International Journal of Computational Intelligence Systems and Applications. Volume 4, Issue 2, (2016) 79-83
http://www.cayley-nielson.com/ijcisa/

Modulation Technology Simulation of WCDMA System

Yongli An*, Zhigang Li, Shujie Li
College of Information Engineering, North China University of Science and Technology, Tangshan Hebei 063009, China
*Corresponding author
E-mail: *tongxinsheji@126.com.cn*

Abstract

This article first describes the evolution of mobile communication system, and then the BPSK modulation technology in WCDMA system and QPSK modulation technology has carried on by Matlab simulation. And the simulation curve of the signal to noise ratio and bit error rate is analyzed. Finally, this paper introduces the principle of direct sequence spread spectrum modulation technology and it is simulated by Matlab. Simulation results show the difference under ideal channel conditions of spread spectrum communication system and strong interference conditions of spread spectrum communication system. At last, it improved the interference condition parameters.

Keywords: WCDMA; Spread spectrum; Simulink; BPSK; QPSK.

1. Introduction

WCDMA mainly originated in Europe and Japan in the early third-generation wireless research activities, GSM tremendous success of the third generation of the standardization system in Europe have a significant impact. Europe in 1988 to carry out RACEI program, and has been extended to June 1992, which represents the third generation of wireless research activities began. Europe between 1992-1995 began RACE II program. ACTS (Advanced Communications Technology and business) was established in late 1995, as UMTS (Universal Mobile Telecommunications System) proposed FRAMES (future wireless broadband multiple access system) program. In these early studies, a variety of different access technologies, including TDMA, CDMA, OFDM, etc. into the testing and evaluation of the technical basis for the WCDMA. Japanese ARIB in 1993 established a research committee to carry out research and development in Japan 3GDE and by assessing the 3G CDMA technology as the main choice. Japanese operator NTT DoCoMo in 1996 launched a WCDMA technology development; accelerate the standardization process of WCDMA.

Third generation mobile communication technology in 2000 by the International Telecommunication Union (ITU) officially identified, WCDMA technology standard is the third generation of mobile communication technology mainstream standards. Now it seems to be used in the third generation of standards WCDMA-FDD mode selected countries is the greatest. Modulation technique WCDMA system simulation, the simulation is mainly BPSK modulation and QPSK modulation simulation, and finally the direct sequence spread spectrum system in the simulation.

2. Uplink simulation BPSK modulation

Binary phase shift keying (BPSK) is based on the two digital base band signal level of the carrier phase of switching between two different values of a phase modulation method. A original signal with

ISSN 2331-1924 / Copyright © 2016 CAYLEY NIELSON PRESS, INC.
July, 2016

the carrier Acos (ωt + θ) to obtain the modulated signal α Acos (ωt + θ), where ω is the carrier frequency, θ is the initial phase of the carrier. The introduction of coherent demodulation (same frequency and phase) of the reference signal Acos (ωt + θ), then get α cos (ωt + θ cos (ωt + θ), using the product of the sum and difference formulas can be obtained:

$$\begin{aligned}&\alpha*1/2*[\cos(\omega t+\theta+\omega t+\theta)+\cos(\omega t+\theta-\omega t-\theta)]\\&=\alpha*1/2*[\cos(2\omega t+2\theta)+\cos(0)]\\&=\alpha/2*[\cos(2\omega t+2\theta)+1]\\&=\alpha/2+\alpha/2*\cos(2\omega t+2\theta)\end{aligned} \quad (2\text{-}1)$$

Using the filter will signal cos (2 ωt +2 θ) filter, that was the original signal α

Simulation results analysis:

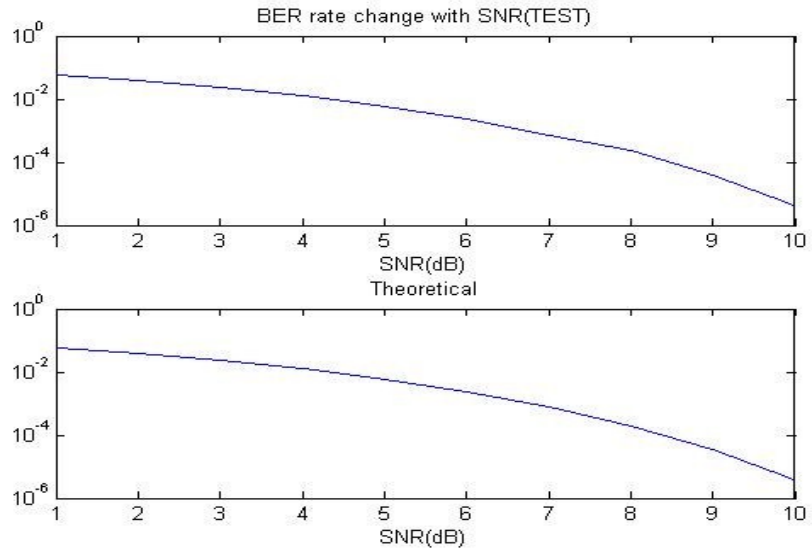

Figure 1. BPSK simulation model diagram

By Matlab simulation, we got different SNR modulated demodulated BER curves with the theoretical curves are almost the same. Observation image can know the error rate after 10dB signal to noise ratio can be almost ignored, the demodulated signal is hardly affected.

