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RESEARCH ARTICLE

A Survey on Spectrum Sensing Technique for 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 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 different parameters like energy detection, false alarm, probabilities of detection. This Paper will contribute in better selection of technical method to reduce false alarm and the interference for Cognitive Radio. One major inadequacy of spatial false alarm, One investigated technique called energy based detection techniques for detection of spatial false alarm (SFA) without affecting the secondary user of the system performance. This is one of the strong candidates for Future communication.

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.

This paper tells about the concepts of cognitive radio and spectrum sensing. It also gives 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.

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Cognitive Radio:-

Cognitive radio is a modern wireless technique that makes partial change 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.
Below, figure1 shows conventional spectrum sensing model for shadow area [10].

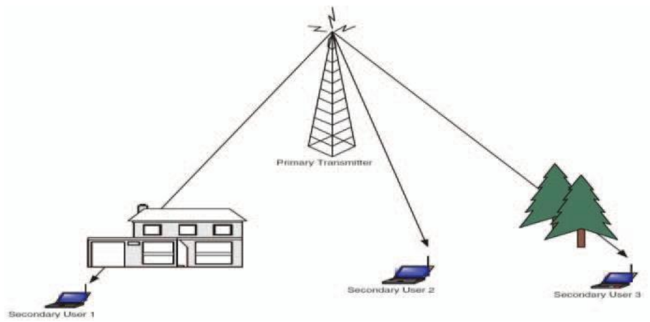

Figure 1:- Spectrum sensing in shadow area

Figure no.2 shows the sensing and interference of secondary user and primary user, [7].

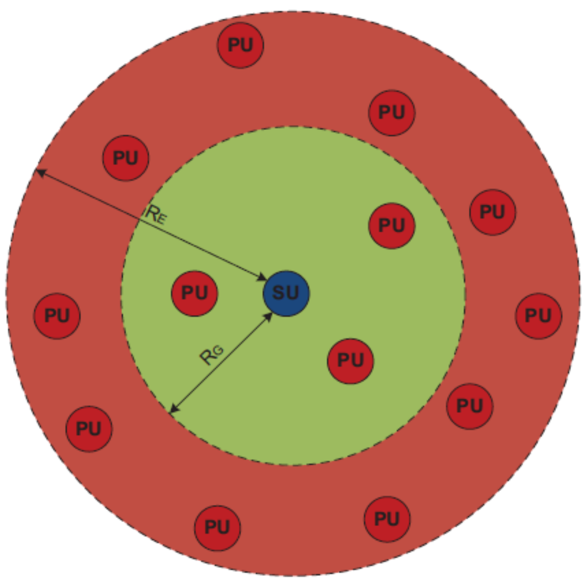

Figure 2:- Sensing (green) and interference (red) regions

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 an 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.
4. Cyclo-stationary Detection (CD): This detection technique is adopted when some characteristics of the primary user are known previously. It requires extra computational complexity.

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. Energy detector measures the received energy in a finite time interval (t_1-t_2) and then match the acquired measurement with a predetermined, threshold. Signal to noise ratio (SNR) is a significant parameter that affects the judgment threshold when the signal is unfamiliar. If the noise intensity that disturbs 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. The estimate of the energy detector is defined as the indication of the energy of the N collected samples:

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

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 $Y_{DE} => \lambda$ the receiver selects the hypothesis H_1. If $Y_{DE} < \lambda$ the channel is well thought-out idle and the cognitive user is allowed to occupy the channel then hypothesis H_0. Detection probability and false alarm probability verify if the judgment taken by the energy detector is accurate and these probabilities can be expressed in terms of the relation between Y_{DE} and λ.

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

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

The performance of the detector would be most effective by maximizing P_d and minimizing P_f.

Effects Of Fading Over Energy Detection:-

Most recent investigations are trade with fading effects in excess of cognitive transmissions. An energy detector and different spectrum detection techniques are well thought-out regarding to the influence of fading in its detection metrics. Rice and Rayleigh fading models are investigated for signals with complex envelope the planned method is based on Bartlett estimator.

The performance of adaptive modulation applied to cognitive networks under Nakagami fading. A statistical model for the cognitive transmission is proposed based on experimental measurements. Experiment data was collected for fading model considered is Nakagami. Although, for the most suitable results of the author, the knowledge of performance comparison of dissimilar fading models over an energy detector has never been directly calculated before the simulation model.

TableNo.1:- Analysis Of Different Techniques

Scheme or Technique	**Distortion In sensing**	**Probability of Detection**	**Complexity**
ED	**low**	**high**	**low**
MF	**high**	**low**	**high**
IT	**high**	**low**	**low**
CD	**low**	**high**	**high**

Conclusions:-

Frequency spectrum is a very valuable resource in wireless communication systems and it has been an 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 the Cognitive spectrum sensing based on energy detector and was analyzed for channels that are subject to fading. This is the best detection probability performance for energy detectors (ED) as compared to other spectrum techniques but fading will degrade the energy detector measurements estimate. One can finish off that cognitive spectrum detection based on energy detector necessity consider the effects of fading to get better the performance autonomously of the fading model considered. The suppression of fading effects on energy detection leads to inaccurate detection probability and the consequence is that the false alarm probability can increase mean degrading the overall performance of the spectrum detection. New opportunities and challenges for spectrum sensing while solving one of the conventional problems. Several sensing methods are studied and collaborative sensing is well thought-out as a solution to some common problems in spectrum sensing.

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