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An efficient Synchronization Aspects in Cognitive Radio Systems

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Abstract

In this paper we discuss the synchronization problems in cognitive radio systems and suggested an efficient synchronization aspect. For this type of system the secondarytransmitter is well aware of the transmission timing of the primary transmitter forbetter harmonizing in the primary and secondary system. We also discuss the time and frequency aspects of the system. For analysis we split the transmission spectral efficiency in two parts from reducing the time delay and improving the efficiency.We estimate the delay in the synchronization and equalization mode by using Matlab for programming and simulation.

Keywords

Cognitive Radio, synchronization, equalization, time delay

1. Introduction

Cognitive radio [1] [2] has attracted plenty of studies inrecent years. It helps to solve the under-utilization of frequencyspectrum [3]. In a cognitive radio system, users without spectrum license called secondary users are allowed to usefrequency bands not being used by users having license called primary users, thus improving the spectrum efficiency.

Cognitive radio (CR) has drawn significantattention from academic and industrial communities tomeet the ever-growing needs of spectrum resources and highdata rate communication [4]. For wideband CR, orthogonalfrequency division multiplexing (OFDM) is an attractivecandidate physical layer technology due to its capability oftransmitting over non-contiguous frequency bands [5]–[9].

However when CR systems are used, the primary-user (PU) has tobe detected. When dealing with multicarrier transmissions, energydetection can be chosen as a spectrum sensing technique [10], [11]. Itis optimal if the cognitive devices have no a priori information aboutthe PU signal. In case of shadowing or fading, PU detection can nolonger be guaranteed. Then the PU signal may be disturbed by undesirable narrow-band interference (NBI) caused by the CR. Thismay lead to an inaccurate estimation of the carrier frequency offset(CFO) and hence increases the bit error rate. Therefore, NBI has tobe detected and taken into account to deduce the CFO. There are several fields where the need of harmonization with the cognitive radio are Uncontrolled Urbanization [12],AODV & DSR Routing Protocol [13],Advanced Instrumentation[14],traffic density conditions with cognitive radios [15] etc.

We provide here an overview of cognitive radio. Other sections are arranged in the following manner: Section 2 introduces related work; Section 3 discusses proposed work; Section 4 describes about result analysis; section 5 shows the Conclusion.

2. Related Work

In 2011, StergiosStotas et al. [16] focus on the throughput maximization of spectrum sharing cognitive radio networks and propose a novel cognitive radio system that significantly improves their achievable throughput. They introduce a novel receiver and frame structure for spectrum sharing cognitive radio networks and study the problem of deriving the optimal power allocation strategy that maximizes the ergodic capacity of the proposed cognitive radio system under average transmit and interference power constraints. They also observe the outage capacity of the proposed cognitive radio system under various constraints that include average transmit and interference power constraints, and peak interference power constraints.

In 2011, Shixian Wang et al. [17] propose an agent based realization method, which had been investigated in the autonomic communication research. They proposed architecture models based on the similarity between cognitive radio and autonomic communication. The autonomic cognitive radio node is expressed by autonomic communication element (ACE) architecture and a realization method is given based on the open-source ACE toolkit, which establishes a simulation environment for cognitive radio research.

In 2012, Mohd. FahadFahim et al. [18] provide an average of maximum-minimum inverse cumulative distribution function (ICDF). They use raised cosine to test the performance of the signal detector to perform the simulation. The average eigenvalue based SVD signal detector was found to be more efficient in sensing signal without knowing the properties of the transmitted signal.

In 2012,Mayank Gupta et al. [19] suggested that the Cognitive radio's rising popularity among variousengineers, scientists and researchers can be credited to the increasing number of users of wireless technology and the radio spectrum which is limited. They also discuss various advance techniques in this direction.

In 2012,Saketkumar et al. [20] suggested that Spectrum has valuable resource in wireless communication. In wireless communication some spectrum is waste due to uses of cyclic prefix (cp) in FFT multicarrier sampling. Authors suggest that in place of FFT used DFT and wavelet transform function for removal of cyclic prefix. Wavelet based OFDM, particularlyusing DWT and WPT-OFDM as situations for Fourier- based OFDM with the focus on impulse noise effects. They begin by constructing the models of the inverse and forward transforms. They explain in detail each model and study the BER performance in two scenarios when varying the Poisson recurrence parameter a from small to large.

In 2012, StergiosStotas et al. [21] propose a novel cognitive radio system that exhibits improved throughput and spectrum sensing capabilities compared to the conventional opportunistic spectrum access cognitive radio systems studied so far. They study the average achievable throughput of the proposed cognitive radio system under a single high target detection probability constraint, as well as its ergodic throughput under average transmit andinterference power constraints, and propose an algorithm that acquires the optimal power allocation strategy and target detection probability, which under the imposed average interference power constraint becomes an additional optimization variable in the ergodic throughput maximization problem.

