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Performance Analysis of FM_DCSK under Multipath Fading Condition and Receiver Equalization

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Abstract:

In Frequency-Modulated Differential Chaos Shift Keying (FM-DCSK) modulation scheme, the digital information to be transmitted is mapped to an inherently wide-band chaotic signal rather than to a sinusoidal carrier. In this sense, FM-DCSK offers a new solution to spread spectrum communications. The FM-DCSK system can be used in every application where multipath propagation rather than thermal noise limits the overall system performance. Multipath performance is an important consideration for chaos-based communication systems. In this paper the performance of the FM-DCSK communication system over a AWGN channel is evaluated by computer simulations. The low-pass equivalent model of the FM-DCSK system is considered. Based on this model, we analyze the bit error performance and the effects of system parameters on the bit-error performance.

Keywords:

FM-DCSK; AWGN.

I.Introduction:

The frequency-modulated differential chaos-shift keying (FM-DCSK) communication system is a simple and practical candidate for spread spectrum (SS) communication applications . Such a system under an additive white Gaussian noise (AWGN) environment has been thoroughly studied (see for a survey). In wireless communications, however, the transmission environment is much more complex than what is covered by the simple AWGN model . The reflecting objects and scatterers in a wireless channel dissipate the signal energy, leading to multiple versions of the transmitted signal arriving at the receiver with different amplitudes, phases, and time delays.

These multipath waves combine at the receiver, causing the received signal to vary greatly in amplitude and phase. Such multipath fading therefore limits the performance in wireless applications. It is generally known that spread-spectrum systems perform significantly better than narrowband systems in a multipath environment. Since chaos-based systems are spread-spectrum systems, their performance in multipath environments should be taken into important practical consideration. The basic idea of the Differential Chaos Shift Keying (DCSK) modulation technique is that every information bit to be transmitted is represented by two chaotic sample functions. The first sample function serves as a reference while the second one carries the information. Bit "1" is sent by transmitting a reference signal provided by a chaos generator twice in succession, while for bit "0", the reference chaotic signal is transmitted, followed by an inverted copy of the same signal. The two sample functions are correlated at the receiver; a positive correlation indicates that bit "1" has been received, while a negative value indicates bit "0". Since a chaotic signal is not periodic, the energy per bit is not constant and can only be estimated, even in the noise-free case. This estimation has a non-zero variance that limits the attainable data rate. This problem can be avoided by using the FM-DCSK technique , where the energy per bit is kept constant. In FM-DCSK, the DCSK technique is combined with frequencymodulation to preserve the noise performance of DCSK modulation scheme and, in addition, to keep the energy per bit constant

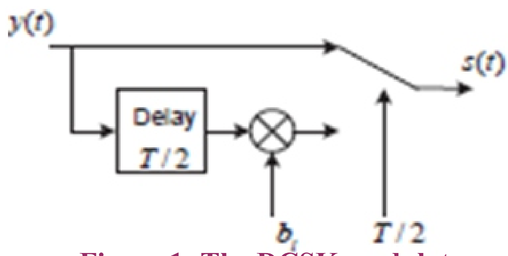

Figure 1: The DCSK modulator

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II. System Model
II.1. FM-DCSK System:

To our knowledge, there is no analytical expression available for the performance of the FM-DCSK system over a multipath channel. The computer simulation method has to be used to obtain the BER results. The FM-DCSK system is a RF band-pass system, which is based on the DCSK system as shown in Fig. 2.1.The multipath channel model used in this study is a two-ray Rayleigh fading channel as shown in Fig. 2.1 To simulate such a system directly, we need a high sampling rate and hence a rather long simulation time. For realistic and fast simulations, we consider the low-pass equivalent model of the FM-DCSK system [8]. The system model is shown in Fig. 2.2. In the low-pass equivalent model, the chaotic signal is generated by the chaotic generator with the chip duration Tc, and is fed into the FM modulator. The FM modulator is divided into two branches, namely, the I branch and Q branch. The outputs of the FM modulator are given by

