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A Review: Implementation on Energy Detection versus Maximum Eigen value Based Detection

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Abstract- The main motive to design this paper to implementation and analysis Cognitive Radio technology (CR) is spectrum sensing. The characteristic of this spectrum sensing the electromagnetic atmosphere to settle in their operation for better radio operating parameters. One of the challenges for CR is to detect the primary users present over the spectrum. This paper 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. The obtained results are plotted using MATLAB simulation

Keywords- Radio spectrum, Energy detection, Matched filter detection, SNR

I INTRODUCTION

These days due to advancement in wireless communication [1], the demand for various types of mobile services have increased and higher data-rates are required. In order to increase data rates more spectrum is required most of the spectrum is allocated to television and radio broadcasts known as primary users (PU) but it has been observed that 70% of the spectrum is underutilized because the spectrum allocated to PU remains unutilized for certain time in a day. This spectrum can be allocated to unlicensed users called as Secondary Users (SU).This can be done with the help of Cognitive Radios. Cognitive radios [2] perform four main operations: spectrum identification, spectrum detection, spectrum tracking and spectrum exploitation. Spectrum identification means determining whether the spectrum hole is wide enough in frequency to accommodate bandwidth of SU. Once a spectrum opportunity has been Identified by a secondary user, the SU must detect when such opportunities exist and when they don't. Spectrum tracking is keeping track of the variations in the spectrum availability. Once the SU has gained knowledge about the spectrum it can access spectrum opportunities with a lower probability of interference. There are many techniques for sensing spectrum. In this paper, comparative analysis of two techniques namely energy detection and cyclostationary feature detection. The main object of energy detection is to detect PU presence accurately. The obstacle which faces energy detection is to determine which hypothesis is true. If channel is empty and sensor decides it is occupied that's called probability of false alarm. If the channel is occupied and sensor decides it is empty that's called probability of miss detection [3].

Matched filter: Based Spectrum Sensing The matched filter strategy is an ideal methodology for spectrum sensing since it increases the signal to-noise ratio (SNR) within the sight of added additive noise. This preferred standpoint is accomplished by relating received signal with a format for identifying the presence of a known signal in received signal [3]. Matched filter detector utilizes from the earlier information of the received signal, for example, frequency, bandwidth, modulation type and pulse shaping. Figure 1 demonstrates the square chart of the matched filter based spectrum sensing

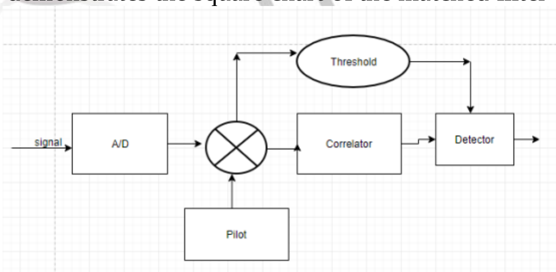

Fig.1 matched filter based spectrum

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 FilterSpectrum 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 behavior" [2].
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
The main functions of Cognitive Radios are
(1) Spectrum Sensing
(2) Spectrum Management
(3) Spectrum Sharing
(4) Spectrum Mobility
In these four functions spectrum sensing is an important and a sensitive task in Cognitive Radio. The main objective of spectrum sensing is to provide more spectrum access opportunities to Cognitive Radio users without interference to the PU networks. Since Cognitive Radio networks are responsible Sarwar Ali et al., International Journal of Emerging Technologies in Computational and Applied Sciences, for detecting the transmission of primary networks and avoiding interference to them, Cognitive Radio networks should intelligently sense the primary band to avoid missing the transmission of primary users [9]. One thing to consider is Spectrum Hole. A spectrum holes (also called spectrum opportunities) is a band of frequencies assigned to a PU, but at a particular time and specific geographic location, the band is not utilized by that user, hence can be accessed by secondary user (SU). In terms of occupancy, channels of the radio spectrum may be categorized as follows [5]: White hole (which are free of RF interferers), Gray hole (which are partially occupied by interferers as well as noise), and Black hole (the contents of which are completely full)Spectrum Sensing Techniques and Methods Spectrum sensing techniques can be classified into four categories: (1) Primary Transmitter Detection, (2) Cooperative Transmitter Detection, (3) Primary Receiver Detection, and (4) Interference Temperature Management. In this paper only Primary Transmitter Detection technique is discussed. Primary Transmitter Detection sensing techniques from perspective of primary signal detection can be classified into these broad categories of sensing methods shown below in Figure 1 [10]

