aesthetic characteristics and bring people a new aesthetic experience in hearing. Therefore, it becomes very important to study the hearing process, which is composed of physiological acoustics and psychoacoustics. At present, China’s research on the hearing process has gradually deepened, and a large number of research results have been obtained, and a more comprehensive understanding has been obtained. However, at present, there is no precise study on the specific mechanism of the interaction between different parts, especially with the participation of the brain, the nervous system and the reaction role need to be further studied. The accurate grasp of the role of psychoacoustics in the process of hearing is directly related to the quality of sound recording.

1. The application of psychoacoustics in the subjective evaluation of sound quality

The objective evaluation of sound quality requires the use of psychoacoustic theories, while the subjective evaluation requires the objective measurement of sound quality. The objective measurement should not only combine qualitative and quantitative, but also have clear parameters and quantifiable indicators. However, due to the subjectivity inherent in the evaluation itself, this will become a big obstacle. The existing qualitative evaluation methods are mainly descriptive, and the definition of adjectives is not clear, and the boundaries of each period are also fuzzy, which increases the possibility of subjects’ subjective arbitrary selection, resulting in the generation of a lot of useless data in a large number of samples, resulting in the loss of accuracy of the survey results. As a result, people began to shift their attention to the quantitative evaluation of sound quality.

The psychoacoustic parameters commonly used at home and abroad are loudness, sharpness, fluctuation (fluctuation caused by changes in low frequency) and roughness (fluctuation caused by changes in high frequency). Satisfaction factor and disturbance factor are used to describe the subjective evaluation of sound quality. The satisfaction factor is a complex sensation that is affected by basic factors such as roughness, sharpness, pitch, and volume. The interference factor represents the various psychoacoustic components of an unpleasant sound, which is influenced by loudness, sound quality, and temporal structure. The subjective evaluation of sound quality is not only closely related to the objective psychoacoustic parameters, but also has a great relationship with people’s aesthetic habits. Therefore, it is necessary to establish a set of criteria for the subjective evaluation of sound quality that is suitable for the hearing habits and aesthetic characteristics of Chinese people.

2. The application of psychoacoustics in the creation of recording art

The application of psychoacoustics in recording art is mainly reflected in experimental psychology, psychophysics and other aspects, especially the impact on human subjective feelings. Therefore, to correctly understand the artistry of recording works, we should not simply take human subjective random as the premise, otherwise it will lead to metaphysics and elusiveness. Audio recording is a form of creative expression on the basis of general laws. Therefore, in the recording process, the creator can use the psychoacoustic principle of music to make use of certain recording technology to artistic effect, which is not only applicable to the overall design of the recording work, but also applicable to the psychological expectation to produce the recording effect.

Because psychoacoustics studies people’s subjective hearing feelings, recording is mainly concentrated in the range of people’s hearing. Although digital audio sampling rates are currently tens of times higher than the maximum audibility range, little research has been done on how people differ in their auditory perception. What’s the difference? How do frequencies outside the auditory distance of the human ear affect hearing? Does the sampling rate of digital signals continue to increase? At the same time, it also introduces the results of psychoacoustic research, and makes a deep analysis of it, and the psychoacoustic phenomenon used in film and television sound effect design. In a word, at present, psychoacoustics has been widely used in recording technology, and its importance is becoming increasingly prominent.

III. The requirements of sound design of recording studio

1. Sound insulation treatment

According to the transmission path of noise, it can be divided into two categories: Noise propagation in the atmosphere and noise

propagation in buildings, because the two noise propagation paths are not the same, so the noise insulation measures taken by different noise types are also very different, but the basic processing ideas are to control the noise around the sound source, in the propagation path and in the receiving area, if conditions permit, the corresponding technical measures can be taken. Reduce the noise to a certain allowable range. Generally, noise travels at a higher rate in solid media than in the air, so vibrations coming out of the ground can have an impact on the studio. In addition, due to architectural design and structure and other factors, its sound insulation processing is often difficult to meet the limit requirements, more or less there is background noise in the recording studio. In order to fundamentally reduce the noise, the recording studio should choose to stay away from the noisy environment as much as possible, if not completely eliminate the noise, but also as far as possible away from the outdoor noise sources and vibration sources. What's more, to stop noise from outside, soundproof the walls, ceiling, and floor of the recording studio.

2. Reverberation treatment

In the recording studio, the reverberation time is closely related to the space volume, so it is necessary to calculate the area of the recording studio roof, walls, floor and so on. In addition, at the noise diffusion level, a variety of sound absorbing materials can be used in the recording studio to ensure a good sound field distribution. In addition, the recording studio ceiling should choose thin resonance acoustic structure, ultra-thin glass wool enhanced sound structure and space diffuser structure.

3. Sound quality design

In order to obtain good recording quality, the sound quality requirements of the recording studio room need to meet the relevant regulations. First of all, it should have a unique direct frequency response and the reverberation time should be short enough. Secondly, the background noise in the shed should be low enough. Finally, the sound diffusion performance should be sufficient. In addition, in order to make the sound quality in the recording studio meet the above requirements, the sound field design should focus on issues such as reverberation timing, sound insulation, vibration isolation, sound diffusion, surrounding environment and space.

In Summary:

To sum up, psychoacoustics, as a discipline that studies the process of hearing, plays an important role in the art of sound recording, such as the application of psychoacoustic parameters in the subjective evaluation of sound quality and the creation of sound recording art. At the same time, the acoustic design of the recording studio is also crucial, including sound insulation processing, reverberation processing and sound quality design. Thus, it provides a better recording environment for recording creators, records high-quality audio works, brings people a richer hearing experience, and then promotes the sustainable development of China's recording industry.

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