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Efficient Cognitive Radio Systems Using PAPR Reduction and Side Lobe Suppression

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Abstract: *It is well known that the high peak-to-average power ratio (PAPR) and large spectrum side lobe power are two primary disadvantages at the transmitter in non-contiguous orthogonal frequency division multiplexing (NC-OFDM) based cognitive radio (CR) systems. In this paper, we propose a novel signal cancellation (SC) method for joint PAPR reduction and side lobe suppression in NC-OFDM based CR systems. The key thought of the proposed strategy is to rapidly expand some part of constellation points on the secondary user (SU) subcarriers and include a few signal-cancellation symbols on the primary user (PU) subcarriers, to create the appropriate cancellation signal for joint PAPR reduction and side lobe suppression. At that point, the SC method formulates the problem of the joint PAPR reduction and side lobe suppression as a quadratic ally constrained quadratic program (QCQP) to acquire its optimal cancellation signal. In addition, we also propose a suboptimal SC (Sub-SC) strategy to efficiently solve the QCQP optimization problem with low computational complexity. Simulation results show that the proposed SC method and Sub-SC technique can provide both significant PAPR reduction and side lobe suppression performances*.

Keywords: *Non-contiguous orthogonal frequency division multiflexing(NC-OFDM),cognitive radio,sidelobe suppression, peak to average power ratio(PAPR).*

1. Introduction

Recently, cognitive radio (CR) has drawn significant attention from academic and industrial communities to meet the ever-growing needs of spectrum resources and high data rate communication. For CR systems, non-contiguous orthogonal frequency division multiplexing (NC-OFDM) is an attractive physical layer technology due to its considerable high spectrum efficiency, multipath delay spread tolerance, immunity to the frequency selective fading channels and high power efficiency depicts the coexistence of the NC-OFDM based CR system with both secondary users (SUs) and primary users (PUs). For the NC-OFDM based CR system, the SUs are cognitive unlicensed users which detect and utilize the subcarriers located in the unused spectrum band for data transmission. Moreover, the PU subcarriers which are located in the PU spectrum band need to be turned off to create spectrum notches to limit the interference to the PUs in the conventional NC-OFDM based CR system.

Although the NC-OFDM based CR system has many advantages, it still suffers from two main drawbacks. The first main drawback is its high peak-to-average power ratio (PAPR) of the transmitted NC-OFDM signals. Since the high power amplifier (HPA) used in the NC-OFDM based CR system has limited linear range, the NC-OFDM signals with high PAPR will be seriously clipped and nonlinear distortion will be introduced, resulting in serious degradation of the bit error rate (BER) performance .Moreover, the high PAPR leads to the out-of-band radiation, which causes serious adjacent channel interferences. The second main drawback of the NCOFDM based CR system is its large spectrum sidelobe.

The large spectrum sidelobe introduces interference to the adjacent PUs, resulting in the serious performance degradation of the adjacent PUs. Hence, it is highly desirable to suppress the spectrum sidelobe as much as possible in the NC-OFDM based CR system.

Recently, various methods have been proposed to reduce the PAPR for the NC-OFDM based CR system in the literature, such as clipping, partial transmit sequence active constellation extension (ACE), and tone reservation (TR). These PAPR reduction techniques can efficiently reduce the PAPR of transmitted signals; however, they do not take the sidelobe suppression into account. Moreover, to suppress the side lobe of the NC-OFDM based CR system, many schemes have been proposed in the literature, such as active interference cancellation (AIC). extended active interference cancellation (EAIC), constellation adjustment (CA) ,pulse shaping (PS) ,spectrum pre coding (SP) ,and side lobe suppression with orthogonal projection (SSOP) ,The AIC method utilizes some subcarriers as the guard band to suppress the side lobe, resulting in the decrease of the spectrum efficiency.

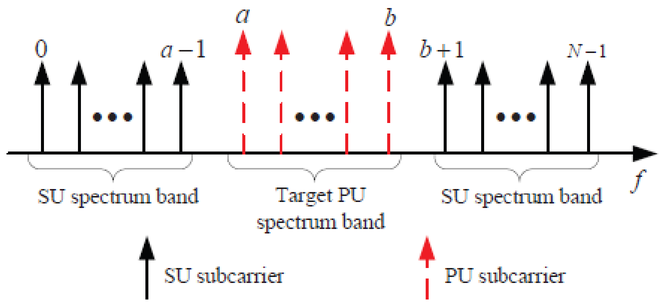


Fig. 1. NC-OFDM based CR system coexisting with the PU and SUs.

