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PERFORMANCE OF COGNITIVE RADIO BASED ENERGY DETECTION USING OFDM AND WAVELET TRANSFORM

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ABSTRACT

The cognitive radio is one of the novel concepts from conventional exclusive spectrum assignment to dynamic spectrum assign. The cognitive Radio built on a software defined radio, is defined as an unpredictable growth of wireless communication scheme, it is automatic adjustment of the electromagnetic environment to adapt their operation and dynamically its radio operating parameters while bring no harmful interference to the PU. This paper proposes energy detection (ED) for spectrums sensing on the basis of estimated SNR, which is calculated in advance for available channels. In the proposed method which is also analysis performance of the SNR and the Decision Accuracy using different FFT and wavelet family of the Haar, and Dabuchesis wavelet in terms of different value of the SNR, Probability of Detection.

KEYWORDS: Cognitive radio, Spectrum Sensing, Energy detection (ED),Wavelet Transform(WT), Haar, Symlets, Dabuchesis wavelet transform, FFT, etc.

INTRODUCTION

Spectrum sensing is one of the core technologies of Cognitive Radio which provide a viable solution to the problem of sparsity of wireless spectrum technique. Nowadays, OFDM techniques are adopted through many existing wireless communication standards. Spectrum sensing algorithm for orthogonal frequency division multiplexing modulated signals is highly desired to implement cognitive radio (CR) when the primary signal uses OFDM modulation. The CR is a metamorphosis technology in wireless communication technique which is cognizant with the surroundings and opportunistically identify the portion of the spectrum without causing the harmfulness hindrance to the PU such as to make secure for effective utilization of the radio spectrum highly reliable and maximizing the quality of the services. The updating technologies the new wireless devices and application will trends to increase the demand of the spectrum. There various method of the spectrum sensing technique such as matched filter detection, energy detection (ED), cyclostationary feature detection. Energy detection is the more robust technique with the low computationally complexity. In the ED is used to find the frequency spectrum is vacant or not. In this paper are analysis. Performance of the wavelet transform based probability detector spectrum sensing and its comparison for different types of wavelet family.

ENERGY DETECTION BASED ON WAVELET TRANSFORM

Energy Detection Method

Energy detection is one of the robust method, is also called radiometer detection which is popularly used as an effective technique of the spectrum sensing performance. The method is deals with identification correctly the available PU signal. It is one of the non-cooperative types of the spectrum sensing method which is easier and low complex in nature [7]. The Energy detector is used to find out the received signal energy and then compared with the threshold value of the signal .In order to measure the energy of the signal, signal is first pass through the band pass filter the with central frequency of fc and bandwidth of the w, allow to pass only those frequency which is within the band. Now the signal is pass through the Analog to digital converter which is possible only through the sampling theorem. In sampling theorem $fc \geq 2$fm by perspective the signal is get sampled. Then after test of the static is applied of the signal to check the availability of the PU.

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The three parameter of the spectrum sensing are follows.

i) Probability of Detection (Pd)
ii) Probability of False alarm (Pf)
iii) Probability of Missed Detection (Pm)

Probability of Detection:-

Probability of Detection and Probability of Occurrence both shows the presence of the primary user signal ie $(H1/H1)$.

Probability of Missed Detection:-

The Probability Missed Detection which shows the presence of the Primary user signal but Probability of the occurrence is absence ie $(H0/H1)$.

Probability of False Alarm:-

The probability of False Alarm which shows the absence of primary user but Probability of the occurrence is Presence i.e $P(H1/H0)$.

The generalized expression for the signal detection is given as

$$H0: y[n] = w[n] \qquad n = 1, 2, \ldots, N$$
$$H1: y[n] = x[n] + w[n] \qquad n = 1, 2, \ldots, N \qquad (1)$$

The Signal Detection is based on the predicating the presence/absence of the primary user signal .Where H0 is the indication of the noise signal but H1 is indication of the signal and noise signal.

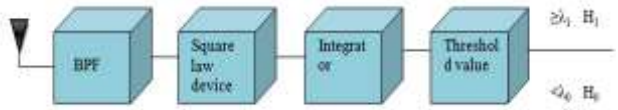

Fig. 1 Block Diagram of the Energy Detector

$H0$: The input y(t) is noise alone :

$$H0: \; a)\, y[n] = w[n] \qquad n = 1, 2, \ldots, N$$
$$b)\, E[n(t)] = 0$$
$$H1: y[n] = x[n] + w[n] \qquad n = 1, 2, \ldots, N \qquad (1)$$

The received is consist of the restricted number of the sample (N) of band limited signal have to be observed during the sensing in the specific time interval .The energy level of the received sample having the noise power spectral density . The 3db noise power is done to get the normalized value of two sided noise power spectral density $(N0/2)$.The test of the hypothesis is used to find out for the availability of the channel is idle or busy and also the availability of the secondary.

