Postprint on the Development of Television Audio Technology in the Ultra HD Era

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Abstract

The era of ultra-high-definition television has arrived. Compared to the transformative advances in video technology, the development of audio technology has lagged somewhat behind. How to seize this rare opportunity to effectively strengthen audio technology development and improve sound quality has become a key consideration for television professionals. This paper presents an analysis based on the history and current status of audio technology development, hoping to provide some reference and suggestions for the industry' s development.

Full Text

Development of Television Audio Technology in the Ultra-HD Era

Abstract: The Ultra-HD television era has arrived. Compared to the transformations brought by video technology, audio technology development has lagged somewhat behind. How to seize this rare opportunity to substantially strengthen audio technology development and improve sound quality has become a key consideration for television professionals. This paper analyzes the history and current state of audio technology development, offering perspectives that hope to provide useful references and recommendations for industry development.

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With the rise of the internet, online media, and rapid advances in communication technology, people have increasingly diverse means of watching video content, leading to declining reliance on television sets. Helping television media break through this encirclement and attract viewers back to TV screens has become a central concern for television technology professionals. The promulgation of 4K Ultra-HD technical standards by the International Telecommunication Union (ITU) in 2012 pointed the way forward. Ultra-HD' s high-resolution technology frees viewers from small screens, enabling them to see more realistic images and finer details on increasingly large displays. 4K Ultra-HD has become a historic opportunity to deepen broadcast supply-side reform, lead new development in the radio and television industry, and win back lost audiences. 4K, 8K, and even higher-resolution Ultra-HD technologies all aim to improve picture clarity and obtain more image details and layers. The continuous advancement of digital SD and HD technologies has brought undeniable improvements in picture quality. While television video technology has effectively captured viewers' eyes, viewers' ears have not perceived comparable changes during the evolution from HD to Ultra-HD. This forces television audio professionals to reflect deeply: how can television audio technology develop in the Ultra-HD era to keep pace with video technology and firmly retain viewers?

1. History and Current Status of Television Audio Technology Development

During television' s evolution from digital SD to digital HD, the introduction of national standards recommending surround sound broadcasting could have enabled television audio to quickly upgrade from mono to stereo and then into the surround sound era, just as film audio did. However, mono production still dominates, standard two-channel stereo recording remains rare, and surround sound production is even scarcer. Although national standards require stereo for HD television broadcasting, most stations have adopted a workaround: they continue using mono for most productions, simply duplicating the mono track later to create a two-channel format that substitutes for genuine stereo with qualitatively superior sound. Today, even as major broadcasters like China Media Group begin experimenting with "3D Audio" production, few ordinary viewers have experienced 5.1 surround sound at home. Loyal viewers can only see the "surround sound production" logo on their screens during limited large-scale event broadcasts and a handful of programs, mentally filling in the surround sound effects themselves.

2. Analysis of Reasons for the Current Development Status

Film is television' s "elder brother," and television has borrowed many creative concepts and technical methods from film over the years, including audio. Film sound has evolved from mono to stereo to surround sound. The immersive experience of giant screens and powerful sound systems in cinemas has thrilled moviegoers. Television, in the Ultra-HD era, hopes to bring viewers

back through a similarly distinctive audiovisual experience, but overlooks the many differences between film and television. Compared to relatively uniform film genres, television programs are far more diverse: news, variety shows, documentaries, sports, dramas, music, etc. This diversity creates practical challenges that prevent a one-size-fits-all approach to television audio production. These factors determine the current state of TV audio technology development.

(1) Television program types are highly varied, and debates within broadcasters about whether surround sound is needed and which programs are suitable have never ceased. News programs, as the most important television content, have been a focal point of debate over surround sound development. While consensus exists that entertainment programs like dramas, documentaries, sports events, and music performances are suitable for surround sound production, there remain different perspectives on how to produce surround sound and what kind of surround sound to create.

(2) Film has dedicated viewing spaces with large areas and good acoustic environments. Film mixing studios provide consistent auditory experiences between production and consumption, and relatively long production cycles enable high-specification sound production. Television viewing conditions are completely different. While cinemas have universal acceptance standards for facilities, home environments vary dramatically. Although affordable, high-performance home theater systems are readily available today, most households lack the architectural acoustic conditions to ensure proper sound reproduction. Cinema audiences are completely passive, receiving visual and audio information in a dark theater, whereas television viewers are entirely active, free to do as they please without focusing on the screen or sound.

(3) The stark contrast between suboptimal home listening conditions and massive human/material investments in production creates a strong disconnect. Many large-scale entertainment programs broadcast in surround sound achieve good ratings, but without big data statistics, it' s impossible to determine how much of this success is attributable to 5.1 surround sound broadcasting or what share of the contribution it represents.