Cognitive radio systems are radios with the ability to exploit their environment to increase spectral efficiency and capacity. As spectral resources become more limited the FCC1 has recommended that significantly greater spectral efficiency could be realized by deploying wireless devices that can coexist with primary users, generating minimal interference while somehow taking advantage of the available resources. Such devices, known as cognitive radios, would have the ability to sense their communication environment and adapt the parameters of their communication scheme to maximize rate, while minimizing the interference to the primary users. Thus the two most popular research areas when it comes to cognitive radios are spectrum sensing and interference management and resource.

2. Literature Review

2.1 Robust End-To-End QOS Maintenance in Non-Contiguous OFDM Based Cognitive Radio.Author's name W.M. Joseph, B.L. Khaled, and C. Zhigang

This work has proposed a recent development in wireless communication is Cognitive Radio (CR) technology, an innovative radio design approach which allows the realization of intelligent allocation of the scarce radio resources such as spectrum. In this paper, we attempt to exploit past channel information and the flexibility of non-contiguous orthogonal frequency division multiplexing (NC-OFDM) based CRs to maintain end-to-end QoS performance under dynamic spectrum sharing environments. So far, most research works in resource allocation in CRs have mainly concentrated on the spectrum opportunity discovery aspect while the robust QoS performance problem has remained largely unexplored. In this work, we use the concept of portfolio optimization to achieve QoS maintenance in NC-OFDM CR systems. The problem of allocating power to maintain throughput is cast into a channel gain variance minimization and mean- variance maximization frameworks to achieve a given throughput performance under fixed BER and power limitation constraints. Numerical results are presented to demonstrate the QoS maintenance performance in various wireless channel settings.

2.2 Adaptive-Mode Peak-to- Average Power Ratio Reduction Algorithm for OFDM-based Cognitive Radio, Author's name Rakesh Rajbanshi, Alexander M. Wyglinski, Gary J. Minden

Introduction:

This paper is defining the a novel low complexity algorithm for reducing the peak-to-average power ratio (PAPR) occurring in OFDM-based cognitive radios. Although several PAPR reduction algorithms exist in the literature, they are often only effective for specific scenarios. Our proposed algorithm exploits the agility of cognitive radio technology to rapidly choose and employ the appropriate PAPR reduction approach from a set of approaches to achieve a large decrease in PAPR, given the current operating conditions. The results show that for a wide range of operating conditions, the proposed algorithm achieves a large decrease in PAPR, unlikely the PAPR results when only a single reduction approach is employed across the same wide range.

2.3. Peak-to-average power ratio reduction scheme in impulse postfix OFDM system

Author's name Byung Moo Lee , Youngok Kim

Introduction:

Here we presents the a recently introduced impulse postfix OFDM (IPOFDM) system achieves the enhanced bit error rate (BER) performance compared to that of conventional OFDM systems, but there is an important peak-to-average power ratio (PAPR) issue of using impulse postfix (IP) that needs to be resolved. This paper proposes a combined IP-OFDM scheme with the selected mapping technique and the optimum power boosting factor (PBF) determination method to resolve the PAPR issue while achieving the enhanced BER performance. In this paper, the effectiveness of proposed scheme is analyzed in terms of the BER performance as well as the input back-off (IBO) to high power amplifier. The analytic results show that the proposed scheme provides the remarkable BER performance enhancement with relatively low IBO (or PBF) rather than with high IBO (or PBF).

3. PROPOSED SYSTEM

In this method we proposed a new signal cancellation (SC) method for joint PAPR decrement and side lobe suppression in NC-OFDM based CR systems. The scheme for proposed method is to dynamically increase a part of constellation points on the secondary user (SU) subcarrier and add minimum signal cancellation symbols on the primary user (PU) subcarrier, for an accurate cancellation signal for joint PAPR reduction and side lobe suppression. The SC method also solves the difficulties of the joint PAPR reduction and sidelobe suppression as a quadratic ally constrained quadratic program (QCQP) to obtain its optimal cancellation signal. The suboptimal SC (Sub-SC) method to effetely overcome the QCQP optimization problem with minimum computed difficulty. The final results show the SC method and Sub-SC method organize both characteristics of PAPR reduction and sidelobe suppression.

