Research on Inter-symbol Interference Suppression Technology of Optical Communication System

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Abstract: Within the channel of an optical communication system, the transmission of signals is highly susceptible to distortion of the receiver signal due to inter-symbol interference. The internal channel must ensure that the pulse signal is not interfered, and it is necessary to apply anti-interference technology to improve system performance. Therefore, based on the analysis of the principle of inter-symbol interference in optical communication systems, this paper discusses the inter-symbol interference suppression method of conventional optical communication systems, and proposes a stronger diversity reception technology for anti-interference technology.

1. Research background

1.1 Literature review

In modern optical communication systems, inter-symbol interference is often formed due to system channel distortion, which ultimately affects the communication quality of the receiver. In response to such a situation, many scholars have carried out corresponding research on the suppression technology of inter-symbol interference to eliminate inter-symbol interference of optical communication systems through effective communication transmission technology. Chen Xiaodong et al. believe that all spectrum resources between LTE cells use this flexible frequency reuse strategy, and therefore inter-cell signals in LTE systems will inevitably cause interference. In response to this, the author introduces the latest research results that explain this signal interference from two aspects of interference cancellation and coordination. Finally, the author analyzes the development trend of inter-cell interference suppression technology in LTE system in combination with LTE standard (Chen, 2010). Xiong Ting, Zou Xuan, Wang Ying. Aiming at the influence of interference factors such as temperature and atmospheric flow on optical signals, a single-cycle dynamic compensation method for suppressing interference between optical communication codes is proposed. The method analyzes the optical communication system with interference, gives the dynamic characteristics of the external disturbance vector, analyzes the performance index of the infinite time domain, and connects the original system and the interference system with the expected output to obtain the optical communication augmentation system. The final simulation results also show that the proposed method has good anti-interference performance (Xiong et al, 2015). Mo Chenxiao, Chen Changying and others believe that inter-symbol interference of optical communication systems is an important factor affecting signal quality. Therefore, improving the performance of high-speed white LED optical communication systems, inter-code interference suppression technology has become the key. The author analyzes the generation mechanism of inter-symbol interference in optical communication system and its influence on the signal of LED system, and then proposes the suppression technology of diversity reception. The experimental results also show that the diversity receiving technology can effectively suppress the influence of inter-symbol interference on the high-speed white LED optical communication system, and the system signal-to-noise ratio is increased by 2dB on average (Mo et al, 2012). Jin Xiaolu et al. believe that code division duplexing supports the same frequency band for both uplink and downlink channels, and there may be large power differences resulting in more serious mutual interference. Therefore, the author base station uses a distributed antenna and interference canceller to deal with interference strategies, and interference between mobile stations can be suppressed by

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positioning technology and scheduling algorithm (Jin et al, 2010).

1.2 Research purpose

In the transmission process of optical communication system signals, it is highly susceptible to interference from natural environment, human factors or channel multipath, and inter-symbol interference occurs. Such inter-symbol interference causes the optical communication system terminal to generate severe distortion in the process of receiving signals regardless of the time domain or the frequency domain. Such distortion is highly likely to cause distortion of signal transmission. Therefore, in order to reduce the distortion of the signal, it is necessary to suppress inter-symbol interference of the channel and optimize the communication channel. The traditional inter-code interference suppression technology of optical communication system mainly adopts the block equalization filtering method and the linear equalization method to equalize the single-cycle channel of the optical communication system, so that the optical communication signal can be superimposed by interference to arrive at the information receiving. point. Therefore, a new inter-symbol interference suppression technology is urgently needed to improve the transmission quality and signal strength of optical communication system information.

2. Principle of inter-symbol interference generation in optical communication systems

The transmission of various types of signals in an optical communication system is carried out under extremely high speed conditions. In the optical communication signal transmission channel, various types of signals undergo high-frequency reflection and multiple ionospheric refractions, which becomes a challenging technology. However, in the channel of an optical communication system, the signal transmission paths are different, and it is very easy to cause interference between signals (Li et al, 2013). Such interference and collisions in the channel and mutual influence, it is easy to reduce the signal quality and reduce the signal to noise ratio. In the channel of the optical communication system, in order to meet the signal quality requirements of the receiver, the whole system will apply the array for signal sequencing. In the case of such array sequencing, the channel is automatically split into a direct channel and a diffuse channel, and the signal is used to select different channels to reach the signal receiver. However, in such a channel selection process, different pulse signals are highly prone to temporal overlap, which in turn causes signal crosstalk problems. When the delay time is higher than the interval of the pulse signal transmission, adjacent signals are prone to alias crosstalk during retransmission. The greater the number of signal stacks, the stronger the resulting crosstalk or skew problem until signal distortion occurs.

