IF : 4.547 | IC Value 80.26

Volume-6, Issue-4, April - 2017 • ISSN No 2277 - 8160

Original Research Paper

Engineering

A Novel Technique for Spectrum Sensing in Cognitive Radio Networks

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ABSTRACT In this paper detailed review of Spectrum shortage and the ineffective use of the electromagnetic spectrum motivated the development of Cognitive Radio (CR), which aims to make bigger the spectral efficiency, with opportunistic access to the obtainable frequency bands. Energy Detection (ED) is the majority adopted spectrum sensing technique for cognitive radio applications due to its simplicity. However, fading special, effects are usually basic or discarded when evaluating, the energy detector performance in spectrum sensing. Study with different possible configurations available to reconcile these quality issues. These configurations, have been illustrious on special parameters, like energy detection, false alarm, probabilities of detection. This paper proposes a novel technique to reduce false alarm and the interference for Cognitive Radio. In this technique detected signal pass through double square energy detector before measures the received energy in a selected time interval from t1 to t2, and match, the acquired measurement with a predetermined threshold energy level. This technique is called double square energy detection (DSED).This is one of the strong candidates technique for Future wire-less communication.

KEYWORDS : Cognitive Radio (CR), Energy Detector (ED), Interference, spatial false alarm (SFA).

INTRODUCTION

Recently the requirement for higher, data rates is rising as a result of the change over from audio communications to multimedia type applications. Given the restrictions of the natural frequency spectrum,[1] it becomes apparent that the current static frequency allocation schemes[2] cannot accommodate the requirements of an increasing number of higher data rate devices. Cognitive radio,[3] is a technique that enables users to investigate the electromagnetic spectrum to opportunistically transmit in accessible frequency bands. Spectrum sensing,[3,5] is the step accountable for calculate frequency bands that can be used by unauthorized users. Several spectrum sensing methods were proposed. Among them, Energy Detection,[8] is the most popular due to its simplicity of implementation. It demands an improved signal to noise ratio to perform properly. The difficulty of how fading and multipath influence,[7] the transmission of a signal in a wireless channel is multifaceted. Consequently, several researchers tend to diminish or even discard fading effects[3] over wireless communications.

The paper tells about, the concepts of cognitive radio and spectrum sensing. It also present information about spectrum, sensing based on energy detector. This paper describes about the effects of different fading models over energy detection and finally describes conclusion.

COGNITIVE RADIO

Cognitive, radio is a modern wireless, technique that makes partial revolutionize transmission, parameters through the interaction of the radio with the environment. CR evaluates the momentarily occupation of the frequency bands in a region. This task is performed by spectrum sensing. When a spectral chance is recognized (also known as a spectrum hole), the radio adapts its transceivers to operate in that frequency channel. Spectral sensing evaluates if any Primary or Licensed Users (PUs) are working in the scanned licensed bands. If no PU is detected, the spectral holes are recognized and the Secondary or Cognitive Users (SUs) are permitted to operate temporarily in that channel. Spectrum holes can be detected in time, frequency or space dimensions. The sensing should be dynamic and meet acceptable interference levels. If a band is temporarily available, cognitive users can transmit in that channel, otherwise, if a priority user is detected, cognitive users should not operate in that frequency band.

Figure1 shows conventional spectrum sensing model,[10]

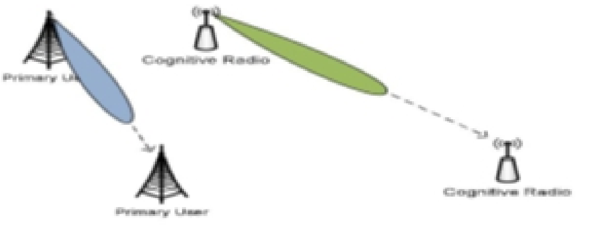

Figure 1. Spectrum sensing

Figure no.2 shows the sensing and interference of primary user problem in cognitive radio systems [7].

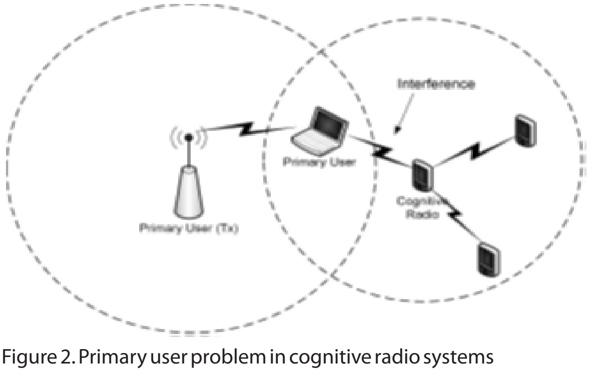

Figure 2. Primary user problem in cognitive radio systems

Spectrum Sensing Methods

Several spectrum sensing techniques are described in literature to detect spectrum.

1. Non-blind sensing
2. Semi-blind sensing
3. Blind sensing

Some of the most adopted spectrum sensing techniques for cognitive radio.