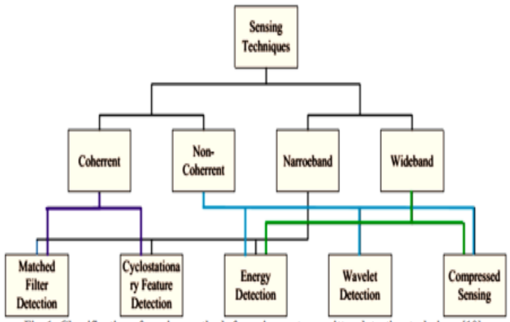

Fig. different spectrum sensing technique

III PROPOSED METHOD
In communication theory it is often assumed that the transmitted signals are distorted by some noise. The most common noise is Additive Gaussian noise, i.e. the so called Additive White Gaussian Noise channel, AWGN. Even though the noise in reality is more complex, this model is very efficient when simulating for example background noise or amplifier noise. Then the model can be complemented by e.g. impulse noise or other typical noise models that are out there. In this chapter we will have a closer look at AWGN channels and see how the previous theory applies here. We will derive a fundamental limit of the signal to noise ration (SNR) specifying when it is not possible to achieve reliable communication. Spectrum Sensing Model The algorithm of spectrum sensing depends on many parameters like number of samples, signal to noise ratio and noise uncertainty. It aims to make decision between two hypotheses (choose H0 or H1) based on the received signal.

$$H0: X(N) = W(N) \quad ....1$$

$$H1: X(N) = S(N) + W(N) \quad ..2$$

Where N is number of samples, X(N) is the received signal , S(N) is the primary users signal, W(N) is the noise , H0 Gaussian noise (AWGN) with zero mean [4]. The key metric in spectrum sensing are the probability of correct detection probability of alarm (occurs when the channel is empty (H0) but spectrum sensor decides that the channel is occupied and probability of misdetection occurs when the channel is occupied (H1) but spectrum sensor decides that the channel is unoccupied [5] A signal in a digital communication system can be represented as by a continuous random variable. This value can be decomposed in two parts added together

$$Y = X + Z$$

Where X is the information carrier component and Z noise component. The average power allocated by the variable X is defined as the second moment,

$$P = E[X^2]$$

A Gaussian channel is a time-discrete channel with input X and output Y = X + Z, where Z models the noise and is Normal distributed,

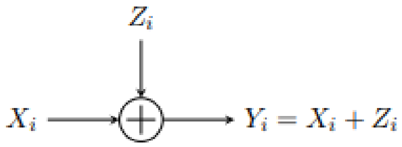

Fig 2 Gaussian channel

The communication signalling is limited by a power constraint on the transmitter side,

$$E[\,X^2] \le P$$

Without the power constraint in the definition we would be able to choose as many signal alternatives as far apart as we like. Then we would be able to transmit as much information as we like in a single channel use. With the power constraint we get a more realistic system where we need to find other means that increasing the power to get a higher information throughput over the channel.1 To see how much information is possible to transmit over the channel we again maximizes the mutual information between the transmitted variable X and the received variable Y, with the side condition that the power is limited by P

IV LITERATURE SURVEY

The available radio spectrum is limited and it is getting crowded day by day as there is increased in the number of wireless devices and applications. It has been found that the allocated radio spectrum is underutilized because it has been statistically allocated not dynamically (allocated when needed). In the present scenario, it has been found out that these allocated radio spectrums are free 15% to 85% most of the time depending upon the geographical area. In order to overcome this situation, we need to come up with a means for improved utilization of the spectrum creating opportunities for dynamic spectrum access [1]

RadioRoshdy et.al.[1] comparative 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" phase by 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 adaboost 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.

2. 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.

3. 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.

V CONCLUSION

To efficiently utilize the wireless spectrum Cognitive Radios were introduced which opportunistically utilize the holes present in the spectrum. The most essential aspects of a Cognitive Radio system are spectrum sensing and various sensing techniques which it uses to sense the spectrum and discussed about Cognitive Radio and different aspect of spectrum sensing techniques of the probability of false detection at different SNR associated with different types of spectrum sensing techniques.

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