Research of OFDM System Channel Equalization Techniques

Wang Juan[1, a]

[1]Chongqing College of Electronic Engineering, Chongqing 401331, China

[a]wj8888886@126.COM,

Keywords: OFDM; Channel Equalization; Communications Technology

Abstract. In a wireless mobile communication, it is required to provide high-speed and high-quality communication services and orthogonal frequency division multiplexing (OFDM) due to a high bandwidth efficiency and resistance to multipath ability, etc., in recent years, widespread attention. Contents of this paper are the OFDM channel estimation and equalization. Paper introduces the principle and performance characteristics of OFDM, on the basis of in-depth discussion of the principles and methods for channel equalization OFDM systems. The paper discusses the various channel estimation method using pilot signals, and in the traditional pilot minimum mean square error estimation algorithm based on an adaptive MMSE estimation algorithm applied to multi-path channel. It is the tap coefficients multipath channel with KL series expansion, which can automatically estimate these unrelated series coefficients [1].

Introduction

Communication and exchange of human ties are coupled with the development of society, people look forward to anytime, anywhere, timely and reliable, free from the constraints of time to carry out the exchange of information. The mobile communication system utilization of wired and wireless communications, and not bound to a fixed terminal can be solved in the movement of people or objects with a fixed terminal on other mobile terminals to communicate liaison problems for freedom of human communication Ideal provides an effective means.

In recent years with the popularity and the rapid development of Internet, people in the image, voice, and data communications applications increasingly demanding. So the future of communications will inevitably move toward to the direction and to support the development of multimedia services. In recent years, people have begun to research and development of next-generation wireless broadband multimedia systems. Create a microcell system worldwide, resulting in the world to build a global information village to support mobile.

Future wireless communication system must develop in the direction toward broadband multimedia, in order to achieve such a system, you need to select the appropriate modulation technology to achieve high-speed transmission and can be effective against frequency selective fading channel and resolve the inter-symbol interference due to multipath problems. In recent years, a multi-carrier technology has been widespread concern Orthogonal Frequency Division Multiplexing o (FDM), it can be a good solution to inter-code radio channel caused by multipath interference problem; it is considered the next generation The preferred modulation techniques for wireless communication systems.

The Relative Research of OFDM Equalization

Since the channel has a frequency selective fading, resulting in a received signal waveform distortion, when using synchronous demodulation, this effect must be eliminated by the equalizer. In OFDM systems, frequency domain equalizer equalizer refers to the signal receiving end DFT demodulated correction refers to the time domain equalizer equalizer DFT demodulated signal receiving end before correction [2].

Under ideal conditions synchronization signal after the receiving end of OFDM systems removes the cyclic prefix demodulated no interference between symbols, each sub-channel signal, respectively, equivalent to a decline by different coefficients of flat fading channel, each

sub-channel signal is received data symbols with the corresponding sub-transmission function of the product sent, frequency selective fading caused by multipath delay caused by stretching subchannel signal amplitude and phase rotation. Just after FFT demodulation separately for each subchannel with single tap complex equalizer coefficients, the magnitude of the compensation subchannel transfer function caused by attenuation and angle of rotation can be achieved equalizer, equalizer structure is relatively simple signal.

Orthogonal Frequency Division Multiplexing is a multi-carrier modulation scheme interesting, it uses to reduce and eliminate ISI (151) to overcome the effects of frequency selective fading channel [3].

When the impact response of the channel length is longer rely solely on the length of the extended cyclic prefix to eliminate interference between the front and rear OFDM symbol will greatly reduce the efficiency of the system, then you can join the time-domain equalizer reduce the input signal demodulator hangover length. DFT time domain equalizer placed in front of the reception signal preprocessing on the receiving end of the DFT input, the transmission signal is affected by channel and time domain equalizer cascade of two systems, the rational design of a time domain equalizer, so that the channel and the time domain equalizer joint response length less than the length of the channel impulse response, so that you can not increase the length of the cyclic prefix, and achieve inter-symbol interference-free transmission. The time domain equalizer just reduce the input signal demodulator hangover length, so that the output signal DFT frequency domain equalizer and then after the elimination of frequency selective fading, realized through a long channel impulse response OFDM signal equalization.

The Equalization of OFDM

In the case of the channel response known, whether it is an ideal channel or a non-ideal channel for demodulating the received signal design the best filter is not difficult. The problem is that the channel response characteristics in practice is often unknown, particularly response characteristics of the mobile radio channel is time-varying. For such a channel, we can not design the best fixed demodulation filters. For unknown non-ideal channel, when the inter-symbol interference is serious, if not used a special device, it can not be transmitted reliably receive sequence. The method is usually to solve this problem is to use both the known transmitted sequence (training sequence), so that it becomes possible to identify the channel, and reliable. First, the transmitter transmits a known, fixed length of the training sequence, so that the receiver equalizer can make the correct settings. Equalizer at the receiver channel characteristics will be evaluated by the algorithm, and corrects the filter coefficients, in order to compensate for the channel. In the design of the training sequence, the requirements done even in the worst channel conditions, the equalizer also through this sequence to obtain the correct equalizer coefficients, so that you can receive after the training sequence, the equalizer coefficient close to the optimal equalizer value, so that the user data is received, the equalizer adaptive algorithm can track the changing channel, the equalizer is also changing its characteristics, so as to ensure the user receives the correct information.