1. Energy Detection (ED): when the level of energy measured in the channel is below a pre determined threshold, the channel is measured, or non-engaged by licensed users. The simplicity of this

technique and its small signal processing load are the positive aspects. However, energy detection demands longer measurements periods.

2. Matched Filtering detection (MF): the most excellent technique when the primary or licensed user characteristics are known a earlier this knowledge optimizes the filtering.

3. Interference Temperature (IT): In this method sensor nodes calculate the level of interference they would foundation at the PU or licensed, at receiver and should adjust their transmission power to not exceed a specific interference temperature level.

ENERGY DETECTION TECHNIQUES

Energy Detection (ED) is the most used technique for the detection of signals. ED is vastly adopted in scenarios which cognitive users do not be familiar with the features of the transmitted signal. Although it is simple to implement, ED requires a high-quality signal to noise relation to perform trustworthy detection. The energy detector, is measures the received, energy in a finite time interval then match the acquired measurement with a predetermined, threshold. Signal to noise ratio,(SNR) is an significant parameter that affects the judgment threshold when the signal is unfamiliar. If the noise intensity that disturb the channel is very high, the noise energy can deform the ED measurements, and leads to false detections; (cognitive network user do not differentiate between the transmitted signal and the noise). Energy detection is generally used in time domain or in frequency domain. In both cases the objective is to compare the signal energy with a predefined sensing threshold.

PROPOSE TECHNIQUE

This paper proposes a novel technique, to reduce false alarm and the interference for Cognitive Radio. In this technique detected signal pass though double square before measures the received energy in a selected time interval from t1 to t2, and match, the acquired measurement, with a predetermined, threshold energy level. This technique is called double square energy detection, (DSED). The estimate of the energy detector is defined as the, indication of the energy of the N collected samples:

$$\mathrm{YDE} = 1/N \sum_{n=1}^{N} |y[n]| \hat{}2 \qquad (1)$$

After collecting the N samples from the primary signal, a Fast Fourier Transform (FFT) processing is perform over all the samples. Total of all the samples considered in the processing is a significant parameter due to the computational processing, time required. The consequence of the FFT point-processing is squared and the judgment about the energy of the detected signal can be taken through the comparison with the threshold λ. If YDE = > λ the receiver selects the hypothesis H1. If YDE < λ the channel is well thought-out idle, and the cognitive user is allowed to occupy the channel then hypothesis H0. Detection, probability and false alarm, probability verify, if the decision, taken by the energy detector, is accurate, and these probabilities can be expressed in terms of the relation between YDE and λ.

$$P_d = \mathrm{Prob}\,(Y_{DE} \; = > \lambda \,|H_1) \qquad (2)$$

$$P_f = \mathrm{Prob}\,(Y_{DE} \; < \lambda \,|H_0) \qquad (3)$$

The performance of the detector would be most effective by maximizing Pd and minimizing Pf.

SIMULATION RESULTS

This section shows the simulated results in terms of probability of detection and SNR, and probability of missed detection and False alarm for AWGN Channel and Rayleigh Channel.

COMPARISION TABLE

Scheme or Technique	Distortion In sensing	Probability of Detection	complexity
ED	low	high	low
DSED	low	Very high	low

CONCLUSIONS

Frequency spectrum is a very valuable resource in wireless communication systems, and it has been a important point for research and development efforts over the last several decades. Cognitive radio, which is one of the most efforts to exploit the available spectrum more powerfully through opportunistic spectrum usage, has become an exciting and capable concept. One of the important elements of cognitive radio is sensing the available spectrum opportunities. This paper describes and explain the Cognitive spectrum sensing, based on energy detector, and was, analyzed for channels that are subject to fading. This paper proposes a novel technique to reduce false alarm and the interference for Cognitive Radio. In this technique the detected signal pass though Double Square before measures the received energy in a selected time interval from t1 to t2, and match the acquired measurement, with a predetermined, threshold energy level. This technique, is called double square energy detection, (DSED). The double square energy detection, decreases the false alarm probability by increasing the overall performance of the spectrum detection.