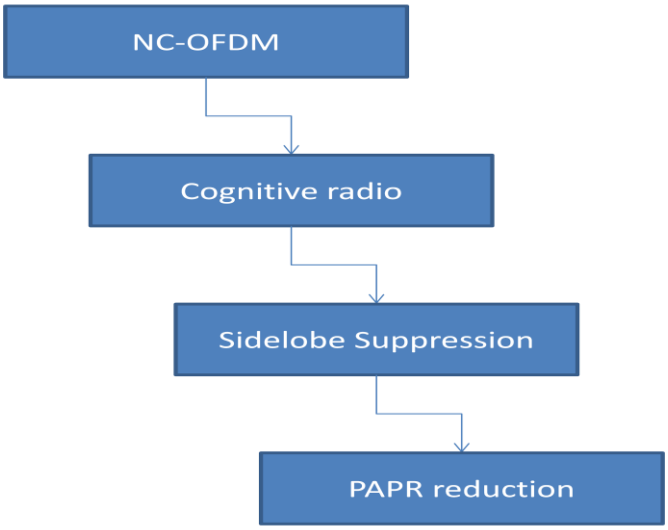
Missing samples are recovered by reinserting data obtained by approximating the original noisy and incomplete data volume with new observations obtained via the rank-reduction process. A detector recovers information of interest that is contained in a modulated wave. The term ''detector'' dates back from the early days of radio use, when all transmissions were done in Morse code and it was only necessary to detect the presence of a radio wave using a device such as a coherer without necessarily making it audible. A more updated term would be ''demodulator''.

The Higher-Order Singular Value Decomposition (HOSVD) is used to reduce the rank of the pre-stack seismic tensor to identify signal of cognitive radio network without any noise interfering. Synthetic data demonstrate the ability of the proposed seismic data completion algorithm to reconstruct events with curvature. The synthetic example also allows quantifying the quality of the reconstruction for different levels of noise and survey sparsity.

The NC-OFDM based CR system has many advantages; also it has two main disadvantages. One of the disadvantages is its high peak-to-average power ratio (PAPR) in NC-OFDM signal transmitter. Till now the high power amplifier (HPA) used in the NC-OFDM based CR system has limited linear range, the NC-OFDM signals with high PAPR will be seriously clipped and nonlinear distortion will be introduced, resulting in serious degradation of the bit error rate (BER) performance. The second main disadvantage of the NC-OFDM based CR system is its large spectrum sidelobe. The large spectrum sidelobe introduces interference to the adjacent PUs, resulting in the serious performance degradation of the adjacent PUs. Hence, it is highly desirable to suppress the spectrum sidelobe as much as possible in the NC-OFDM based CR system. In our method we propose a new method named as signal cancellation (SC), for joint PAPR reduction and sidelobe suppression in the NC-OFDM based system.

The proposed SC method, part of the outer constellation points on SU subcarriers are dynamically extended while several signal cancellation symbols are added on the PU subcarriers, to create the effective cancellation signal for joint PAPR reduction and sidelobe suppression. In the SC method correct the problem of the joint PAPR reduction and sidelobe suppression as a quadratically constrained quadratic program (QCQP) and the optimal cancellation signal can be obtained by convex optimization. We also propose a suboptimal SC (Sub-SC) method to effectively solve the QCQP optimization problem with low complexity.

4. Architecture of the Proposed System



4.1.Ofdm Modulation/Demodulation:

The bit stream to be transmitted is mapped to QAM symbols followed by a 64-point IFFT, parallel-to-serial conversion and extension of the resulting time-domain sequence by a cyclic prefix of length 16. Since IEEE 802.11a is a time division duplex (TDD) system, the same hardware can be reused to perform the FFT. Moreover, one I/FFT hardware block is shared by the four transmit (receive) antennas. At the system clock frequency of 80 MHz, a single-butterfly radix-4 I/FFT was found to provide sufficient performance.

4.2.Fft/Ifft Block:

Each FFT stage of radix 2 FFT stage include one radix 2 butterfly computing unit, memory blocks to cache the streaming data, ROM to store FFT twiddle factors, control logic. The memory size of each stage equals the stage number. Here only one butterfly resource is used for each stage because of serial FFT implementation instead of 4 butterfly resources in case of typical 8-point FFT. The FFT of each OFDM symbol is performed to find the original transmitted spectrum. In order to perform frequency domain data into time domain data, IFFT block is used. Inverse Fast Fourier Transform (IFFT) correlates the frequency domain input data with its orthogonal basis functions, which are sinusoids at certain frequencies. This correlation is equivalent to mapping the input data onto the sinusoidal basis functions. It provides complete spectrum setting. The FFT and IFFT are the most important blocks in the OFDM system and their performances have a big effect on the whole system. IFFT increase the speed of processing and decrease the computational complexity.

