Research on Ultra High Definition Television Terrestrial Broadcasting Technology and Test System Postprint

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Abstract

This paper conducts a comprehensive analysis of the advantages of ultra-high-definition television terrestrial broadcasting technology, such as relatively wide coverage, diverse forms of information services, and high frequency efficiency, briefly introduces the significant value of properly utilizing ultra-high-definition television terrestrial broadcasting technology and test systems, and proposes specific application points and considerations that can ensure the effective application of the technology and enhance the utilization efficiency of broadcasting signal resources, aiming to provide valuable assistance and reference for relevant practitioners.

Full Text

Research on Ultra-High-Definition Television Terrestrial Broadcasting Technology and Test Systems

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Abstract: This paper provides a comprehensive analysis of the advantages of ultra-high-definition television terrestrial broadcasting technology, such as its extensive coverage, diverse forms of information services, and high frequency efficiency. It briefly introduces the important value of rationally utilizing ultra-high-definition television terrestrial broadcasting technology and test systems, and proposes specific application points and precautions for ultra-high-definition television terrestrial broadcasting technology and test systems to ensure its proper application and improve the utilization rate of broadcasting signal resources, aiming to provide valuable assistance and reference for relevant practitioners.

Keywords: Ultra-high-definition television; Terrestrial broadcasting technology; Broadcasting signal resources; Test system

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Introduction

With China's comprehensive socioeconomic progress and development, the quality of life for the masses has effectively improved, and information acquisition methods have become increasingly diversified. To further meet residents' actual production and living needs, the broadcasting industry needs to actively adopt advanced television technologies. Ultra-high-definition television terrestrial broadcasting technology has become a commonly used signal transmission method in the current stage due to its low cost, ability to fully achieve mobile reception objectives, minimal susceptibility to external factors, and prominent anti-interference performance.[2] This technology can achieve rapid reception and processing of wireless television signals. For the vast audience, by utilizing signal reception devices and receiving antennas, various types of television program information can be quickly received, thereby better improving television program playback effects. Additionally, because this technology possesses strong anti-interference capabilities, it can prevent signal data loss during wireless signal transmission.

2.2 Diverse Forms of Information Services

The rational application of ultra-high-definition television terrestrial broadcasting technology can solve the problem of being unable to watch programs after signal transmission is completed. Simultaneously, due to the effective extension and application of this technology, current ultra-high-definition television can achieve on-demand playback of various programs, allowing audience users to freely play their preferred television programs according to their specific needs. Ultra-high-definition television terrestrial broadcasting technology is not susceptible to external signal interference, which can significantly improve audience satisfaction.[3] Applying terrestrial broadcasting technology to ultra-high-definition television can ensure comprehensive expansion of its functions and continuously broaden its scope of application. By creating a television model that integrates comprehensive information, leisure, entertainment, and learning, it can provide more services to millions of households and better meet the specific needs of the broad audience.

2.3 High Frequency Efficiency

In the current period, although wireless spectrum resources are being well utilized, to some extent, wireless frequency resources still remain idle. By employing ultra-high-definition television terrestrial broadcasting technology, wireless spectrum resources can be efficiently utilized, further improving television spectrum efficiency. If television stations or relevant operating departments can fully utilize existing television channels, they can ensure the gradual expansion of the application scope of ultra-high-definition television terrestrial broadcasting technology, making the application methods of this technology more sophisticated. This can not only significantly improve spectrum efficiency but also reduce resource idleness and enhance the comprehensive utilization efficiency of spectrum resources.[4]

3.1.1 Rational Selection of Transmission Antennas

Spatial radiation of electromagnetic waves is a core functional indicator for measuring transmission antennas. In the process of transmission and radiation, transmission antennas occupy a crucial position; therefore, rationally selecting transmission antennas is particularly important and can further enhance the application effectiveness of ultra-high-definition television terrestrial broadcasting technology.[5] Because the electromagnetic waves received by the system possess certain directionality and interference characteristics, the load signals can cause interference to the normal transmission of other signals. Vertical and horizontal polarization serve as one of the quality indicators for transmission antennas. By improving horizontal polarization quality, the transmission antenna can rapidly receive various signals, while enhancing vertical polarization levels can shorten signal reception distances.