In addition to the path selection, signal distortion is easily generated, and channel distortion may cause intersymbol interference to the signal. The channel distortion causes the symbol to generate a delay in the process of transport, and the waveform of the signal appears as a smearing of the symbol pulse. The signals adjacent to each other are based on the cause of time lag, and the pulse signals are extremely likely to overlap, so that the receiver receives the distorted signal. Generally, the frequency of the lower frequency signal, the distortion caused by the pulse overlap is negligible. With the increase of the frequency of the pulse signal, the signal time lag is higher than the symbol period, and the adjacent pulse signal will have signal interference. That is, the performance of the optical communication system increases as the inter-symbol interference efficiency increases.

3. Inter-symbol interference suppression method for conventional optical communication system

3.1 Change the signal encoding method

The so-called change signal coding method is to replace the original modulation mode that does not return to zero code with the return-to-zero code. In this regard, the changed return-to-zero code has a corresponding time protection period for the adjacent pulse signal, that is, the difference between the pulse width and the symbol period. In this case, the time protection period is changed and shortened, and the pulse signal does not cause inter-symbol interference. When the root mean square delay spread phase is small, the performance characteristics of the return-to-zero code are better than those of the non-return to zero code. However, this way, by changing the signal coding method, it is limited, and the output efficiency of the transmission bandwidth needs to be improved.

3.2 Orthogonal frequency division multiplexing

The orthogonal frequency division multiplexing method has strong anti-multipath capability, that is, it can automatically separate various channels in the optical communication system. Therefore, such an orthogonal frequency division multiplexing method has a wide range of applications in high-speed wireless communication. Orthogonal frequency division multiplexing can ensure that the signal transmission period is much higher than the multipath delay and ensure the high efficiency transmission of the signal. The basic principle of signal transmission in orthogonal frequency division multiplexing is to decompose various high-speed data signals into multi-path parallel low-speed data signals, thereby ensuring simultaneous transmission of multiple carriers (Jiang et al, 2011). As far as the propagation of low-speed data signals is concerned, the distortion effect corresponding to multipath effects is much reduced due to the widening of the symbol period. The signal processed by each orthogonal frequency division multiplexing method is absorbed by the guard time almost instantaneously, and therefore the inter-symbol interference in the channel is negligible.

4. Diversity reception technology

The Orthogonal Frequency Division Multiplexing (OFDM) method is applied to an actual optical communication system and is usually attached to a multi-carrier signal. However, under such a technology, multi-carrier has higher requirements on the channel sub-carrier of the optical communication system, and this invisibly increases the complexity of the pulse signal. Therefore, there is a need for a simpler and more efficient inter-symbol interference suppression technique for anti-interference output of signals. The diversity receiving technology concentrates on the core processing ideas and performs anti-interference processing on the signals. The signal diversity receiving technology, in more cases, solves the problem of signal fading and disconnection in the multipath channel, thereby improving the signal output quality of the optical communication system through customer service such problems.

In the optical communication system, the diversity receiving technique is generally adopted, and polarization diversity, time diversity, frequency diversity, and spatial diversity are usually adopted. Spatial diversity is the most widely used diversity. Spatial diversity for signal reception is performed on the signal receiver. Several signal detection receivers are installed at the same time. By comparing the signal conditions in each spatial channel, the pulse signal with the largest signal-to-noise ratio is finally selected. Under such conditions, the transmission signal in the channel will minimize inter-symbol interference, and the detector of the best signal band will ensure the smooth communication when the signal encounters the largest external interference. Moreover, the best combination of spatial diversity reception techniques is to form four detectors at a 60-degree angle, which further enhances signal acceptance.

Under normal circumstances, different signal selection methods, the signal transmission efficiency of optical communication systems will also have high and low points. Therefore, when the channel signal transmission efficiency is low, the detectors can be placed in a mode of 60 degrees to each other, as shown in FIG. For detectors that are at a 60-degree angle to each other, the power output is clearly higher than the signal that can be received by a single detector. Such a detector placement mode greatly increases the signal-to-noise ratio of the receiver, and the communication distance is also extended accordingly. If the signal transmission rate in the optical communication channel exceeds 100 Mb/s, the signals detected by the detectors cannot be simply added at this time because of the inter-symbol interference caused by different paths in the optical communication channel with high operation rate. The noise increase ratio is the ratio of the increase in signal strength. Therefore, the best signal transmission path of the optical communication channel operating at a high rate is to select the path with the strongest signal among the multiple signals as the final communication link.

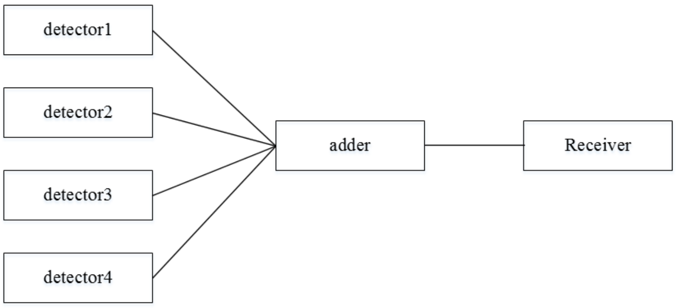

Figure 1.Principle of signal receiving and receiving of communication system

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