International Journal of All Research Education and Scientific Methods (IJARESM)
ISSN: 2455-6211, Volume 5, Issue 7, July- 2017, Impact Factor: 2.287

A review on Spectrum Sensing Techniques & Challenges

Pushpender Kumar Raj[1], Hemant Narayan[2]

[1]M.Tech scholars, MDU, Rohtak, Haryana
[2]Astt. Professor, MDU Rohtak, Haryana

ABSTRACT

In any detection technique, while detecting the presence of PU there are two possibilities of errors that can take place in fixing the threshold value. In the first case, if the threshold value is too high the detection device fails to recognize the presence of PU signal even though the PU signal is present. This type of error in decision making is known as Probability of Misdetection (P_{md}) [1]. Because of this error the SU tries to use that frequency channel which leads to interference and it is not desirable. In the second case, if the threshold value is too low the detection device detects the presence of PU signal even though the PU signal is not present. This type of error in technical terms is known as Probability of false alarm (P_f). Because of this error the SU not able to use that frequency channel which leads to the underutilization of spectrum.

I. INTRODUCTION

Cognitive radio allows secondary users, who have no spectrum licenses, to utilize the temporarily unused licensed bands without interfering with the license holders, also known as primary users. Hence cognitive radio should have the ability to accurately detect the spectral opportunities for the secondary users without any harmful interference to primary users; this ability is called spectrum sensing.

Further in this paper, traditional spectrum sensing techniques for narrowband spectrum sensing have been discussed. They are then followed by the existing wideband spectrum sensing techniques which have been discussed and categorized based on their sampling rates.

Its transceiver is designed to use the best wireless channels in its vicinity. Such radio automatically detects available channels in wireless spectrum, then accordingly changes its transmission and reception parameters to allow more concurrent wireless communications in given spectrum band at one location. Cognitive radio network is complex multiuser wireless communication system to provide efficient use of radio spectrum. The idea of cognitive. Radio extends by using the concepts of hardware radio and software defined radio from a simple, single function device to a radio that senses its operating environment.

The concept of cognitive radio is that unlicensed users (cognitive radio users) can access the spectrum owned by licensed users (primary users) while they cannot interfere with primary users when exploiting spectrum. Thus to realize the technique of cognitive radio, a cognitive radio user must have the ability to measure, to sense and to learn channel characteristics and availabilities. In addition primary users can claim the spectrum anytime when they have data to send, thus cognitive radio users should be able to identify the presence of primary users in time and vacate the occupied bands immediately to prevent the interference to primary users.

II. NARROWBAND SPECTRUM

1) The bandwidth of interest is less than the channel coherence bandwidth. It works on bandwidth less the coherence bandwidth of the channel spectral opportunities are also less. Traditional narrowband spectrum sensing techniques include energy detection, matched filtering and cyclostationary feature detection shown in figure 1

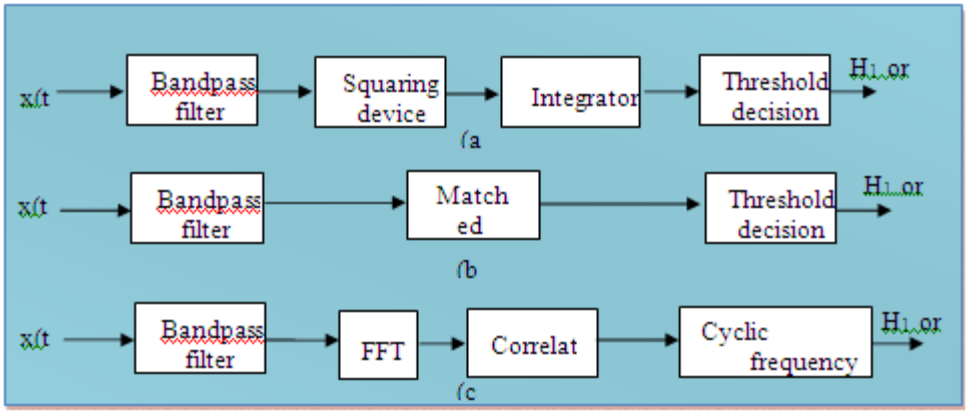

Fig 1: Block diagrams for narrowband spectrum

2) Spectrum Sensing*:* It refers to detect the unused spectrum and sharing it without harmful interference with other users. It is an important requirement of the Cognitive Radio network to sense spectrum holes, detecting primary users is the most efficient way to detect spectrum holes.