4.3.Ofdm Transmitter:

A transmitter or radio transmitter is an electronic device which, with the aid of an antenna, produces radio waves. The transmitter itself generates a radio frequency alternating current, which is applied to the antenna. When excited by this alternating current, the antenna radiates waves. Orthogonal frequency division multiplexing (OFDM) transmitters typically consists of a discrete DFT matrix and a digital-to-analogy (DAC) converter. In transmitter input signal should be selected randomly for the transmitter to send the packets to one node to another node as source to destination procedure. The following manner is considered as two impotent drawbacks occurred at the transmitter in during the transaction of signals. Using powerful signal cancellation at the transmitting signals for reducing the joint PAPR and suppresses the sidelobe suppression in whole process of OFDM based CR system.

4.4.Ofdm Receiver:

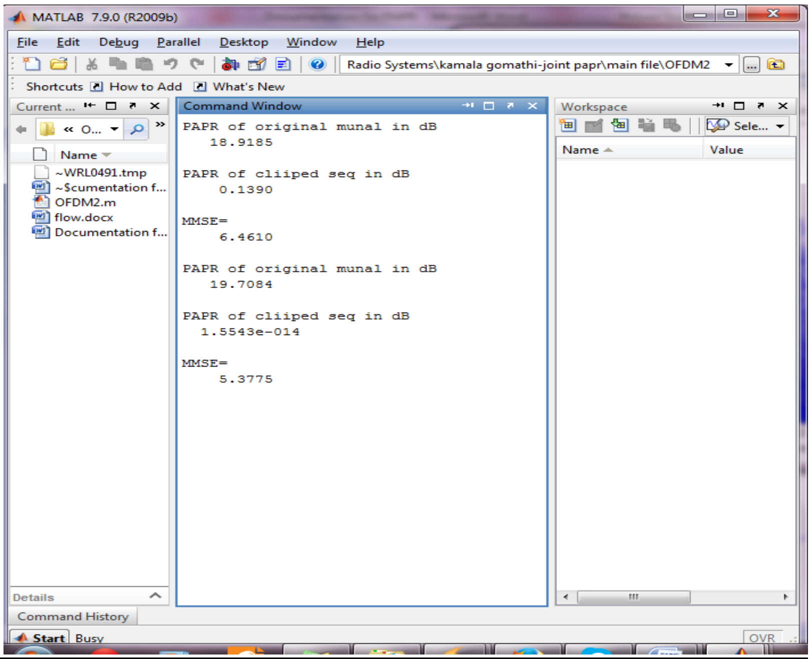
The receiver blocks are depends on method used to code the signal in transmitter. The receiver picks up the signal $r(t)$, which is then quadrature-mixed down to baseband using cosine and sine waves at the carrier frequency. This also creates signals centered on $2f_c$, so low-pass filters are used to reject these. a radio receiver is an electronic device that receives radio waves and converts the information carried by them to a usable form. It is used with an antenna. The antenna intercepts radio waves (electromagnetic waves) and converts them to tiny alternating currents which are applied to the receiver, and the receiver extracts the desired information. The baseband signals are then sampled and digitized using analog-to-digital converters (ADCs), and a forward FFT is used to convert back to the frequency domain. This returns N parallel streams, each of which is converted to a binary stream using an appropriate symbol detector. The information produced by the receiver may be in the form of sound images a data. A radio receiver may be a separate piece of electronic equipment, or an electronic circuit within another device These streams are then re-combined into a serial stream, $\hat{s}[n]$, which is an estimate of the original binary stream at the transmitter. After receiving the symbol cyclic prefix should be removed. Then data is transmitted to the FFT block.FFT block converts time domain signal to frequency domain Receiver is designed separately before connecting it to transmitter. FFT is calculated using an algorithm developed for transmitter. DIT radix-2 butterfly is used to calculate FFT and IFFT.

Similar to transmitter, receiver also uses the IP cores for floating point complex multiplication, additions and subtractions. Receiver operations are broken in to different processes and merged to have complete system. After FFT operation, demodulation is done for demodulation look up table approach is used. Once the bits are recovered from the received constellation, the reception is completed. After the receiver signal to be captured by the user signal could be saved and transmitted the upgrading processes of further transactions at the OFDM based CR system.