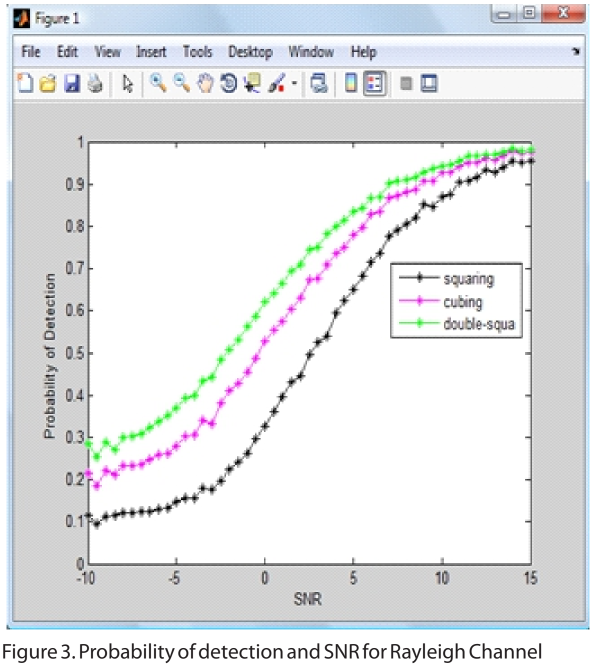

Figure 3. Probability of detection and SNR for Rayleigh Channel

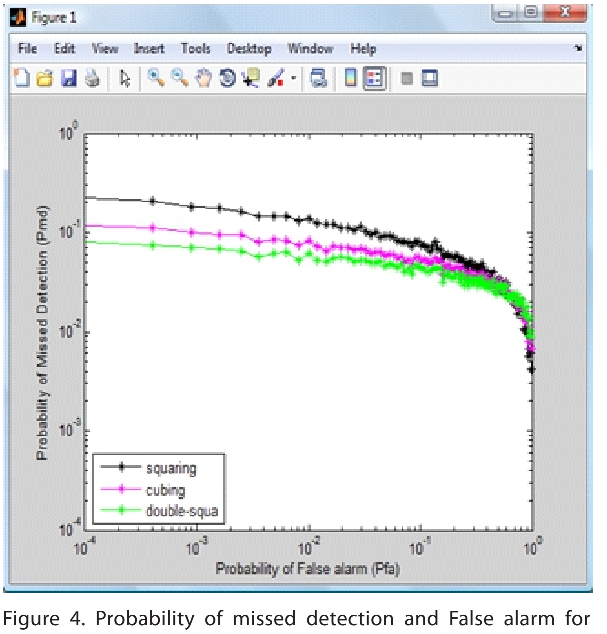

Figure 4. Probability of missed detection and False alarm for Rayleigh Channel

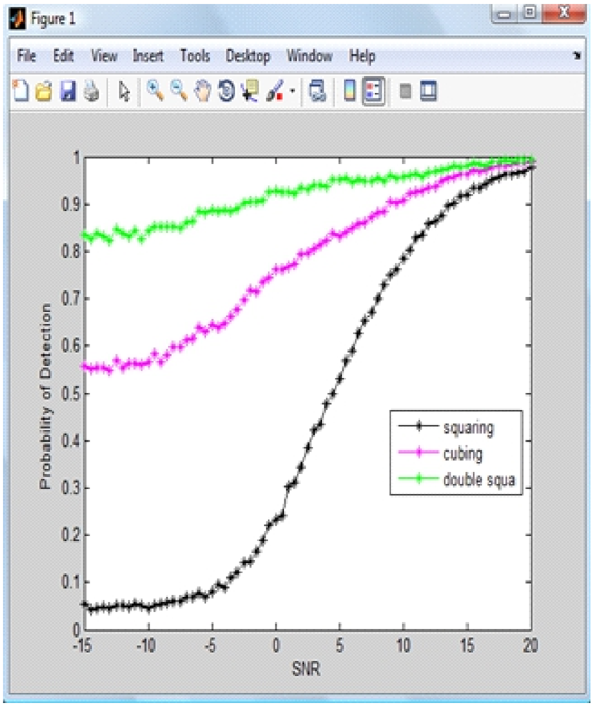

Figure 5. Probability of detection and SNR for AWGN Channel

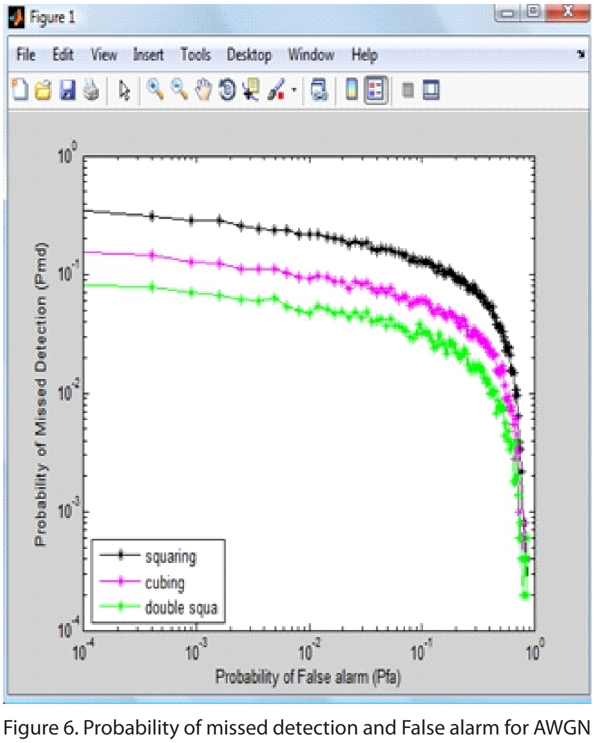

Figure 6. Probability of missed detection and False alarm for AWGN Channel

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