3) Spectrum Management*:* It is the task of capturing the best available spectrum to meet user communication requirements. Spectrum Mobility*:* It is defined as the process where the cognitive user exchanges its frequency of operation.

4) Spectrum Sharing*:* This refers to providing a fair spectrum scheduling method among the users. Sharing is the major challenge in the open spectrum usage.

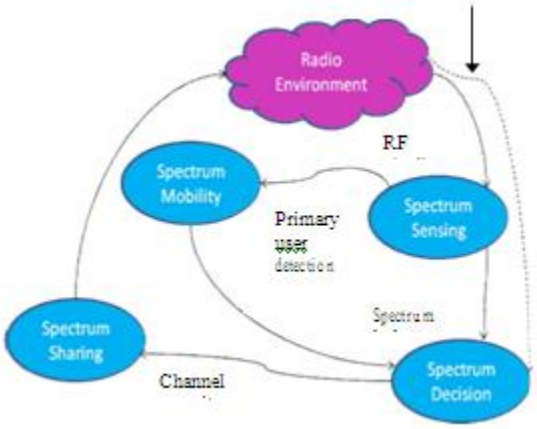

Fig. 2: Spectrum Analysis

1) Wideband Spectrum

Frequency bandwidth of interest is larger than the coherence bandwidth of the channel. For example, for determining spectral opportunities in the whole ultra-high frequency (UHF) TV band, between 300 MHz to 3GHz, wideband spectrum sensing should be employed. Narrowband spectrum sensing cannot be directly applied to WSS because they made single decision for the whole spectrum, impeding identification of individual spectrum opportunities

Spectrum sensing is defined as the task of finding of spectrum holes by sensing the radio spectrum in the local neighborhood of the cognitive radio receiver in unsupervised manner. The spectrum holes stands for those sub bands of the radio spectrum that are underutilized at particular instant of time and specific geographic location. Spectrum Sensing is the capability to determine and sense whether license user is present or absent.

2) Energy Detection

If the secondary user cannot gather sufficient information about the PU signal, the optimal detector is an energy detector, also called as a radiometer. Energy detection is a non coherent detection method that is used to detect the licensed User signal. If the noise power is known, then energy detector is good choice It is a simple method in which prior knowledge of primary or licensed user signal is not required, it is one of popular and easiest sensing technique of non- cooperative sensing in cognitive radio networks. It is common method for detection of unknown signals**.**

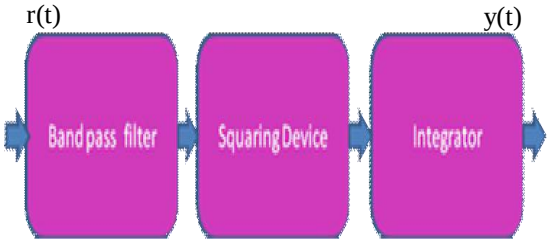

Fig.3: Block Diagram Of Energy Detection

The above block diagram is of energy detection which consists three blocks such as band pass filter, squaring device and integrator. The band pass filter selects the specific band of frequency to which user wants to sense. After the band pass filter there is a squaring device which is used to measure the received energy.

3) Matched filtering:

Matched filtering is a coherent non-blind signal detection method. It is an optimum method of detection since it maximizes the SNR in the presence of additive noise. It requires the prior knowledge of the primary user and cognitive radios to be equipped with carrier synchronization and timing devices, which increase the implementation complexities. Matched filter estimates the presence of the primary user by correlating the signal with the time shifted version and comparing the predetermined threshold with the output of matched filter.

III. COMPARISION OF ED CSD TECHNIQUE

The individual performance of each technique is shown in the Figure 2.9. The drawbacks of Energy Detection technique (ED) i.e., poor performance at low SNR which is giving 0 probability of detection (Pd) at -20dB can overcome by using ED And CSD technique.