A simple hypothesis is used to find out whether a channel is idle or busy where the $H0$ is the null hypothesis means the channel is idle in nature and no primary user is present, H1 is the indicate the licensed user are present. y[n] is the sample of the signal w[illegible]e of the noise is the Number of the samples during the observation interval[5] $Y = \frac{1}{N_0}\int_0^T y^2(t)dt$

Taking Y as decision sta[illegible] under.

Discrete Wavelet Transform

The DWT analyzes the signal at different frequency bands with different resolutions by decomposing the signal into a coarse approximation and detail information. DWT employs two sets of functions, called scaling functions and wavelet functions, which are associated with low pass and high pass filters, respectively. The decomposition of the signal into different frequency bands is simply obtained by successive high pass and low pass filtering of the time domain signal. The original signal x[n] is first passed through a half band high pass filter g[n] and a low pass filter h[n]. After the filtering, half of the samples can be eliminated according to the Nyquist's rule, since the signal now has a highest frequency of π/2 radians instead of π. The signal can therefore be subsampled by 2,

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simply by discarding every other sample. This constitutes one level of decomposition and can mathematically be expressed as follows:

$$y_{high}[k] = \sum_n x[n] \cdot g[2k - n] \quad (4)$$

$$y_{low}[k] = \sum_n x[n] \cdot h[2k - n] \quad (5)$$

where yhigh[k] and ylow[k] are the outputs of the high pass and low pass filters respectively, after sub sampling by 2. This decomposition halves the time resolution since only half the number of samples now characterizes the entire signal.

At every level, the filtering and subsampling will result in half the number of samples (and hence half the time resolution) and half the frequency band spanned (and hence doubles the frequency resolution). Figure illustrates this procedure, where V2 is the original signal to be decomposed, H[z] and G[z] are low pass and high pass filters respectively.

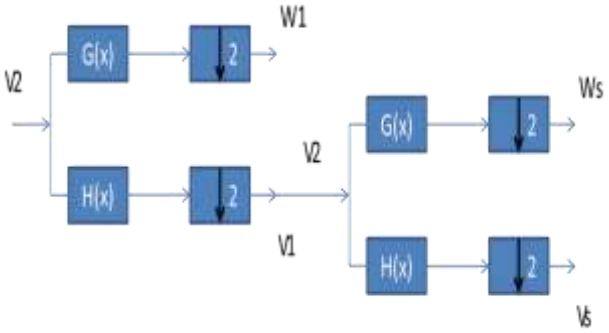

Fig. 2 Two level decomposition

RESULTS

A simulation is performed to verify the effectiveness of the proposed method. The Energy Detection using Fast Fourier Transform (FFT) and Wavelet Transform (WT) for Cognitive radio. Spectrum-sensing cognitive radio is used to detect channels in the radio frequency spectrum. Spectrum sensing is a fundamental requirement in cognitive radio network. Many signal detection techniques can be used in spectrum sensing so as to enhance the detection probability.