In 2013, SrinivasSethi et al. [22] has been analysed the efficiency and routing load of on-demand routing protocol based on ad hoc on-demand distance vector (AODV) routing protocol for CRAHN. They observed that the overall performance of routing protocol in CRAHN is better at less numbers of secondary users (SUs) presents in the Cognitive radio ad hoc network.

3. Proposed Work

In this we consider the knowledge of primary transmitter with the code word value. It can be send with the pilot message as to the receiver as from the transmitted signal. Then for the required transmission can be detected. The main motivation behind the research is to estimate the frequency and offset delay as shown in flowchart in figure 1.

To fulfill the above objective we first concentrate on the alternatives to obtaining the message or code word from the primary user from the cognitive receiver end. But if we consider that the information of primary is already to the secondary transmitter then the overlay system may starts sending or transmitting. While the authorize receive can decode the code word. For the sake of harmonization the built in system produce the capacitive way of deterring the things in a synchronous manner. Then if the primary ends send the message to the secondary side user, then there is new possibility of outcome can be generated, because of the change. It can be uses in the variety of ways to cancer or overlap the spectrum in both of the ways. Then by the blind receiving technique, it can receive in the receiver side so that it will be discarded or canceled from both primary and secondary users. Then we check the compensation and equalization at both the sender and receiver side. This is the primary received for the relay overhead system.

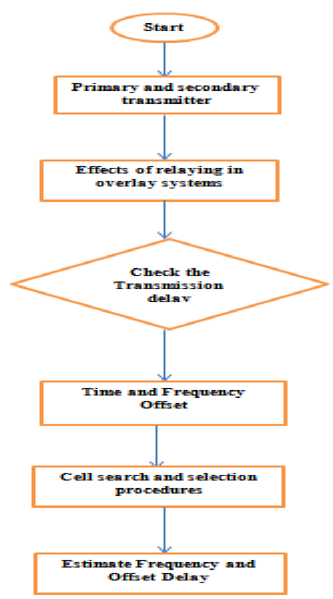

Figure 1: Flow Chart

By choosing an optimum secondary transmission to relaying-power-ratio, the decreasein signal-to-noise ratio (SNR) at the primary users due to the interferencecaused by the secondary transmitters can be compensated by the increase in SNRat the primary users due to the assistance from the secondary relay signal. Thisguarantees that the primary user's rate remains unchanged while the secondary userallocates part of its power for its own transmissions. Note that the overlay paradigmcan be applied to either licensed or unlicensed band communications. In licensedbands, cognitive users would be allowed to share the band with the licensed userssince they would not interfere with, and might even improve, their communications.

In order for the Long term evaluation (LTE) terminal to extract the system information transmitted fromthe base station and to locate the pilots exactly, the frame timing between thetransmitter and the receiver should be synchronized. As we already know the primary transmitted signal plays an important aspect so it will be retain in the receiver side. So the timing signal has gained in the radio spectrum of cognitive system. Then the secondary system finds the spectrum holes based on the different pilot equalization value. In this system the primary and secondary system shares the same global space that permits the secondary system to create its own spectrum.

If we discuss and analyze then we see that we sequence the transmission and pilot receivers to the same channel in the concatenation of the receiver and transmitter.

The pilot symbols we receive after the first transmissions are following:

0.2097 0.2116 0.2017 0.2222 0.2149 0.2136
0.1495 0.1448 0.1488 0.1435 0.1620
0.1415
0.0966 0.1052 0.1012 0.0999 0.0972
0.0959
0.0522 0.0403 0.0556 0.0536 0.0516
0.0410
0.0179 0.0192 0.0278 0.0218 0.0265
0.0298
0.0086 0.0093 0.0139 0.0106 0.0026
0.0093
0.0026 0.0013 0 0.0026 0.0007 0.001

Then in the second transmission we analyze the following:

.2050 0.2136 0.2202 0.2275 0.2249 0.2163
0.1442 0.1488 0.1422 0.1561 0.1283
0.1455
0.0873 0.0952 0.0807 0.0761 0.0840
0.0774
0.0483 0.0529 0.0430 0.0635 0.0443
0.0470
0.0159 0.0212 0.0198 0.0185 0.0172
0.0159
0.0112 0.0079 0.0086 0.0073 0.0073
0.0093
0.0007 0.0007 0.0026 0 0.0007 0.0013

So we observe the multipath behavior and constant delay which is better shown in the result section.

4. Result Analysis

The searing in the LTE for the available cells in the transmission paths which try to access the further communication. There are several ends or user simultaneously connects to the same set of radio set to access the multi user simultaneously. So the initial cell timing and frequency mapping with delay is observed. Hence the initial cell search procedure must also be implementedin timing and frequency synchronization. This paper presents how a LTE mobileunit performs this cell search and identifies the strongest available radio cell near it.The timing and frequency synchronization that is required as part of this cell searchprocedure is also performed. Results are shown in the subsequent figures.

