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Development of Terrestrial Digital Television Transmission Technology in Radio and Television Broadcasting (Postprint)

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Abstract

Currently, the main types of signal transmission in China include: satellite transmission, terrestrial transmission, and cable digital television transmission. Digital television primarily utilizes digital television technology to accomplish complete encoding, compression, and processing of image and audio signals. This article provides a brief overview of terrestrial digital television transmission technology in the development of broadcasting technology, hoping to offer some insights.

Full Text

Abstract

Currently, the main types of signal transmission in China include satellite transmission, terrestrial transmission, and cable digital television transmission. Digital television primarily relies on digital television technology to achieve complete encoding, compression, and processing of image and audio signals. This article briefly describes the development of terrestrial digital television transmission technology in broadcasting and television technology, hoping to provide some inspiration.

Keywords: broadcasting and television technology; terrestrial digital; television transmission technology

1. Development of American and European Digital Television Standards

Compared with digital television development in other countries worldwide, Europe' s digital television development began relatively early and has a long history. In its initial stages, Europe focused on developing digital SDTV before implementing the DVB-T digital television standard. Broadcasting and television represent a primary channel for information dissemination and occupy a very important position in real life. Their existence enriches our lives, broadens our horizons, and expands our knowledge, playing a crucial role in the lives of the general public. With the rapid development of society, we have entered the information age, accompanied by the emergence of terrestrial digital television transmission technology. This technology offers numerous advantages, making new reforms in broadcasting and television essential.

During the specific development of the European standard, due to its characteristics and advantages, it received widespread attention and promotion in the early stages of development and implementation. [**?**] The European DVB-T digital television standard has now been adopted in approximately 30 countries and regions worldwide. The core of this standard involves adding a large number of pilot signals and guard intervals. Inserting numerous pilots ensures synchronization of signal channels—the more pilots added, the higher the synchronization frequency. Additionally, guard intervals provide excellent protection during terrestrial digital television signal transmission, better defending against interference from signals originating in different countries and largely ensuring image clarity. However, due to the large number of pilot inputs and guard intervals, the digital television signal' s frequency band suffers significant damage during DVB-T operation. Clearly, this protection measure based on high cost is not an ideal choice. Nevertheless, because the European DVB-T standard uses mixed signals, it is much stronger than other standards in application and can resist interference from other signals without any technical modifications. Notably, it also performs very well on mobile devices, making it quite popular in countries such as Australia. However, due to its significant self-inflicted damage, its global promotion has faced substantial obstacles. [**?**]

In 1998, the United States officially implemented the ATSC digital television standard, marking the true beginning of the digital television era and making America one of the earliest countries to adopt digital television broadcasting. In its early development stages, American digital television followed the corresponding digital television technical design standards of Europe and Japan. However, during long-term development, since Japanese and European digital television standards could not fully adapt to America' s own development needs, they could not maximize their effectiveness in the technological development process. Subsequently, to better suit American conditions, the United States began developing and improving digital television technology standards, striving to create a more suitable digital television standard. With rapid market development, America recognized the enormous market potential of digital television

and began attempting to develop a completely new digital television standard. This effort later produced the ATSC digital television standard, which is highly adapted to America' s overall national conditions. [**?**] According to statistics, approximately 30 countries worldwide have now begun using the ATSC digital television standard, with over 20 regions implementing it in the United States alone. This system' s greatest advantage is its excellent anti-interference performance; it can compress two-layer signals to ensure clearer received images and eliminate interference signals during terrestrial transmission, thereby reducing screen snow. However, this system also has a significant disadvantage: very poor mobile signal reception capability. When receiving devices are in a high-speed mobile state, signal quality becomes very poor, or no signal can be received at all. Therefore, the ATSC system still has major limitations in mobile device development.

2. Technical Analysis

Compared with previous broadcasting and television technologies, terrestrial digital television transmission technology offers more stable transmission and broader television signal content reception. Based on the current development status and trends in foreign countries and regions, terrestrial digital television broadcasting technology features very fast transmission speeds and high performance requirements. It can receive signals in both mobile and fixed locations, offering wide applicability and suitability for complex environments. This means that in China, we should strengthen broadcasting and television technology to create a high-performance, mobile-friendly, stable-signal receiver that can adapt to complex working environments and achieve broad coverage.

Terrestrial digital television transmission has many differences compared to conventional broadcasting and television. Previously, wireless television operated by receiving antenna signals, which suffered severe interference from many factors, resulting in unstable signals. Terrestrial digital television transmission, however, operates through specific line-based signal transmission, allowing signals to propagate along designated paths. Additionally, these lines can transmit very large amounts of information, ensuring people can access numerous television programs. [**?**] In summary, China should vigorously develop terrestrial digital television transmission technology by drawing on relevant development experiences from developed countries, which will greatly promote the development of China' s broadcasting and television industry. The development of terrestrial digital television transmission and technology has ushered Chinese digital television into a relatively new era, significantly promoting the development of China' s information technology and other related fields. [**?**]

2.1 High-Quality Images and Sound Effects

Digital television offers significant advantages in image and sound quality because the signal quality of programs has been substantially improved, resulting in clearer images and better sound quality. Due to rich content, users have

considerable freedom when selecting digital television program content. Digital television can provide numerous video-on-demand and interactive programs, allowing users to make various choices based on their preferences and watch personalized content. The scope of services has also expanded, offering various services such as electronic program guides, stock information, and numerous convenience services. [**?**] Users can select information according to their needs, making life more convenient. Digital television possesses strong anti-interference capabilities, effectively eliminating television "snow," "dark stripe flickering," and other unstable images. This technology enables clearer pictures and higher image quality. In previous television technology usage, technical limitations resulted in significant waste of many channel resources. After adopting digital television technology, many channel resources have been fully released, allowing users to watch numerous television programs—even up to hundreds of programs —with rich television resources.