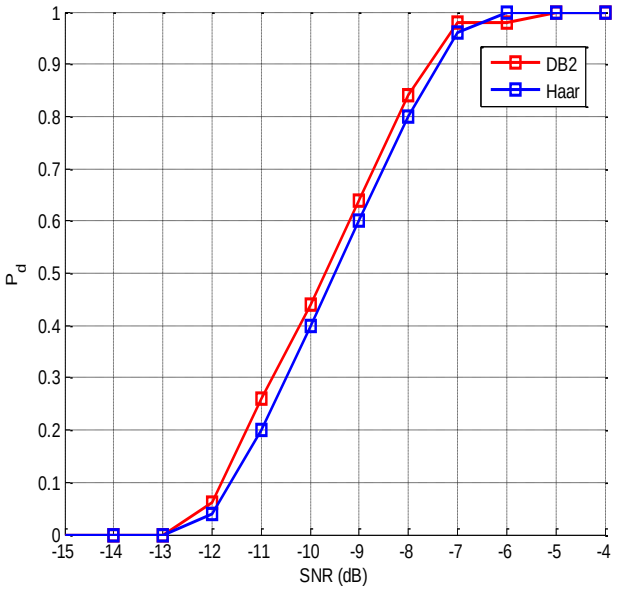

Fig. 3 Performance of SNR Vs Detection Probability Using Wavelet

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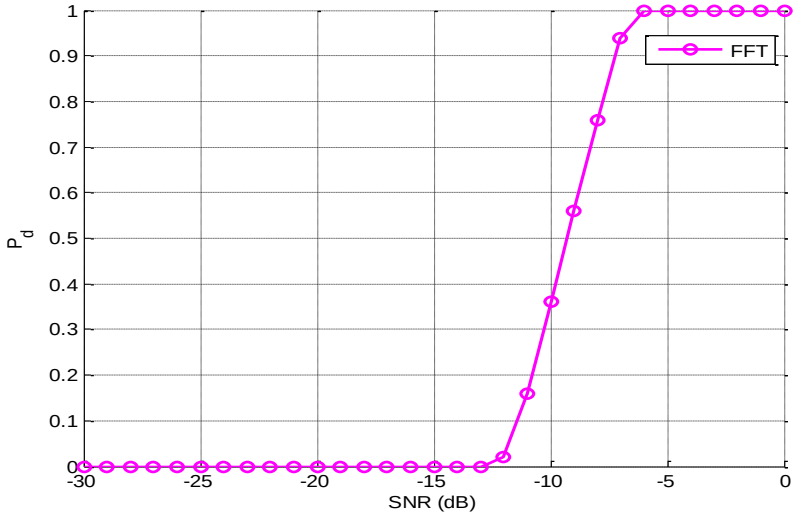

Fig. 4 Performance of SNR Vs Detection Probability Using FFT

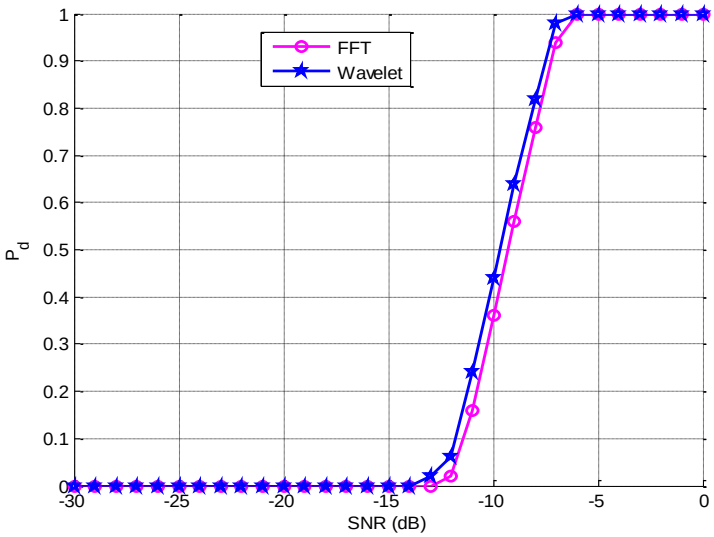

Fig. 6 Performance of Comparison Wavelet and FFT

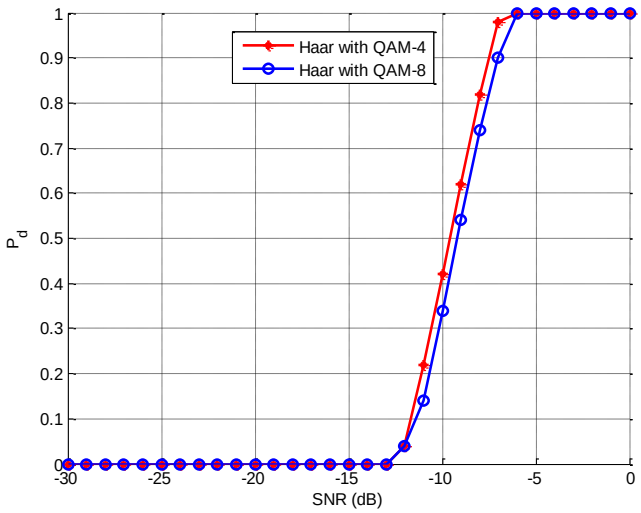

Fig. 7 Performance of Comparison QAM-4 and QAM-8

CONCLUSION

In this paper proposed method wavelet transform based on energy detection method in Cognitive radio. Also comparison through various value of SNR in terms of the Availability of Free spectrum and signal to noise ratio. It is an efficient perspective method to classify the spectrum which improves the performance of the energy detector by measuring the PSD for various SNR and calculated threshold value. However threshold which can accurately detect the Probability of the Detection of the received signal using different types of wavelet family.

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