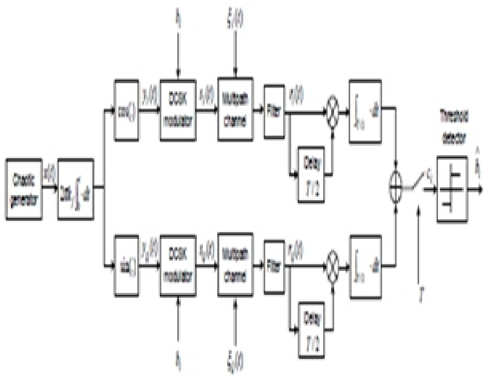

Figure 2.1: The FM-DCSK System

The multipath channel model used in this study is a two-ray Rayleigh fading channel as shown in Fig. 2.1 To simulate such a system directly, we need a high sampling rate and hence a rather long simulation time. For realistic and fast simulations, we consider the low-pass equivalent model of the FM-DCSK system [8]. The system model is shown in Fig. 2.2. In the low-pass equivalent model, the chaotic signal is generated by the chaotic generator with the chip duration Tc, and is fed into the FM modulator. The FM modulator is divided into two branches, namely, the I branch and Q branch. The outputs of the FM modulator are given by

$$y_I(t) = \cos\left(2\pi k_f \int_0^t x(t)dt\right) \ldots\ldots\ldots(1)$$

$$y_Q(t) = \cos\left(2\pi k_f \int_0^t x(t)dt\right) \ldots\ldots\ldots(2)$$

These signals are fed into the DCSK modulator. The binary information bit, bl , is modulated in this modulator, as shown in Fig. 1. After being modulated, every transmitted bit is represented by two chaotic signal . The first one serves as the reference whereas the second one carries the information. If "+1" is to be transmitted, the information-bearing segment will be identical to thereference segment, while if "–1" is to be transmitted, the information segment will be the inverted version of the reference i.e.

$$S(t) = \begin{cases} y(t) & (l-1)T \le t < (l-1)T + \frac{T}{2} \\ b_{ly}\left(t - \frac{T}{2}\right) & (l-1)T + \frac{T}{2} \le t < lT \end{cases} \ldots(3)$$

where T denotes the bit duration. The transmitted signal s(t) passes through the channel and is distorted, as a result of the fading and multipath delay spread. Before reaching the receiver, the transmitted signal is also corrupted by AWGN ξ(t). At the receiver, the received signal r(t) is demodulated by a differential coherent demodulator, after being filtered by the low-pass filter. The decision variable is then obtained by

$$c_l = \int r(t) r\left(t - \frac{T}{2}\right) dt \ldots\ldots\ldots(4)$$

Finally the decoded information bit is determined according to the following rule:

$$\widehat{b_l} = \begin{cases} +1 & if\ c_l \ge 0 \\ -1 & if\ c_l < 0 \end{cases} \ldots\ldots\ldots\ldots(5)$$

II.II. Multipath Fading Channel Model:

In the analysis of chaos-based communication systems, an AWGN channel model is often assumed. This assumption is valid for some practical communication systems and makes the analysis computationally tractable. However, in spread-spectrum wireless communication systems, the channel is more complex and the transmitted signal will suffer from fading and multipath delay spread in addition to the effect of noise. Under this condition a commonly used channel model is the two-ray independent Rayleigh fading channel model .

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Fig. 2.1 shows the block diagram of such a channel. The output of the channel is given by

$$\text{Output} = \alpha_1\, s(t) + \alpha_2\, s(t - \Delta T) + \xi(t)$$

where α1 and α2 are independent and Rayleigh distributed random variables, and Δτ > 0 is the time delay between the two paths. Also, ξ(t) is the AWGN with mean equal to zero and power spectral density N0/2. In a narrowband communication system, if the signals from two paths are out of phase, they cancel each other, resulting in a large attenuation. Moreover, they may reinforce each other if the signals are in phase. This effect is called multipath-related nullings and reinforcements . In the FM-DCSK system, however, one information bit is divided into several chips. Also, the frequencies of different chips are different as a result of applying FM. Suppose the variance of the carrier frequency is σf . It is readily shown that if Δτ □ Tc and √σf Δτ □ 1, "approximate" nullings (reinforcements) occur when the phase shifts due to the delay in the two paths are close to π, 3π, 5π, ... (0, 2π, 4π, ...). When these conditions are not met (which is the case for most practical situations), no multipath-related nullings or reinforcements would occur. This is one of the reasons why the FM-DCSK system performs better in a multipath environment than narrowband systems do.

