BER Analysis of Chaos Shift Keying Based OFDM for Future Communication

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Abstract- The system endeavors to provide a good trade-off between robustness, energy efficiency and high data rate, while still being simple compared to conventional multi-carrier spread spectrum systems. This system can be seen as a parallel extension of the DCSK modulation where one chaotic reference sequence is transmitted over a predefined subcarrier frequency. Multiple modulated data streams are transmitted over the remaining subcarriers. This transmitter structure increases the spectral efficiency of the conventional DCSK system and uses less energy. The receiver design makes this system easy to implement where no radio frequency delay circuit is needed to demodulate received data. Various system design parameters are discussed throughout the paper, including the number of subcarriers, the spreading factor, and the transmitted energy. Once the design is explained, the bit error rate performance of the MC-DCSK system is computed and compared to the conventional DCSK system under multipath Rayleigh fading and an additive white Gaussian noise (AWGN) channels. Simulation results confirm the advantages of this new hybrid design.

Keywords- DCSK, AWGN, additive white Gaussian noise, modulation, transmitter.

I. INTRODUCTION

The communication happens once the receiver recognizes the particular message sent by the transmitter. At present, the wireless communication systems face the request for enhanced data rates, larger carrier frequencies, higher mobility and more link reliability. In wireless communication, wireless channels are described by multipath, frequency and time selectivity, fading and limited bandwidth which make system design as a challenge one. Thus the behaviour of wireless channels to know their performance limits and the corresponding system design become vital to understand. These wireless channels include several nodes and used to calculate SNR. The models which are included in the channels are nothing but function of separation between transmitter and receiver, the channel gain and the path loss exponent. Channel gain is one such a time-variant parameter which can be modelled using various probability distributed function. Thus it is significant to assess the execution of wireless accessory by considering the wireless channel parameters, transmission characteristics and device structure. The execution of data transmission over wireless channels is taken by finding their BER, i.e. function of SNR at the receiver side. A wideband, periodic signal with noise is used as carrier signal in against to the general modulation scheme which resulted in better correlation features and robustness against multipath fading effects. The models/distribution to be assessed is Rayleigh, Gaussian, and Additive White Gaussian Noise Channel, expecting that one of the models with high BER considers as the best model. The generated data is transformed to bits, redesigned and modulated with DNSK signalling arrangement. Many design tools are available to execute and calculate the improvement of DNSK receiver among those tools Math Works TM called Simulink TM which is very flexible one and is considered as a high-level design/simulation tool. The description structure of circuit is much related to design and implemented further. In addition, various representing tools to alter including Simulink HDL coder is used which copied directly hardware devices known as Field Programmable Gate Array (FPGA) devices.

II. RELATED STUDY

In this paper, we first introduce a new design of OFDM-DCSK system. On the transmitter side, all of the occupied subcarriers are grouped into several groups (assume L groups). In each group, one subcarrier is assigned to transmit the reference slot, while the other subcarriers (assume M subcarriers) will carry the data slots. This design not only increases the data rate and saves the transmitted bit energy because one chaotic reference is used to transmit M bits, but also solves the RF delay problem. Then, we analyze the BER performance under AWGN channel with Gaussian approximation, which assumes that the correlate output follows the normal distribution. Moreover, numerous simulation results are given under AWGN and two-path Raleigh flat fading channels. Finally, we compare the accuracy of the BER expression with the numerical performance. At the receiver end, the data are recovered via the reference signal (the middle subcarrier) in the current group, while all of the data are detected via the same reference signal (the first subcarrier). As well know that OFDM system can be considered as a wideband system. Each subcarrier forms a narrowband system and the adjacent subcarriers' have similar channel gains. For AWGN channel, maybe all of the subcarriers in an OFDM symbol have similar channel gains, while for flat fading Rayleigh channel; different subcarriers have different channel gains. Thus, it is very important to divide all of the occupied subcarriers into several groups and the data are detected by interference signal in the current group, which is similar as the concept of resource block in 3GPP LTE.