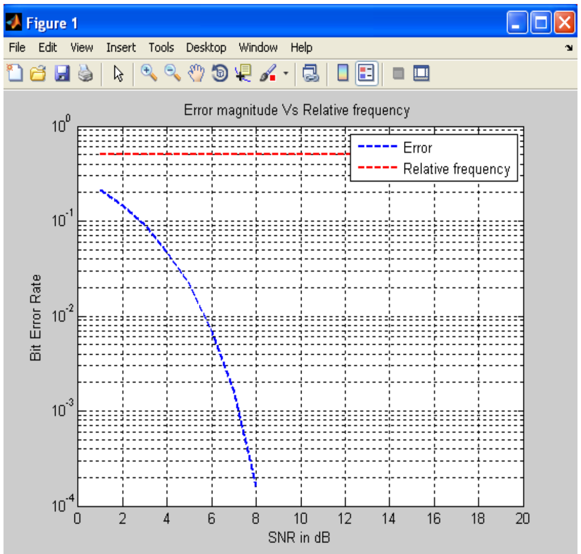

Figure 2: Error Magnitude VS Relative Frequency

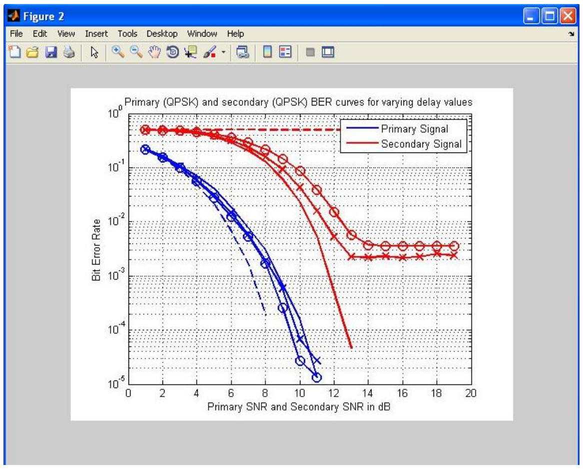

Figure 3: BER Curves

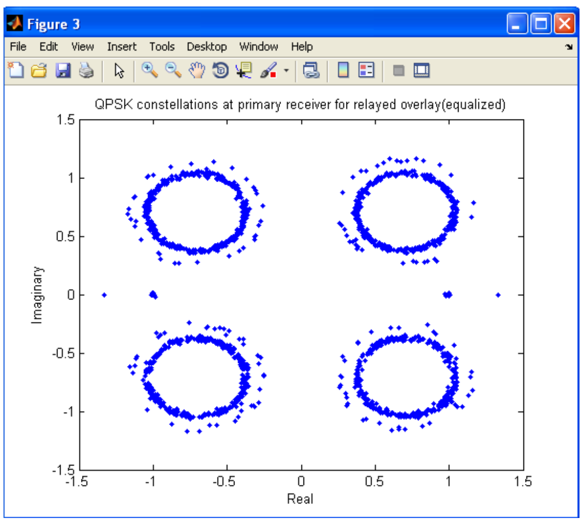

Figure 4: QPSK Constellation at Primary receiver

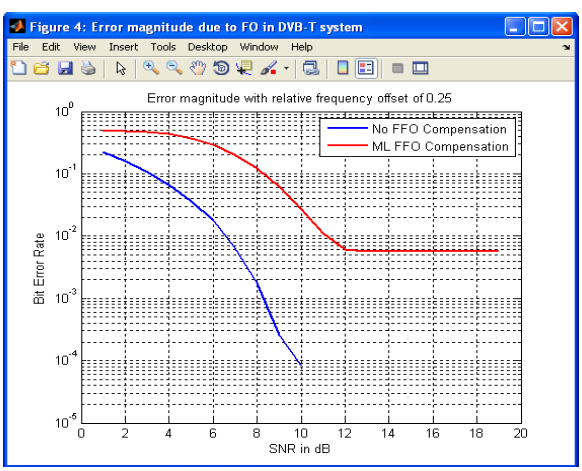

Figure 5: Error Magnitude

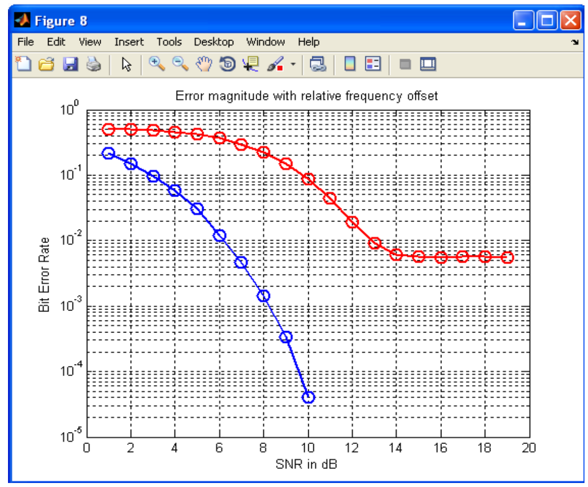

Figure 6: Error Magnitude with relative frequency offset

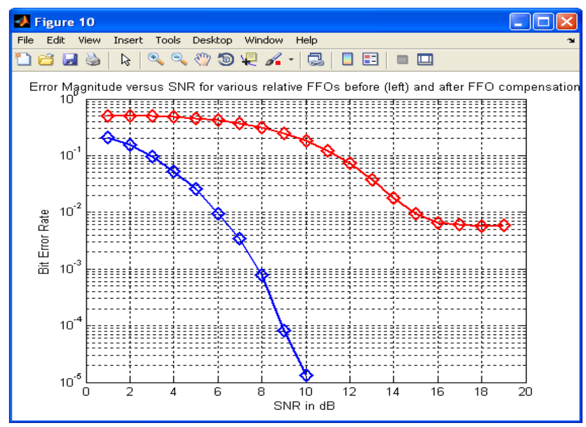

Figure 7: Error Magnitude VS SNR

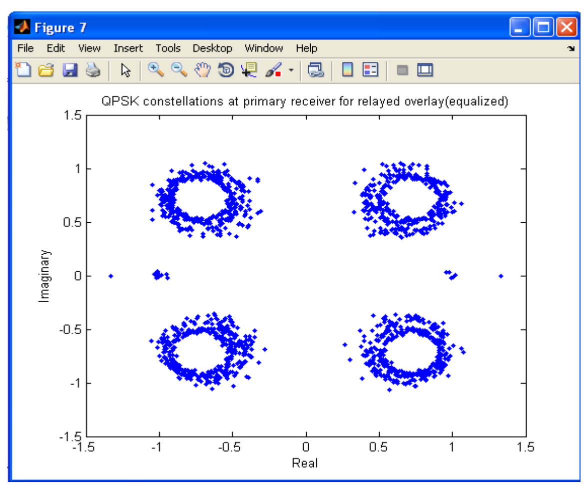

Figure 8: QPSK Constellation at Primary receiver

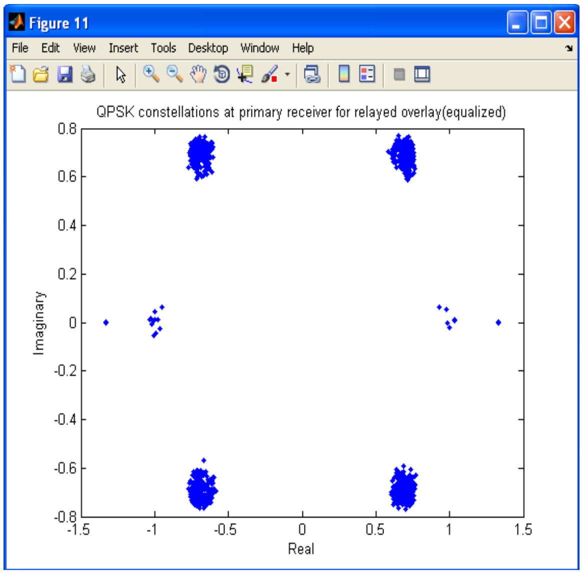