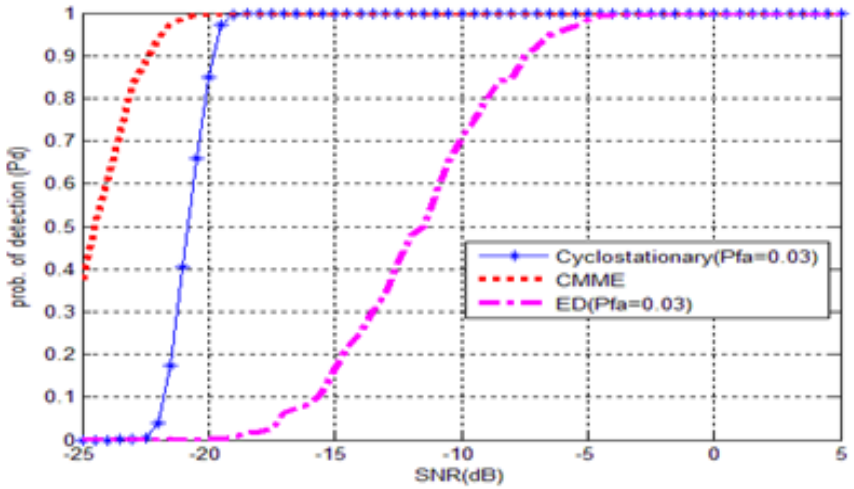

Fig: 4: Comparison of ED CSD and MMME technique

CONCLUSION

In this paper we discuss about three spectrum sensing techniques of cognitive radio such as cooperative, non-cooperative and interference based detection and type of spectrum used. Cyclostationary feature detection shows the better detection performance as compared with the matched filter and energy detection techniques. And we discuss the feature of ESD technique over ED technique and how to how to interface with SNR of different probabity of detection. The wideband spectrum sensing techniques based on standard ADCs lead to high sampling rate or implementation complexity; thus, sub-Nyquist wideband spectrum sensing or compressive sensing techniques become increasingly important.

REFERENCES

[1]. Y.-C. Liang, Y. Zeng, E. C. Peh, and A. T. Hoang, "Sensing-throughput tradeoff for cognitive radio networks," Wireless Communications, IEEE Transactions on, vol. 7, no. 4, pp. 1326–1337, 2008.

[2]. Z. Quan, S. Cui, and A. H. Sayed, "Optimal linear cooperation for spectrum sensing in cognitive radio networks," Selected Topics in Signal Processing, IEEE Journal of, vol. 2, no. 1, pp. 28–40, 2008.

[3]. D. Cabric, S. M. Mishra, and R. W. Brodersen, "Implementation issues in spectrum sensing for cognitive radios," in Signals, systems and computers, 2004. Conference record of the thirty-eighth Asilomar conference on, vol. 1. IEEE, 2004, pp. 772–776.

[4]. V. Gonçalves and S. Pollin, "The value of sensing for tv white spaces," in New Frontiers in Dynamic Spectrum Access Networks (DySPAN),2011 IEEESymposiumon. IEEE, 2011, pp. 231–241.

[5]. S. Maleki, A. Pandharipande, and G. Leus, "Two-stage spectrum sensing for cognitive radios," in Acoustics Speech and Signal Processing(ICASSP), 2010 IEEE International Conference on. IEEE, 2010, pp. 2946–2949.

[6]. M. Yang, J. An, X. Bu, and L. Sun, "An improved eigenvalue-based algo- rithm for cooperative spectrum sensing," in Wireless Communications Net- working and Mobile Computing (WiCOM), 2010 6th International Conference on. IEEE, 2010, pp. 1–4.

[7]. H. Liu and W. Chen, "A robust detection algorithm based on maximum- minimum eigenvalue for cognitive radio," in Wireless Communications, Net- working and Mobile Computing (WiCOM), 2012 8th International Confer- ence on. IEEE, 2012, pp. 1–4.

[8]. A. Satheesh, S. Aswini, S. Lekshmi, S. Sagar, and H. Kumar, "Spectrum sensing techniques a comparison between energy detector and cyclostationarity detector," in 2013 International Conference on Control Communication and Computing (ICCC).