III. AN OVERVIEW OF PROPOSED SYSTEM

Secondly, we thoroughly analyze the performance under multipath Rayleigh fading and AWGN channels, without neglecting the dynamic properties of chaotic sequences. In our computation approach, the transmitted bit energy is not considered as constant. Many approaches have been considered for computing the bit error rate performances of the DCSK system, such as Gaussian approximation (GA). This approximation assumes that the correlate output follows the normal distribution. Applied to the DCSK system over an AWGN or multipath channel, this method provides rather good estimates of the bit error rate (BER) for very large spreading factors, but when the spreading factor is small, the results produced by the Gaussian approximation method are rather disappointing. Another accurate computation methodology is developed to compute the BER performance DCSK over different wireless channels. Their approach enables the dynamic properties of the chaotic sequence by integrating the BER expression for a given chaotic map over all possible chaotic sequences for a given spreading factor. This latter method is compared to the BER computation under the Gaussian assumption, and seems more realistic to match the exact BER.

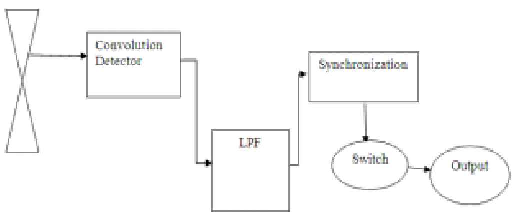

Fig.1: Model diagram

The information frames formatting scheme for multiple access system, where the reference sample and data sample are different for different users, is presented in Figure 2. For the user, every frame will consist of half bit slots, where the first i half-bit slot is used to transmit i half bit slot is used to transmit I reference samples, while the remaining I half-bit slot is used to transmitting the data samples. If "+1" is transmitted in slot i+1, the sample in slot 1 is repeated in slot i+1, otherwise, the inverted copy is sent. The algorithm is repeated for 1+ N slot within a frame. Reference samples and data samples will be transmitted sequentially within each frame for each user. The number of slots in a frame is a reflection of the number of users for whom the transfer of binary information is executed. On the receiver's side, the reference sample for each slot will correlate with the data sample that corresponds to it throughout the frame.

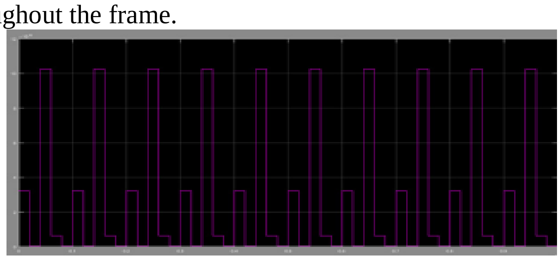

Fig.2: Receiver Output

IV. CONCLUSION

A multi-user OFDM-DCSK has been proposed in this paper. This new system aims at increasing the spectral and energy efficiencies, allowing multiple access transmission, reducing complexity by using IFFT/FFT operations instead of parallel matched filters as in MC-DCSK and solving the RF delay line problem faced in conventional DCSK schemes. The key element of this design is to assign NP private subcarriers to each user and leave the remaining NS = N − P NP subcarriers as shared public subcarriers. Simulation results match the theoretical BER expression. Compared with DCSK system, 1) increase the energy efficiency DBR from 1/2 to M/(M+1), where one chaotic reference signal should be transmitted for each information bit, while M bit information share one chaotic reference signal in the OFDM-DCSK system; 2) simulation results show an increase in performance as compared with the same spread factor β; 3) solve the radio frequency delay problem not only in DCSK system, but also in HE-DCSK or CS-DCSK systems. Compared with OFDM system, no channel estimation is needed at the receiver side and no CSI feedback is needed to the transmitter side. Compare with the OFDM-CSK in [8], we can obtain better BER performance under two-path Rayleigh channels. It is much easier to apply in practice.

V. REFERENCES

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