Figure 9: QPSK Constellation at Primary receiver

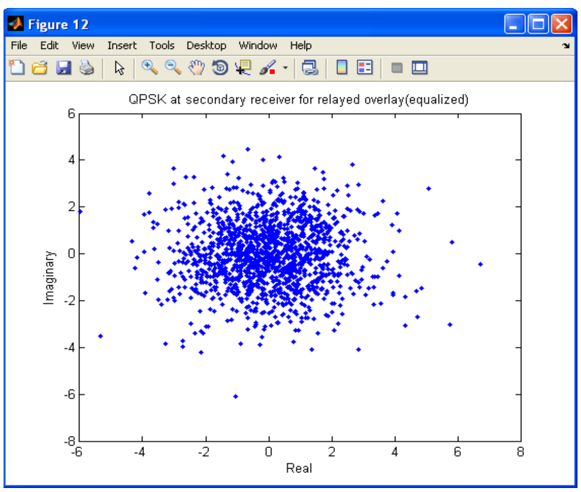

Figure 10: QPSK Constellation at Secondary Receiver

5. Conclusion

In this paper we survey and analysis of different harmonic way of analyzing cognitive system. We also discuss several aspects in cognitive radio for analyzing equalization and cognitive system. We also estimate the frequency and offset estimation. The realization of the concepts and the above results shows the concept of synchronization at the transmitter and receiver side.

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