4.5.Advantages of the Proposed System:

- It is the very effective method for reduction joint PAPR and Sidelobe suppression.
- Using signal cancellation (SC) for joint PAPR reduction and sidelobe suppression.
- The process done by NC-OFDM is based on cognitive radio (CR).
- High throughput savings are achieved even when the number of CR users is as small.
- It is robust to changes in the hardware spectrum switching delay.
- Throughput savings is achieved by increase the number of frequencies in the CRN cell and hardware switching delay for a unit frequency difference.

5. RESULTS & SCREEN SHORT:



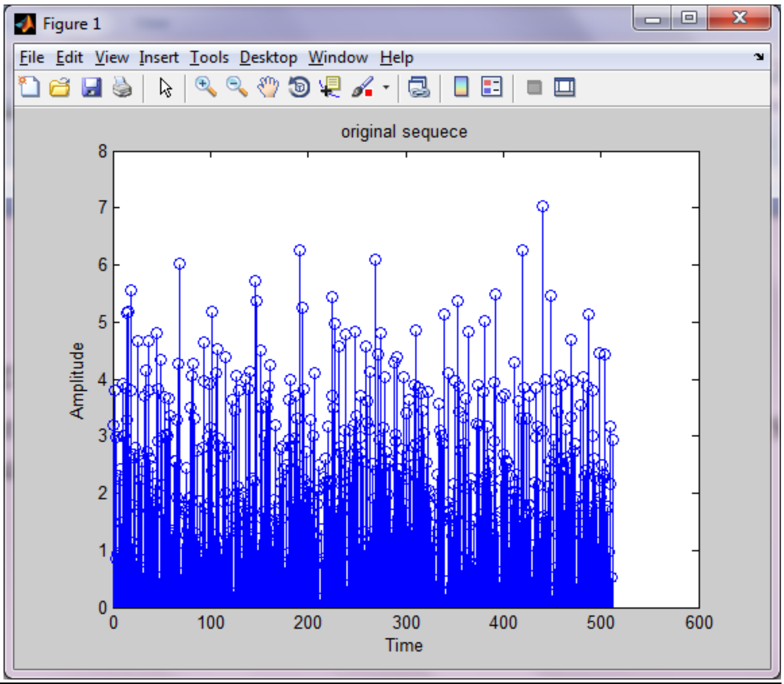


Figure 1
File Edit View Insert Tools Desktop Window Help
original sequece
Amplitude
Time
0
1
2
3
4
5
6
7
8
0
100
200
300
400
500
600

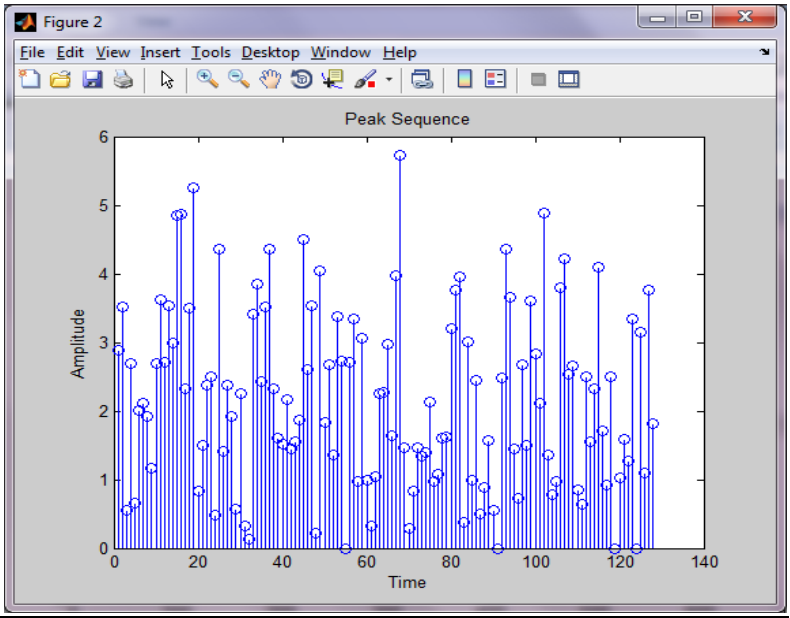


Figure 2
File Edit View Insert Tools Desktop Window Help
Peak Sequence
Amplitude
Time
0
1
2
3
4
5
6
0
20
40
60
80
100
120
140