But with the development of communication in the direction of high speed, high capacity, adaptive equalizer increasingly exposed its limitations [4]:

In order to effectively eliminate inter-symbol interference, the equalizer needs to periodically make repetitive training. Especially for time-varying channels, to update the channel estimation must be periodically transmitted training sequence, which would reduce the effective rate channel, the problem in time division multiple access system particularly serious. Because the training sequence is bound to change the channel parameter estimation and sent a large number of slots occupied, so that users can take advantage of the number of slots to receive greatly reduce a few.

For severe fading channel, it must send a training sequence frequently.

In the broadcast or multipoint communication, if a branch suddenly appeared at the receiving signal interruption, to resume work on the requirements of the central station to re-initialize the receiver sends the training sequence, or require transmission signal has been inserted Training signal. But in fact, the former case is impossible, the latter is also unacceptable.

For certain cases, only the transmission channel, there is no reverse request channel. To know each other in a timely manner whether the signal is received, the request must increase the reverse channel. This will increase the size and cost of the receiving device in practice, it is not feasible.

In summary, in order to adapt to the development of modern communications, we must develop blind equalization. Blind equalization technique does not require training sequence will be able to adaptively adjust the parameters, effectively overcome the defects have training sequence. For the impact of recurring fading channels, serious non-linear in time-varying characteristics, multipath propagation, etc., as well as communications receivers can not track the channel characteristics and the emergence of an interrupt, it will adaptive equalization, adjust parameters, tracking channel characteristics, complete the best estimate of the signal.

Blind Equalization Principle. Adaptive equalizer is an adaptive filter, which is converted by the adaptation process produces an estimate of the expected response, so that the filter output signal recovery and hope are equal. Blind equalization signal because no training, system utilization is high and attention. According to the data conversion where plus nonlinear equalization divided into three categories:

Busgsnag algorithm: memoryless non-linear transfer function is the adaptive equalizer output;

High-end or cyclic statistics algorithms: nonlinear transformation in the input of the adaptive equalizer;

Non-linear adaptive equalizer is present in the interior, that the use of non-linear filters and neural network and compared to the latter two blind equalizer, since Busgsnag Blind Equalization is the minimum mean square error optimal filter criterion, based LMS algorithm, with a small amount of calculation, clear physical concept, easy to implement, and its convergence speed and performance after convergence also good, so adaptive in OFDM system channel as blind equalization method chosen topic in class equalizer Busgsnag balancing role.

Time Domain Equalizer. OFDM system, when the channel impulse response time is less than the guard interval, the system does not interfere with the front and rear of OFDM symbols, respectively, through the respective sub-channel signal corresponds to a flat fading channel, as long as access in each sub-channel transfer function receiving end, for each sub-channel signal multiplied by the inverse of the sub-channel transfer function can be achieved on the signal equalization. But sometimes the channel impulse response is very long, does not meet the channel impulse response time is less than the guard interval time requirements, then the previous OFDM symbol of the OFDM symbol tailing will cause interference, resulting in 151. But only rely on increasing the length of the cyclic prefix 151 will allow the system to avoid reduced efficiency, this time in time domain equalization equalizer and frequency domain equalizer integrated use can be employed, which shortens the time domain equalizer demodulator input signal OFDM hangover length to eliminate inter-symbol interference, frequency domain equalizer eliminate frequency selective fading.

Serial communication systems, time domain equalizer goal is to completely eliminate ISI, namely joint response equalizer and channel in addition to the symbol in the present judgment in time is not zero, but in other symbols judgment time samples were as O. For OFDM systems, time-domain equalizer is designed to eliminate interference between OFDM symbols, when the impact of the equalizer and channel cascaded response of the system is equal to or less than the length of the cyclic prefix length of the system, to a demodulator (DFT) and INTRODUCTION signal trailing time is less than the cyclic prefix length, there will be no interference between the front and rear OFDM symbol.

Balancing technology is an effective way to overcome the digital communication system ISI, it has been widely used at present. The blind equalization technology has no initial training signals can be adaptively adjust equalizer tap coefficient and much attention. So this chapter also introduced adaptive equalization and time domain equalization, it is transformed by the adaptation process produces an estimate of the expected response, so that the filter output signal and want to restore equal.

This paper studies the OFDM channel estimation and equalization techniques at home and abroad through a large collection of scientific research and data collation and analysis of OFDM channel estimation and equalization theory and its application in communications were studied. Because of the characteristics of the OFDM signal, frequency domain equalization is relatively simple, and accurate channel estimation OFDM system is to ensure the transmission quality, to play its key advantages, so the focus of discussion and research papers channel estimation method, and propose MMSE adaptive algorithm it utilizes the KL series expansion, which is SVD decomposition, it makes the calculation process easier, while avoiding the computing channel covariance inverse matrix.

Conclusion

With the development of communication technology, OFDM and its key technology will get more attention and in-depth development. OFDM system channel estimation and equalization is a direction with great research significance. In the future we will continue to study OFDM channel estimation and equalization techniques, focusing on the emerging new technologies of the field and continuously improve their research capabilities.

References

[1] By Fu Yan, Zhang Hailin, Wang Yumin: Natural Science, Vol. 3 (2007) No33, p.121-124

[2] Zhang Xian, Bao Zheng: Communication Signal Processing, Vol. 12 (2005) No 27, p.74-76

[3] Simon Haykin, Adaptive Filter Principle, Vol. 6 (2004) No 53, p.25-26

[4] Fan Changxin, Xu Bingxiang: Communication Theory, Vol. 1 (2006) No 33, p.11-14

[5] Information on .http://lawbooks.com.cn/lw/lw_view.asp?no=961