From this result, it can be seen BPSK modulation and demodulation system, anti-noise ability. However, the operating system is running Matlab simulation found the response time is very long, you need a computer to run a long time to complete the simulation operation process. In addition to large amount of computation algorithm causes outside the system, BPSK signal transmission efficiency of the system itself is not high, which also confirms communication theory textbooks mentioned BPSK system characteristics, namely anti-noise ability, but the data transfer is inefficient.

3. QPSK modulation simulation downlink

QPSK modulation: the input baseband signal A (t) is not zero bipolar binary symbols, which is "the serial / parallel conversion" circuit into two symbols a, b, becomes the parallel symbols a, b, the the duration of each symbol is two times the input symbol. The two-way parallel symbol sequences were used and two quadrature carrier multiplication. Vector a (1) represents a path signal element binary "1", a

(0) represents a path signal element binary "0"; similar vector b (1) represents a path signal element binary "1" , b (0) represents a binary channel signal element "0." two signals are summed in the adding circuit to obtain the output vector s (t), each vector represents 2b.

QPSK Demodulation: QPSK demodulation block diagram as 3.3, since the QPSK signal can be regarded as the superposition of two orthogonal 2PSK signals, so with two orthogonal demodulation to the wanted carrier, can be easily analysis of the two orthogonal 2PSK road signals. Coherent demodulated two parallel symbols a, b through the parallel / serial transform, a serial data output.

Simulation results:

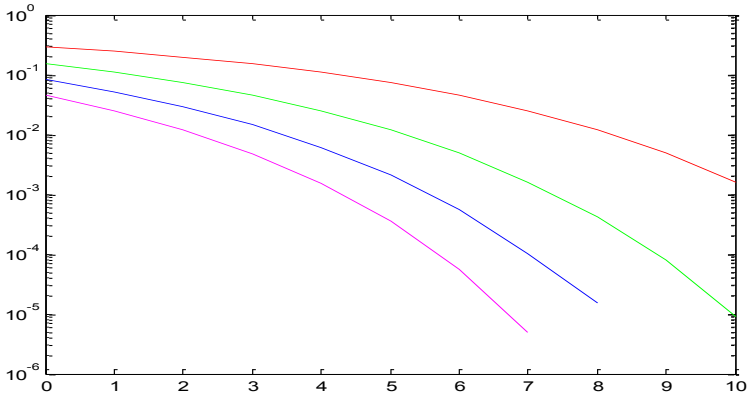

Figure 2. QPSK simulation waveform

In this simulation model, we plotted four curves were adjusted when the QPSK demodulator Sample per symbol parameter is equal to 1,2,3,4 QPSK signal BER performance. As can be seen from the figure, Sample per symbol parameter settings that largely affect the demodulation performance of a QPSK signal. For example, when the SNR is equal to 7 dB, if Sample per symbol is equal to 1, QPSK adjustment signal equal to the bit error rate of about 2.5%; if Sample per symbol is set to 4, then only about 0.0005% error rate. It can be seen that the bit error rate of QPSK communication with the signal to noise ratio increases. The results are consistent with the theoretical results, and fully demonstrated how to use Simulink toolbox communication system simulation. Its innovation lies with other communication system simulation models, the simulation model is simple, but to achieve the desired results for the communications system simulation study proposes a method.

4. Direct Sequence Spread Spectrum system simulation

Direct Sequence Spread Spectrum (DSSS) technology is today well known one spread spectrum technology, which with optical fiber communications and satellite communications together known as the three major high-tech information age communication transmissions. Its initial purpose is to provide protection for military communications, due to the direct sequence spread spectrum communication signal information is to expand a width of narrow-band noise signal, so it is difficult to detect enemy, not even detect the correct code, the signal cannot be restored to initial state. Because of its anti-noise performance, but also for business. Allow public use of wireless devices in the electromagnetic environment, its other traditional microwave equipment caused minimal disruption, while other nearby devices has higher

immunity.

Direct sequence spread spectrum is the direct use of a high rate using a variety of spread spectrum modulation on the transmit side, the message to be transmitted using pseudo-random (PN) sequence extended to a wide band up, at the receiving end, for sending side extension with the same pseudo-random sequence of the received spread spectrum signal correlation processing to recover the original information.

Its main technical advantages: DSSS system to take advantage of multipath interference to improve the energy performance of the system; anti-jamming; DSSS system with strong security performance; easy to implement CDMA.

