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A Review on analysis of Maximum Eigen value and Energy Detection Techniques

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ABSTARCT: The electromagnetic spectrum is a characteristic asset. The present spectrum authorizing plan is not able to oblige quickly growing demand in wireless communication due to the static spectrum allocation strategies. This allocation prompts increment in spectrum scarcity issue. Cognitive radio (CR) technology is a propelled remote radio design which aims to expand spectrum utilization by distinguishing unused and under-used spectrum in rapidly evolving environments. Spectrum sensing is one of the key strategies for cognitive radio which detects the presence of primary client in authorized licensed frequency band utilizing dynamic spectrum assignment policies to utilize unused spectrum. One of the challenges for CR is to detect the primary users present over the spectrum. That presents the Maximum Eigen value Based energy detection and .Also highlighted the effect of different parameters like number of samples, signal to noise ratio in addition apply comparison between the two methods using the simulation technique. In this Paper, spectrums sensing technique is introduced but the main work would be for energy detection methods. Energy detection technique is implemented using MATLAB simulation and the obtained results are plotted using MATLAB simulation

KEYWORDS: Energy detection. Maximum Eigen value ma, CR, OR rule, AND rule, majority rule

I. INTRODUCTION

CR is an advanced technique which lessens the issue of spectrum scarcity in electromagnetic spectrum. Spectrum sensing is one of the systems which checks the vacancy of primary user designated to particular frequency spectrum. There are a several methods for spectrum sensing for non-cooperative and cooperative CR users. There are few techniques for non-cooperative CR users such as energy detection, matched filter detection, cyclostationary feature detection. Energy detection technique is less complex than matched filter and cyclostationary methods. The energy detection technique does not require any data about the signal structure present in the permitted band to detect the occupancy of user in that band. Energy detection works in high signal – to – noise ratio values compared to other methods. The main aim of this work is to explain the problem of spectrum sensing, various spectrum sensing methods, such as cyclostationary detection, covariance detection, wavelet based detection, matched filter detection, energy detection. We are mainly focusing on energy detector spectrum sensing algorithm, the performance of energy detection algorithm by varying some parameters and the performance of dynamic threshold on spectrum sensing algorithms (Matched filter detection and Energy detection).

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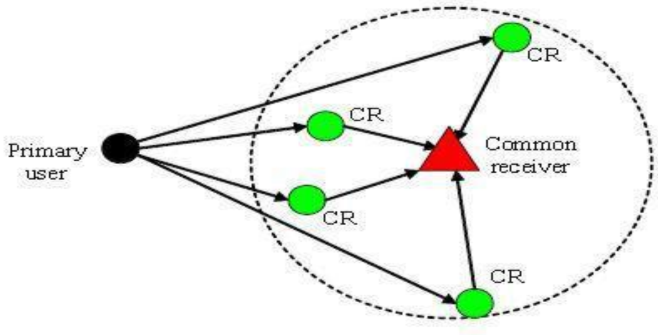

Figure 1Spectrum sensing structure in a cognitive radio network [14]

A-SPECTRUM SENSING: Spectrum sensing is defined as the capability of the CR to allocate the best available unused or ideal licensed spectrum to the secondary users (SUs) satisfying their Quality of service (QoS) but without causing any interference to the primary or licensed users.

B-ANALYTICAL MODEL (TWO HYPOTHESES)

One of the most important elements in the cognitive radio network is spectrum sensing. For communication to take place in fact, it is the first step that needs to be performed. Spectrum sensing can be thought of an identification problem, popularly known as the hypothesis testThe sensing algorithm has to just decide one of the following two hypotheses:-$H1: x(t) = s(t) + n(t)$

$$H0 : x(t) = n(t)$$

S (t) is the signal that is transmitted by the PUs. ***(t)*** is the signal which is received by the SUs.

N (t) is known as the AWGN (Additive White Gaussian noise).

H0 hypothesis tells that no primary signals are present in the spectrum and only noise is present. And hence it can be allotted to the secondary users.H1 hypothesis tells that primary signals are present in the spectrum along with the noise. And hence it cannot be allotted to the secondary users else it will cause harmful interference to the primary users.