3.1 Allowing Some Users to Experience the Benefits of High-Quality Sound Production

The development status of television audio technology is closely related to viewers' equipment and environment. Although we cannot rapidly change audience viewing conditions single-handedly, we must first establish technical standards to guide capable viewers in configuring their equipment and environment properly. This will cultivate viewing habits through excellent audiovisual experiences, preparing for the comprehensive development of the Ultra-HD era.

As the national economy continues developing and living conditions improve,

architectural acoustic environments suitable for high-quality sound reproduction are no longer out of reach for many viewers. They hope to experience television programs with cinematic sound quality at home. Based on relevant guidelines, they can adjust their home environment and equipment to meet requirements and enjoy a completely different television experience.

Since August two years ago, relevant organizations have conducted big data surveys on audience viewing needs and home architectural conditions. Building on this research and theoretical studies of surround sound and "3D Audio," the document "Home Theater Configuration Standards Based on 4K Ultra-HD Images and Surround Sound/3D Audio" was officially released in May this year.

According to architectural acoustics requirements, a room with good listening effects has clear specifications for area and volume, requiring interior design and decoration to control sound reflection and absorption. Key technical parameters include room area, volume, length-width-height ratios, and reverberation time. Beyond these basic parameters, certain sound pressure levels are necessary for good audio experiences, but high sound pressure levels can easily disturb others. Therefore, we must ensure proper sound insulation in home viewing spaces.

These standards and specifications provide a basis for viewers with the means and desire for excellent audiovisual experiences, laying a solid foundation for television audio technology development in the Ultra-HD era. From these standards, it' s clear that Ultra-HD era television audio work extends far beyond the broadcasting industry. To help audiences perceive changes in sound production, improving source production alone is insufficient; we must start with architectural and decorative work in listening spaces to achieve multiplier effects. The broadcasting industry must collaborate with architectural design departments to formulate relevant standards, as excellent architectural acoustic conditions mark the beginning of Ultra-HD era television audio work.

3.2 Establishing Proper Audio Concepts and Continuously Improving Production Standards

Film sound has progressed from silent films through mono, stereo, surround sound to today' s immersive audio, achieving its current success through solid, incremental steps. Television audio technology must follow the same path without shortcuts, relying on time and accumulated experience. Compared to film, we have more program types and greater volume. By clarifying concepts, establishing correct audio perspectives, and engaging in deliberate, high-intensity sound production practice across diverse genres, we can rapidly improve.

Although the history and current reality of television audio technology development are less than ideal, audio professionals must maintain confidence and recognize that television technology development has never stopped. The progression from mono to stereo, from stereo to surround sound, and from surround sound to immersive audio is inevitable. We must clarify that surround sound is not mysterious—it' s simply a standard and mode of sound production and

broadcasting that provides listeners with more realistic auditory experiences.

Television surround sound differs from film. It doesn' t feature as many scenes with rapidly moving, constantly shifting sound sources like racing cars, flights, fights, or gun battles that allow ordinary audiences to easily distinguish surround sound from stereo. Television programs primarily feature static surround sound. The current primary task is to produce good surround sound for sports and variety shows. The production goal at this stage is to achieve good localization of front sound sources, excellent timbre in the front sound field, comfortable spatial sense, envelopment, and a continuous 360-degree sound field.

3.3 Improving Relevant Audio Technical Indicators to Deliver High-Quality Sound to Audiences

During analog-to-digital conversion, sampling frequency and quantization bit depth are the most critical metrics. Current television audio uses 48kHz sampling frequency and 20-bit quantization. While these represent progress compared to the 44.1kHz sampling and 16-bit quantization of standard CDs, significant room for improvement remains.

As the Ultra-HD era approaches, we must pay close attention to development trends, thoroughly understand industry conditions, and propose the most feasible technical solutions. We should aim for the high standards of film sound while fully considering China' s current national conditions. Changing television sound production formats like surround sound to universally improve perceived audio quality for TV audiences cannot be accomplished overnight. It' s a long journey requiring joint efforts across society and multiple industries.

Under these circumstances, we can start with the most fundamental and important technical indicators by increasing the sampling frequency during analog-to-digital conversion, enabling television audiences to hear a wider frequency range, lower distortion, and sound closer to analog signals. The improved listening experience from technical indicator enhancements will make audiences more anticipate further development of Ultra-HD era television audio. We should promptly upgrade the audio system from 48kHz sampling/20-bit quantization to higher multiples like 96kHz sampling/24-bit quantization, thereby achieving optimal cost-performance matching for television audio technology in the Ultra-HD era.

In summary, television audio technology in the Ultra-HD era must adapt to circumstances and act timely, working together with video technology to contribute to deepening broadcast supply-side reform and leading the development of the radio and television industry.

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