The combined effect of horizontal and vertical polarization can ensure consistent field strength of the transmission antenna within the corresponding spatial range, significantly improving television signal quality. If the signal coverage area is relatively large, the requirements for horizontal polarization are also higher. Meanwhile, when the terrain and landforms within the signal coverage area are complex or the vertical distance is substantial, it is necessary to select appropriate vertical polarization standards. Generally speaking, in plain areas, transmission antennas with better horizontal polarization effects are primarily used; in forested areas or regions near water bodies, it is preferable to choose transmission antennas with better vertical polarization.[6]

3.1.2 Determination of Specific Transmission Points

Transmission antennas are typically installed on relatively high mountain tops or the roofs of high-rise buildings, with antenna installation positions being relatively elevated. Apart from being influenced by vertical distance factors, they should be installed in areas with favorable environmental conditions whenever possible. If the installation area for the transmission antenna is significantly

affected by lightning and rainfall factors, it will not only severely impact signal transmission quality but also shorten the operational lifespan of the transmission antenna.[7] In the process of selecting transmission antennas, relevant personnel must also consider local weather conditions and scientifically choose transmission methods. If external rainfall is heavy and the air is relatively humid, horizontal polarization transmission methods should be selected whenever possible to prevent signal quality degradation.

In addition to comprehensively considering environmental factors, relevant personnel must also fully consider signal transmission conditions to ensure that various signals can be transmitted to all receiving points within the coverage area, minimizing dead zones during signal transmission. When determining signal transmission locations, it is preferable to select positions near the center of the coverage area to avoid regional omissions. Simultaneously, relevant personnel must consider economic factors, as different antenna installation locations entail varying installation costs. In the process of determining antenna installation positions, coordination between different antenna transmission points should be strengthened to avoid overlap, thereby effectively increasing signal coverage area and reducing signal interference phenomena.[8]

3.1.3 Scientific Adjustment of Transmission Frequency

Transmission frequency has a significant impact on signal quality. At the current stage, with the continuous expansion of ultra-high-definition television coverage, scientifically adjusting signal transmission frequency is particularly important. LDMOS serves as the most commonly used transmission power amplifier module at present, with UHF having the highest transmission frequency. By rationally adjusting the original transmission frequency, the dynamic influence range of signal transmission can be further expanded. FFT functions as a common channel adjustment device, but such devices operate at relatively slow speeds and have long signal delay times. As signal transmission frequency gradually increases, the adjustment difficulty of the device also increases.

Based on the above analysis, high transmission frequencies have numerous drawbacks; generally speaking, signal transmission frequency should not exceed 700MHz. However, if the signal frequency is too low, it will also affect the final television program playback quality. In complex terrain such as water areas or jungles, the reception effect of high-frequency signals is significantly lower than that of low-frequency signals. High-frequency signals possess relatively strong anti-interference capabilities and are not easily affected by external electromagnetic interference; therefore, signal transmission frequency should not be lower than 550MHz. If the terrain and landforms of a certain area are particularly complex with substantial external electromagnetic interference, relevant personnel can appropriately increase signal frequency and adopt high-frequency signals to achieve good results.[9]

3.1.4 Precautions

First, closely monitor various obstacles. Before applying ultra-high-definition television terrestrial broadcasting technology, relevant departments need to establish test receiver chips that can completely simulate system operating conditions, as well as signal transmission and reception end instruments and equipment, to conduct a series of detection tests. For various implementable technical modes and transmission modes, it is necessary to effectively measure various parameters to ensure more accurate and timely signal transmission.[10] In actual testing processes, relevant personnel need to intensify research and development efforts. By actively developing new technologies and introducing advanced testing instruments and equipment, the application of ultra-high-definition television terrestrial broadcasting technology can be better ensured.