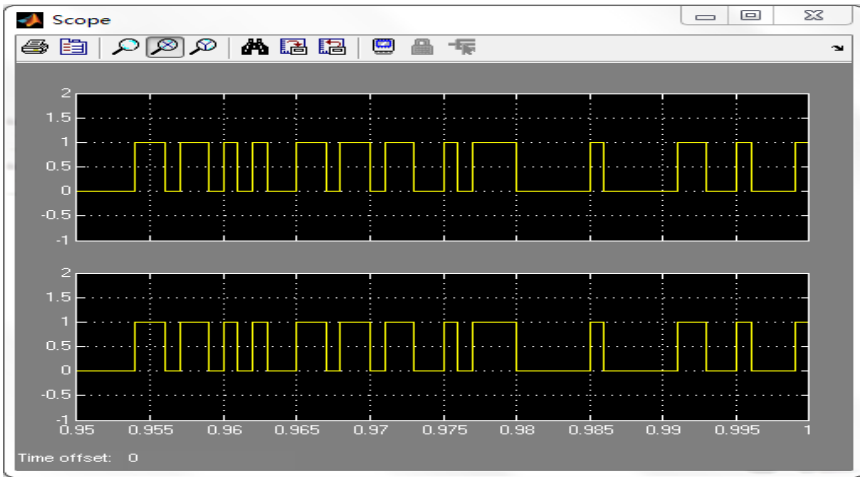

Figure 3. Input and output waveforms

Observed and compared two waveforms, known under ideal conditions, the signal interference.

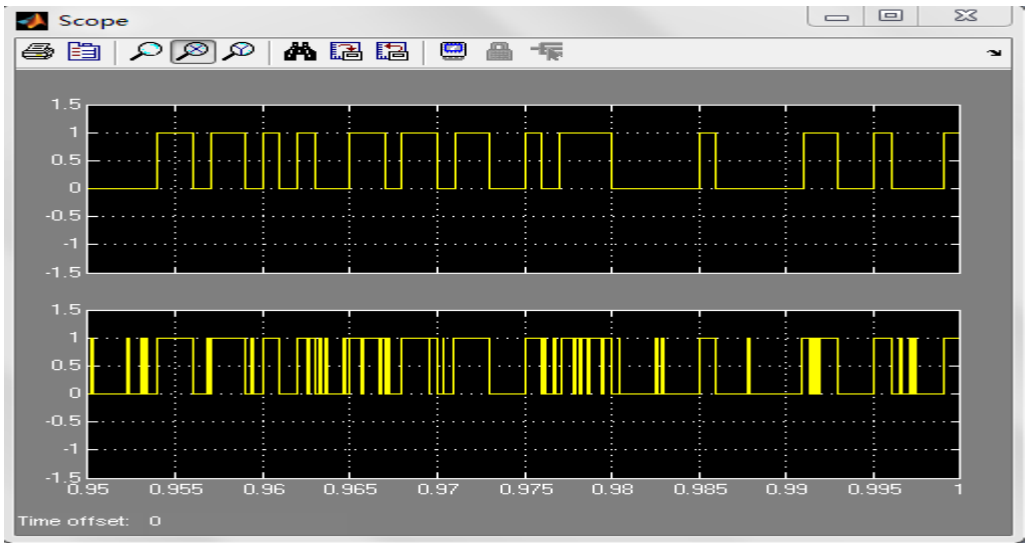

Figure 4. Input and output waveforms

Compare two waveforms can be found in the input waveform and the output waveform is inconsistent, which proved spread modulated signal after demodulation after dispreading is not restored to the initial

state, which could explain the Gaussian white noise added to the ideal conditions exist which difference signal is not extracted out.

5. Conclusion

Comparison of the two cases, the error rate is zero under ideal conditions, in strong interference conditions is 0.04895.AWGN channel parameters will be gradually increased from one SNR observed Display error rate, decreases, when the SNR is 8, the error rate is 0, continue to increase the SNR value, the error rate does not change. Description SNR = 8 the optimum value is a minimum. When results continue to increase its value no longer changes, namely through improved to achieve the desired effect.

Acknowledgements

This project is supported by the National Science and technology support program (No. 2013BAH72B01), Hebei Natural Science Foundation of China: (No. F2014209276), Scientific Research Plan Project of Hebei China: (No. QN2014099) and Tangshan Science Research Foundation of Hebei China: (14130217B).

Reference

[1] S. Haykin. Cognitive radio: brain-empowered wireless communications [J]. IEEE J. Sel. Areas Commun, 2005, 23(2):201-220.

[2] Hou Y. Thomas, Shi Yi, Sherali Hanif D. Spectrum sharing for multi-hop networking with cognitive radios [J]. IEEE J. Sel. Areas Commun, 2008, 26(1):146-155.

[3] H. Islam, Y. Liang, A. Hoang. Joint power control and beamforming for cognitive radio networks [J]. IEEE Trans. on Wireless Communications, 2008, 7(7):2415-2419.

[4] N.Seshadri and J.H.Winters. Two Sehemes for Improving the Permance of Frequeney Division Duplex(FDD) Transmission Systems Using Transmitter Antenna Diversity. International Journal of Wireless Information Networks, Vol. 1, PP.49-60, Jan. 1994.

[5] S.M.Alamouti, A simple transmit diversity technique for wireless communications, IEEE Journal on Selected Areas in Communications，vol.16, pp.1451-1458, Oet.1998.