C-ENERGY DETECTOR: Energy detection is a non-coherent method of spectrum sensing which is used in detecting the presence of primary signal in the frequency spectrum being sensed. This type of sensing technique is popular because it does not require prior knowledge of primary signal and it is simple. In both time and frequency domain energy of the signal is preserved. Figure 2.4 shows the time domain representation of the energy detection method and Figure 2.5 shows the frequency domain implementation. But whichever representation we use, there is no difference in the eventual result. However, pre-filter matched to the bandwidth of the signal is required in the time domain representation. It makes time domain representation relatively inflexible compared to the other. So it is desirable to use the frequency representation for analyzing the received signal. The physical implementation of the detection method is shown below both for time and frequency domain:-

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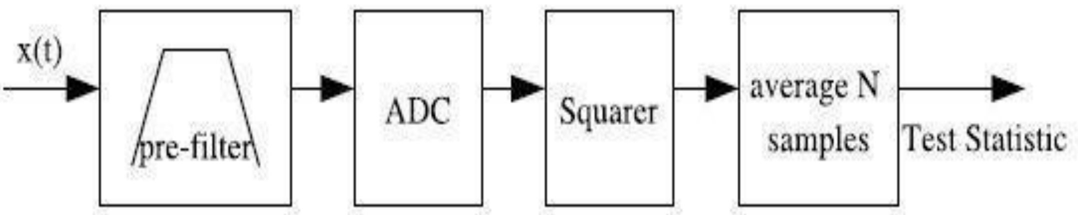

Figure 2: Representation of energy detection mechanism in time domain

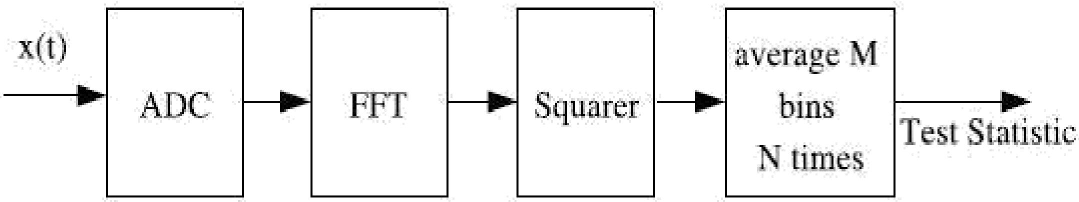

Figure 3 Frequency domain representation of energy detection mechanism

The flow chart of the energy detection is depicted in Figure 2.6. In this technique signal is made to pass through the BPF with a band bandwidth W followed by integration over the time interval. The threshold calculated by the below mentioned formula is compared with the output received from the Integrator. Whether the primary or licensed user is present or not is discovered from the comparison. Energy detection is also known as Blind signal detector as the characteristics of the signal is ignored by it. The presence of a signal is estimated by the comparison of receiving energy with a threshold v calculated from noise statistics.

C-MATCHED FILTER DETECTION: Matched filter is designed to maximize the output SNR for a given input signal. MF detection is applied when the secondary used has prior knowledge of the residing user. In matched filter operation convolution of the unknown signal is done with the filter whose impulse response is time shifted & mirrored with respect to the desired signal. The expression for Where the unknown signal is 'x' and the impulse response (h) of matched filter that is matched to the reference signal is convolved with it for maximizing the SNR. Matched filter detection is applicable only in cases where the cognitive users know the data from the primary user The block diagram of implementation of matched filter spectrum sensing algorithm is given below:-

Figure 4: block diagram of matched filter detection

II. RELATED WORK

Rapid growth of wireless applications and services has made it essential to address spectrum scarcity problem in the limited available spectrum. Thus we need a new communication paradigm to utilize the existing wireless spectrum and efficient in spectrum usage. Cognitive Radio technology attempts to resolve this problem through improved utilization of radio spectrum, in which secondary usage of the spectrum resources is done without interfering with the primary usage of the licensed users. Spectrum sensing is a fundamental requirement in Cognitive Radio network to enhance the primary user signal detection probability in the spectrum. In this research, a comparative study has been made to evaluate the performance of three main spectrum sensing techniques i.e., Energy Detection, Matched Filter Spectrum Sensing in Cognitive Radio The idea of Cognitive Radio was first presented officially in an article by Joseph Mitola III and Gerald Q. Maguire, Jr in 1999.Cognitive Radio is one of the new long term developments and can be define as “A radio that is aware of its environment and the internal state and with knowledge of these elements and any stored predefined objectives can make and implement decisions about its behaviour” [2].

III. LITERATURE SURVEY

A major challenge in Cognitive Radio is that the secondary users need to detect the presence of primary users in a licensed spectrum and quit the frequency band as quickly as possible if the corresponding primary radio emerges in order to avoid interference to primary user (PU). For this it should detect the PU signals as faster as it can. This detection technique is called spectrum sensing. Most research work currently focuses on spectrum sensing in Cognitive Radio

Radio Roshdy et.al.[1] **c**omparative Study of Spectrum Sensing for Cognitive Radio System Using Energy Detection over Different Channels - the radio spectrum is the most source that needs to be utilized using cognitive radio (CR) system Detecting primary users (PU) over the spectrum is one of the problems that face cognitive radio system. To overcome this problem, we use sensing techniques like energy detection, matched filter detection and Cyclostationary feature detection. This paper focuses on spectrum sensing using energy detection technique for both cases over additive white Gaussian noise(AWGN) channel and Rayleigh fading channel. Also plots of the probability of missed detection (Pm) vs. probability of false alarm (Pf) for both channels were obtained using MATLAB software.