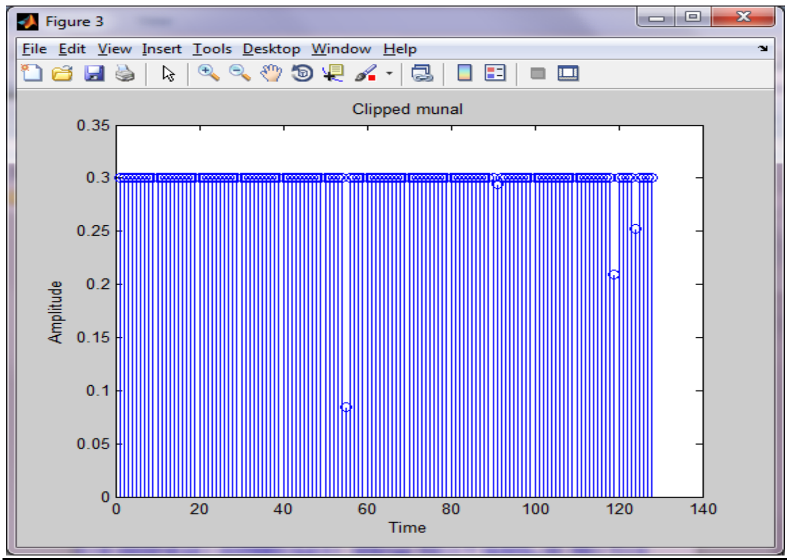


Figure 3
File Edit View Insert Tools Desktop Window Help
Clipped munal
Amplitude
Time
0
0.05
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0.15
0.2
0.25
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0.35
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20
40
60
80
100
120
140

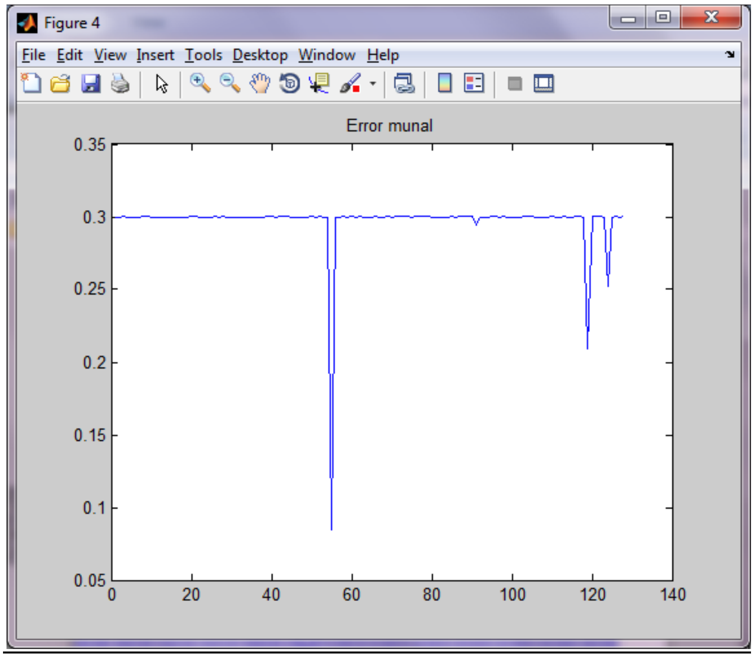


Figure 4
File Edit View Insert Tools Desktop Window Help
Error munal
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0 20 40 60 80 100 120 140

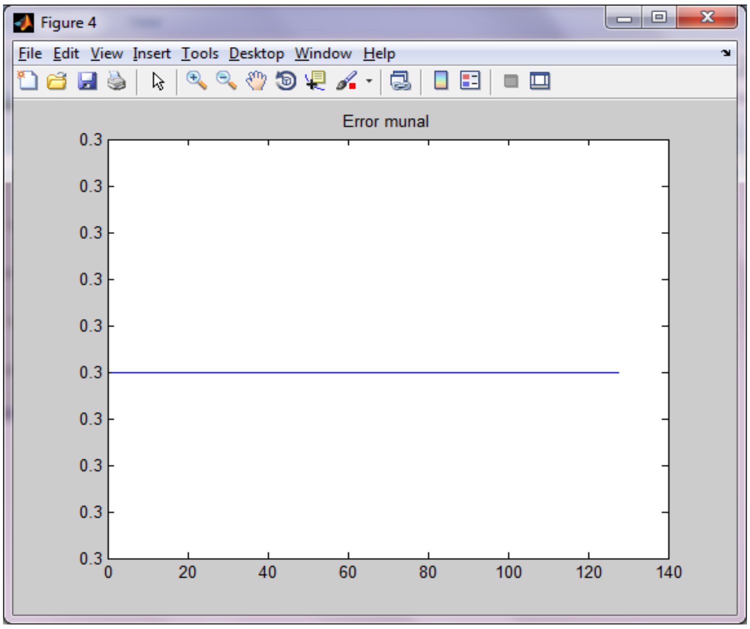


Figure 4
File Edit View Insert Tools Desktop Window Help
Error munal
0.3
0 20 40 60 80 100 120 140