To prevent terrestrial broadcasting signals from remaining in a relatively vacuum state for extended periods, relevant personnel must also standardize and improve ultra-high-definition television terrestrial broadcasting technology. By effectively integrating ground digital technologies within different coverage areas, signal coverage damage caused by technical incompatibility can be avoided. In specific standards, relevant personnel need to formulate comprehensive signal transmission rules and reasonably determine terminal equipment models. While expanding network signal coverage, ensuring that various operational parameters such as transmitters comply with specified requirements will promote the comprehensive development of ultra-high-definition television terrestrial broadcasting technology.[11]

Second, based on the current application status of ultra-high-definition television terrestrial broadcasting technology, to further improve its application effectiveness, relevant personnel need to scientifically select operating modes. By effectively choosing operating modes, the coverage range of this technology can be appropriately expanded and the system' s anti-interference performance can be enhanced. After selecting the optimal operating mode, relevant personnel must also intensify promotion efforts. Simultaneously, formulating sound management policies and vigorously improving existing laws and regulations can also achieve good results. At the current stage, ultra-high-definition television terrestrial broadcasting technology is in a transitional phase. During this process, relevant national departments should formulate flexible policy guidelines based on current market development conditions to achieve stable transition.

Furthermore, by enhancing standardized production levels, establishing a complete industrialization model, and strengthening industrial production efforts, the promotion costs of ultra-high-definition television terrestrial broadcasting technology can be significantly reduced. In the process of applying this technology, it is also necessary to coordinate the use of various hardware materials and conduct corresponding testing and comparisons to better determine the models and specifications of various devices, truly achieving industrialization and scaled development goals.[12]

3.2 Ultra-High-Definition Television Test System

The effective application of ultra-high-definition television terrestrial broadcasting technology can significantly improve signal reception effectiveness, thereby satisfying the diversity of signal reception requirements. The scientific application of this technology can not only promote the vigorous development of China' s broadcasting technology but also further meet the actual needs of the broad signal-receiving audience. Therefore, vigorously improving the existing ultra-high-definition television terrestrial broadcasting technology and effectively putting it into practical use holds important significance.[13] In the current period, although this technology has already been put into practical application, many problems still exist in the specific application process. In the future, this technology will become more mature and has broad development prospects.

In the Jiaxing ultra-high-definition television test system, by adopting ultra-high-definition television terrestrial broadcasting technology, comprehensive testing was conducted on ultra-high-definition digital television terrestrial transmission and signal reception performance, as well as signal coverage performance. The testing focused on digital television audio coding and terrestrial channel coding, including reception demodulation and audio-video decoding, among other aspects. Coverage tests were performed on single-frequency-point ultra-high-definition television terrestrial broadcasting, with the transmission system primarily comprising DTMB-A exciters and transmitters, among other components.[14] In the ultra-high-definition television test system, by detecting program code streams and performing channel coding modulation and up-conversion, RF signals are output and transmitted to the transmitter. The RF signals undergo comprehensive power amplification in the transmitter, and after amplification processing, the signals are sent via feeders to the transmission tower antenna and then transmitted into the air. In this test system, video coding is 2160p with 4:2:2 and 4:2:0 color subsampling, and the compressed data rate is 36Mbps. Meanwhile, during channel transmission, the channel capacity of each single frequency point is 40Mbps, and the system' s carrier-to-noise ratio threshold is 13.8dB.

Furthermore, system reception and playback are performed by a single-antenna set-top box for reception and decoding, supporting 2160p and compatible with all video formats. This ultra-high-definition transmission adopts a multi-frequency network testing method, utilizing the DTMB-A standard transmission mode, with an operating mode employing 256APSK, 2/3 code rate, 32k FFT, and a static payload of 39.74Mb/s. The program resolution used in the testing is 3850*2160, with a frame rate of 55 frames/second, using H.265 encoding. The code stream rate after encoding is 36Mb/s. The field strength test results at various outdoor test points are shown in Table 1 .

Through the rational application of ultra-high-definition television terrestrial broadcasting technology and test systems, the goal of ultra-high-definition ter-

restrial broadcasting can be achieved, ensuring that single-channel points can rapidly transmit wireless signals and continuously expand the wireless signal coverage range. As the wireless coverage range gradually expands, signal reception effectiveness is significantly improved, thereby providing more experience for the subsequent comprehensive launch of ultra-high-definition television broadcasting channels.

In summary, through effective analysis of the application points and precautions for ultra-high-definition television terrestrial broadcasting technology and test systems, the proper utilization of these technologies can be ensured. Simultaneously, relevant personnel in their specific work must combine the current application status of ultra-high-definition television terrestrial broadcasting technology and test systems to identify defects and deficiencies in the practical application process and make timely improvements to continuously enhance the final application effectiveness.

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