Mesut Doan et.al.[2] Target Detection by Energy Features Extracted from Simulated Ultra Wideband Radar Signals The ultra-wideband ground penetrating radars (GPRs) are successful in sensing not only conductors but also dielectric objects. For that reason, GPRs are used in many applications to detect and identify objects, which are hidden behind obstacles such as walls or buried under ground. In such problems, the early reflections from the wall or ground surfaces are very strong. These strong electromagnetic wave components must be removed during the “preprocessing” phaseby suitable and effective methods as they lead to detection/identification errors by masking the relatively weak signals reflected/scattered from the actual targets. The novel and effective method implemented in this work is also fast due to its low computational cost and it is used to obtain an energy based feature curve corresponding to a time signal measured by the radar. The details of feature curves around the regions with very large slopes indicate the presence and location of not only wall/ground surfaces but also buried/hidden objects with enhanced accuracy at a single computational step. In this study, we firstly simulate the GPR data for four different spherical targets of the same size, which are composed of different materials over the frequency band from 0.2 GHz to 7.5 GHz. Each sphere is placed behind the same concrete wall at the same distance, one at a time. Then, the energy based feature curves are computed for the simulated GPR data to investigate their potential benefits in the problem of through-the-wall target detection/identification.

Cheng Jiang The Face Detection Algorithm Based on Local Elastic Potential Energy Feature- Face detection is an important step in face recognition. Ineffective algorithm used for face detection will have a negative impact on the performance of face recognition. Face detection technology is not only a key step in face recognition technology, but also is an independent widely-used technology. It is important to design a suitable feature for face detection technology. This paper proposes a new face feature, which can be used in face detection. The face feature has the property of rotation and scaling invariant under some certain conditions. The algorithm regards an image as an elastic surface and regards the grey level as deformation. The algorithm calculates local elastic potential vectors and uses them as the input to the ad boost classifier. The output of the classifier is the final result. Theoretical analysis and experiments demonstrate that the feature proposed in the paper can improve accuracy to some certain extent and is robust to rotation and scaling transformation.

W.Y Lee et al. introduced an optimal sensing framework with three different functionalities. Firstly, sensing parameter optimization is proposed to maximize the sensing efficiency. Secondly, a spectrum selection and scheduling algorithm based on opportunistic capacity concept is introduced to extend multi-spectrum environment and lastly cooperation sensing is used.

T. Yucek et al. re-examined various aspects and methodologies of spectrum sensing. Various challenges related to spectrum sensing are discussed along with their possible solutions like cooperative sensing, external sensing algorithm and other alternatives. Furthermore, in order to predict PU behaviour a statistical modelling of network traffic is studied and utilization of these models is discussed.

K.J.R. Liu et al. studied the effect of errors in the spectrum sensing process on the performance of the multiple access layers of both primary and secondary networks and concluded that using different designs for spectrum sensing and the channel access mechanisms can Detroit the performance of both primary and secondary networks. So in this paper a joint design of spectrum sensing and channel access mechanisms is proposed which uses binary hypothesis testing to check the reliability of outcome. Proposed technique achieves significant improvement in throughput of both PU and SU networks.

S. Maleki et al. designed a censored truncated sequential technique for spectrum sensing as an energy-saving approach. To design this technique, average energy consumption of each sensor is minimized to a lower bound of probability of detection and an upper bound of false alarm rate to control the interference to the PU due to miss detection and the network throughput as a result of a low false alarm rate. Lastly, the performance of the proposed scheme is compared with a fixed sample size censoring scheme under different cases and it is shown that that for low-power cognitive radios, proposed technique outperforms existing technique.

IV. CONCLUSION

The main purpose of the thesis was to study the performance of energy detection algorithm for spectrum sensing in cognitive radio by drawing the curves between probability of false alarm vs. probability of detection, SNR vs. probability of detection and the performance of dynamic threshold on spectrum detection techniques(Matched filter detection, Energy detection) in cognitive radio systems A method based on the eigenvalues of the sample covariance matrix of the received signal will be proposed using a single antenna for cognitive radio networks. A temporal smoothing technique is utilized to form a virtual multi-antenna structure. Simulations using randomly generated signals will be carried out the performance of the Optimal-detection method. It will be shown that the performance of Optimal-detection is very close to that of the MED detection with multiple antennas. The method can be used for various signal detection applications without knowledge of signal, channel and noise power. Besides, the proposed optimal-detection method can reduce system overhead and avoid the eigenvalue decomposition processing by utilizing power method.

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