2.2 Extensive Data Provision

Compared with certain European digital television standards, DTMB differs in that it does not waste a large number of pilot signals on equalization, preserving pilot signals for better data transmission expansion. Additionally, under the same environment, its effective payload capacity is much stronger than certain European digital television standards. Higher effective payload capacity ensures that significantly more data can be obtained in the same wireless spectrum compared with European digital standards. To ensure broader signal coverage, the received signal sensitivity during DTM operation is much higher than certain European digital television standards. In other words, under the same conditions, DTM can receive more signals, resulting in broader transmission signal range. This ensures maximum signal coverage area with the same investment while also reducing hazards from electromagnetic radiation during signal transmission. [**?**]

2.3 Time-Domain Fast Channel Estimation Technology

Because DTM uses time-domain fast channel estimation technology, it can effectively conduct business in various high-speed carriers. In terms of technical design, system synchronization and channel estimation speed are approximately 100 times faster than European DVB-T. Consequently, China' s DTMB system can still maintain image clarity at speeds of 200 kilometers per hour, ensuring that image clarity is not affected by speed and enabling excellent usage on trains, automobiles, and ships. This technology better achieves the goal of using digital television in high-speed transportation and makes full preparations for subsequent digital television development. The development of DTM digital television technology has solved many previous problems, and it is believed that in future development, DTMB technology will better integrate with network technology, further expand Internet applications, add more services, promote better development of portable services, and lay a more solid foundation for

subtitle television development.

3. Development and Importance of Broadcasting and Television Technology

3.1 Specific Development of Broadcasting and Television Technology

Broadcasting refers to a method of transmitting information to people solely through audio. Its advantages include timely information delivery, fast propagation, and extensive coverage. Audiences can use their imagination through sound without gender or cultural limitations. However, broadcasting also has obvious disadvantages: it can only transmit information through audio and cannot display information in detail through vivid images. Moreover, messages transmitted by wireless stations often fail to move people. Broadcasting and television significantly improved upon radio by retaining its advantages while adding more visual images to express information. In contemporary times, it serves as a platform for information transmission, cultural promotion, and social entertainment. Broadcasting and television have gradually developed based on scientific and technological progress, with continuous improvement of shortcomings, making the development process increasingly better. [**?**]

3.2 Importance

As is well known, both radio and television provide specific channels for delivering real-time information to people. The existence of broadcasting and television helps people better understand social trends. Additionally, broadcasting and television serve as excellent channels for publicizing national policies. They can vividly explain various national policies to people and better display various social news through images—something previous radio could not accomplish. Furthermore, broadcasting and television make people' s lives more enjoyable; television dramas and entertainment programs broadcast on television can relax people' s body and mind, bringing greater pleasure. Movies and television can also educate people through various subtle aspects, enabling them to receive more education in an imperceptible atmosphere. Broadcasting and television are very important and have become an indispensable part of people' s lives. The rapid development of broadcasting and television has driven the development of the television industry and television technology, making significant contributions to economic development.

4. Far-Reaching Significance

In summary, broadcasting and television in the new era must possess new era characteristics during development to better adapt to the transmission characteristics required by the new era and better satisfy people' s new demands in the new era. It is believed that with rapid technological development, China will reach new heights in the development of terrestrial digital television transmission technology.

Terrestrial digital television transmission technology has developed based on networks. Networks provide a very large development platform that is in a completely open state. Network broadcasting and television can compensate for the shortcomings of broadcasting and traditional broadcasting and television, better adapting to and satisfying people' s relevant demands for broadcasting and television in the new era. The corresponding development of terrestrial digital television transmission technology can not only improve the targeting of information dissemination but is also open and free. It has very rich information resources and relatively huge capacity, enabling real-time communication. [**?**] In short, this technology allows people to have a better visual enjoyment, makes life more colorful, enables people to quickly understand various events happening in society, and plays a very important role in broadening horizons and enriching knowledge.

5. Technical Implementation Considerations

5.1 Antenna Selection

Transmission antennas occupy a very important position in signal transmission and radiation processes, fundamentally playing a decisive role in the quality of digital terrestrial television transmission. During transmission, electromagnetic waves themselves have characteristics such as interference, directionality, and diffraction, which cause significant interference to signals inside the load and ultimately seriously affect transmission quality. Therefore, in the antenna selection process, it is necessary to select antennas with relatively high requirements for horizontal polarization and digital polarization.

5.2 Transmission Site Selection

Broadcasting and television antennas are mostly installed on top of high-rise buildings and mountain peaks. Therefore, relatively good ground conditions play a very important role in delivering terrestrial positioning. Special attention must be paid to not installing antennas in areas with dense thunderstorms, as this not only greatly affects transmitted signal quality but also significantly shortens antenna service life. Therefore, in the transmission site selection process, it should be positioned at the center of the coverage area to effectively avoid regional omission problems.

5.3 Economic Cost Factors

Economic factors play a very important role in the installation process of broadcasting and television antennas. Costs will vary according to different installation positions and locations. During antenna installation, coordination between antenna quantity and antenna position should be well managed, requiring advance planning to effectively avoid coverage area overlap and better achieve digital television signal coverage.

5.4 Transmission Frequency

Transmission frequency has a significant relationship with digital terrestrial television signal quality. Since digital television coverage is relatively small, selecting different transmission frequencies according to actual conditions is very important. FFT is a channel demodulation device that inherently has the disadvantages of relatively slow transmission speed and signal delay, disadvantages that are amplified with increasing transmission frequency. [**?**] Therefore, in practical applications, correct selection of high-frequency and low-frequency signals should be particularly emphasized.

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