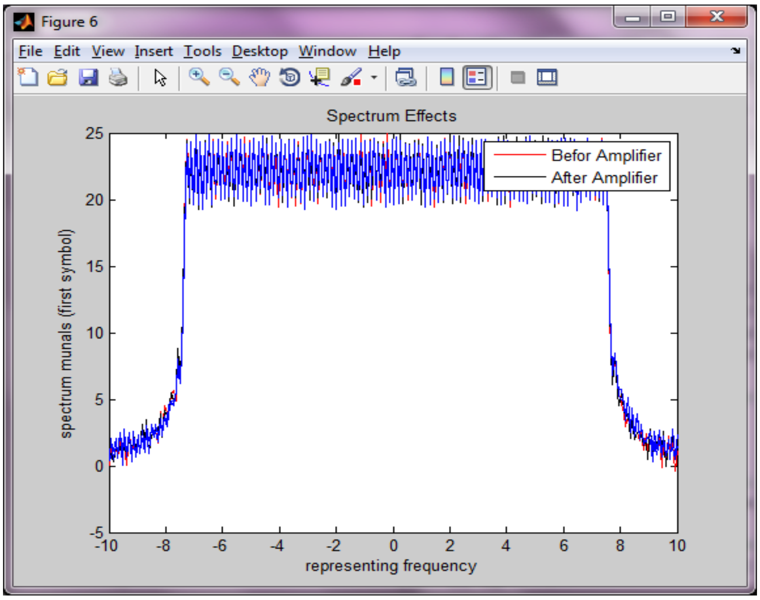
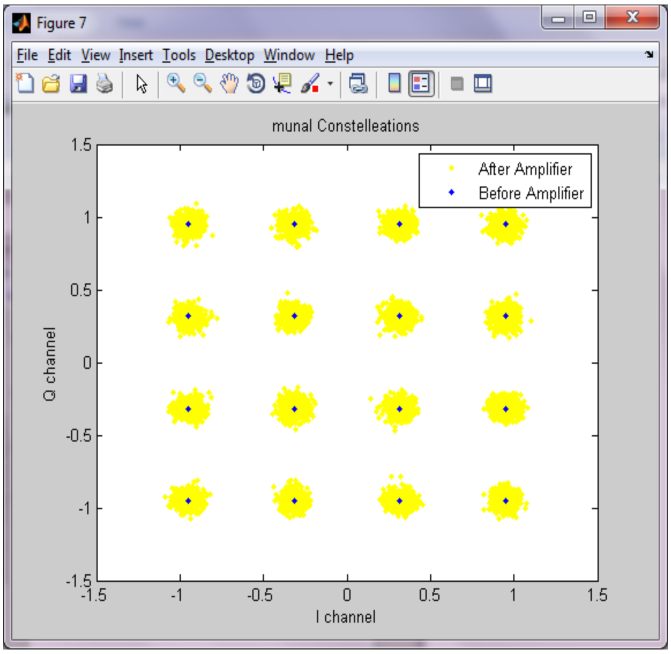
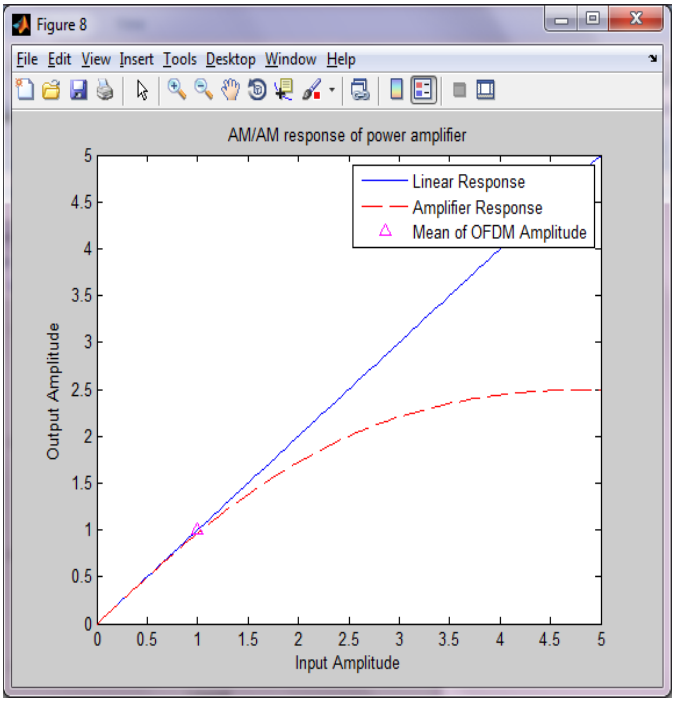