III.Results:

In this project, Under Multipath Fading Condition, BER performances of FM-DCSK system has evaluated. The Multipath Fading Used here is Two Ray Independent Rayleigh Fading Channel.

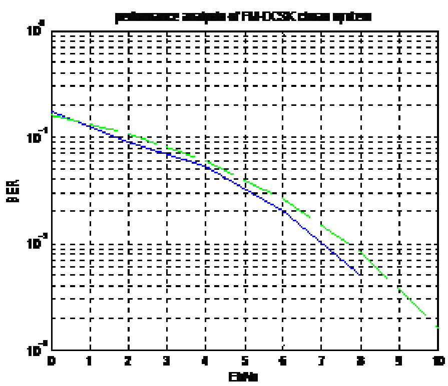

Figure 3.1 BER performance of FM-DCSK With respect to EbNo.

In Rayleigh channel, Figure 3.1 shows BER performance of FM-DCSK system with respect to Energy per bit has been Evaluated.

Figure 3.2 shows BER performance of FM-DCSK System Under Multipath Fading Channel with respect to Signal to Noise ratio.

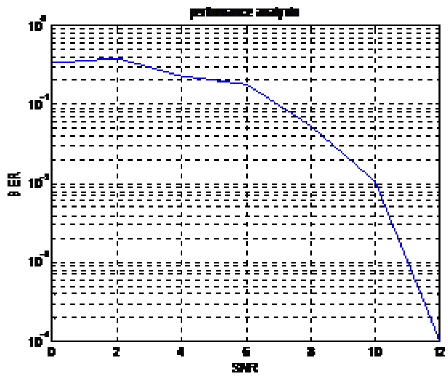

Figure.3.2. BER performance of FM-DCSK system with respect to SNR

IV. Conclusion:

In this project, in Rayleigh fading channel, BER performances of FM-DCSK System Under Mulipath Fading Channel Condition has been Evaluated. Firstly the BER performance of FM-DCSK system with respect to Energy per bit has been Evaluated. Lastly BER performance of FM-DCSK System Under Multipath Fading Channel with respect to Signal to Noise ratio. Thus, the figure shows the BER performance of FM-DCSK System with chaos System has improved.

V.Acknowledgement:

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Finally, I express our immense gratitude with pleasure to one and all who either directly or indirectly have contributed to our need at right time for the development and execution of project work.

References:

[1] G. Kolumb´an, B.Vizv´ari, W. Schwarz, and A.Abel. Differential chaos shift keying: A robust coding for chaotic communication. In Proc. NDES'96, pages87–92-,Seville, June27–28 1996.

[2] M.P.Kennedy and G.Kolumb'an. Digital communications using chaos. Signal Processing, 80(7):1307–1320, July 2000.

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A Peer Reviewed Open Access International Journal

[3] G.Kolumb´an. Theoretical noise performance of correlator-based chaotic communications schemes.IEEE Trans. Circuits and Systems–Part I: Fundamental Theory and Applications, 47(12):1692–1701,Dec. 2000.

[4] S. Haykin. Communication Systems. John Wiley &Sons, New York, 3rd edition, 1994.

[5] E. Kreyszig. Advanced Engineering Mathematics.Wiley, New York, 1999.

[6] S.Mandal and S. Banerjee, "Performance of differential chaos shift keying over multipath fading channels "Indian Nat. Conf. Nonlinear Syst. Dynamics, 2003.

[7] Y. Xia,C. K. Tse, and F. C.M. Lau, "Some benchmark multipath performance data of coherent CSK digital communication systems," Proc. Int. Workshop on NonlinearCircuits Signal Processing, 2004, pp. 261–264.

[8] Y. Xia, C. K. Tse, and F. C. M. Lau, "Performance of differential chaos-shift-keying digital communication systems over a multipath fading channel with delay spread," IEEE Trans. Circuits and Systems II.

[9] G. Kolumb´an, "Performance evaluation of chaotic communications systems: determination of low-pass equivalent model," Proc. IEEE Workshop on Nonlinear-Dynamics of Electronic Systems, Budapest, Hungary,pp. 41–51, 1998.688