Figure 6
File Edit View Insert Tools Desktop Window Help
Spectrum Effects
Befor Amplifier
After Amplifier
spectrum munals (first symbol)
25
20
15
10
5
0
-5
-10 -8 -6 -4 -2 0 2 4 6 8 10
representing frequency





6. Conclusion

In this paper, we proposed a signal cancellation method for joint PAPR reduction and sidelobe suppression in NC-OFDM based CR systems. The proposed SC method dynamically extends part of constellation points on the SU tones and adds several signal-cancellation symbols on the PU tones to jointly reduce the PAPR and suppress the sidelobe of NC-OFDM signals. Moreover, we also proposed a suboptimal SC method to efficiently reduce the PAPR and suppress the sidelobe with low computational complexity. Simulation results show that both the SC method and suboptimal SC method can provide significant PAPR reduction and sidelobe suppression performances.

References

[1]. S. Haykin, “Cognitive radio: Brain-empowered wireless communications,” IEEE Journal on Selected Areas in Communications, vol. 23, no. 2, pp. 201-220, Feb. 2005.

[2]. Y. Zou, Y. Yao, and B. Zheng, “Cooperative relay techniques for cognitive radio systems: Spectrum sensing and secondary user transmissions,” IEEE Communications Magazine, vol. 50, no. 4, pp. 98-103, Feb. 2012.

[3]. X. Huang, G. Wang, and F. Hu, "Multitask spectrum sensing in cognitive radio networks via spatiotemporal data mining," IEEE Transactions on Vehicular Technology, vol. 62, no. 2, pp. 809-823, Feb. 2013.

[4]. Z. Li and X.-G. Xia, "Time-domain interference cancellation for ALAMOUTI-coded cooperative OFDM systems with insufficient CP," IEEE Transactions on Vehicular Technology, vol. 59, no. 6, pp. 3131- 3136, Jul. 2010.

[5]. D. Qu, Z. Wang, and T. Jiang, "Extended active interference cancellation for sidelobe suppression in cognitive radio OFDM systems with cyclic prefix," IEEE Transactions on Vehicular Technology, vol. 59, no. 4, pp. 1689-1695, May 2010.

[6]. J.-C. Chen, M.-H. Chiu, Y.-S. Yang, and C.-P. Li, "A suboptimal tone reservation algorithm based on cross-entropy method for PAPR reduction in OFDM systems," IEEE Transactions on Broadcasting, vol. 57, no. 3, pp. 752-756, Sep. 2011.

[7]. J.-C. Chen and C.-P. Li, "Tone reservation using near-optimal peak reduction tone set selection algorithm for PAPR reduction in OFDM systems," IEEE Signal Processing Letters, vol. 17, no. 11, pp. 933-936, Nov. 2010.

[8]. T. Jiang, C. Li, and C. Ni, "Effect of PAPR reduction on spectrum and energy efficiencies in OFDM systems with Class-A HPA over AWGN channel," IEEE Transactions on Broadcasting, vol. 59, no. 3, pp. 513- 519, Sep. 2013.

[9]. D. Qu, J. Ding, T. Jiang, and X. Sun, "Detection of non-contiguous OFDM symbols for cognitive radio systems without out-of-band spectrum synchronization," IEEE Transactions on Wireless Communications, vol. 10, no. 2, pp. 693-701, Feb. 2011.

[10]. I. Gutman, I. Iofedov, and D. Wulich, "Iterative decoding of iterative clipped and filtered OFDM signal," IEEE Transactions on Communications, vol. 61, no. 10, pp. 4284-4293, Oct. 2013.