

Cyclostationary Based Detection Method of Spectrum Sensing for Cognitive Radio

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Abstract-Spectrum is very valuable resource of communication field. To sense the unoccupied spectrum gap is essential task of cognitive radio. There are so many spectrum sensing algorithm available for cognitive radio. This paper describes cyclostationary based detection method of spectrum sensing for cognitive radio. Cyclostationary based detection method is used to sense unoccupied spectrum gap through cyclic autocorrelation function in Simulink.

Keywords - Cognitive radio, Spectrum Sensing, Primary User, Secondary User, Spectrum gap.

I. INTRODUCTION

As wireless technology is growing, the need for higher data rate is also increasing. Because of that the current static frequency allocation scheme cannot accommodate the requirement of higher data rate. The utilization of assigned spectrum is shown in fig.1 [1]. To set up new services, it is difficult to find vacant spaces because most of useful radio spectrum has already assigned [1],[2].

Cognitive radio is one of the solutions for this spectral utilization problem. CR can provide new path to unused spectrum for spectrum access. There are two types of user. One which has higher priority called primary user or license user and which has lower priority called secondary user or unlicensed user [2]. The main aim of this paper is to focus on spectrum sensing i.e. to sense the spectrum continuously for finding the spectrum gap. Spectrum gap is gap between the assigned spectrums by primary user or also say unused part of primary user.

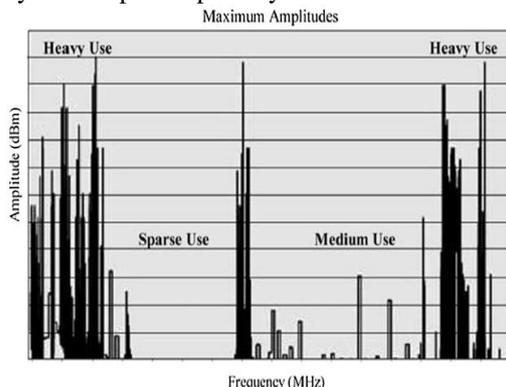


Fig.1 Utilized spectrum [1]

II. SPECTRUM SENSING TECHNIQUE

One of the main important features of CR is to sense the spectrum. Spectrum sensing is essential task of CR to detect the existence of primary user. These techniques depend on transmitter parameter i.e. at which frequency transmitter is operating [1]. A hypothesis model for transmitter detection techniques [3] are:

$$y(t) = n(t) \quad \text{when PU is absent}$$

$$y(t) = Ax(t) + n(t) \quad \text{when PU is present}$$

Where $x(t)$ is the signal transmitted by primary user, $n(t)$ is additive white Gaussian noise, A is the amplitude of channel and $y(t)$ is signal received by SU [3]. Spectrum sensing algorithm is classified in different method which is Matched filter, Energy detector, Cyclostationary feature detection and other sensing technique [1]. This paper describes cyclostationary based detection method of spectrum sensing for cognitive radio.

III. CYCLOSTATIONARY BASED DETECTION METHOD

Cyclostationary feature detection method is also called as spectral correlation method because it uses cyclic correlation function for detecting present of signal in a given spectrum. These process having periodicity in statistical property like mean, autocorrelation are cyclostationary [2]. By using periodic statistics of primary user waveform, CR can detect random signal in presence of noise. And these features are extracted using spectral correlation function [5]. Fig.2 represent basic block diagram of cyclostationary based detection method [4].

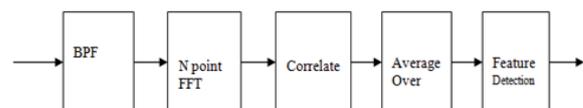


Fig.2 Block diagram of cyclostationary based detection method [4]

IV. IMPLEMENTATION IN SIMULINK

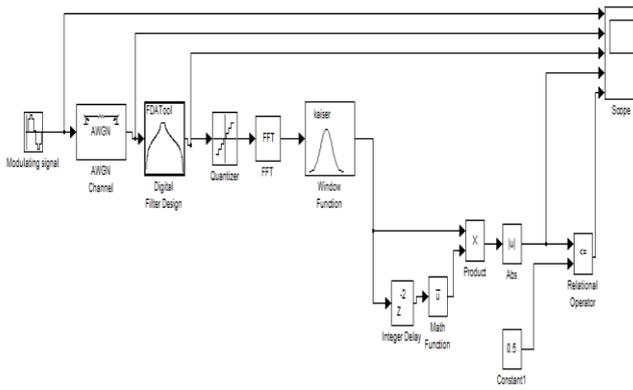


Fig.3 Simulink model for cyclostationary based detection method

The aim of this paper is to detect primary user by implementing basic block diagram of cyclostationary based detection method in Simulink. Fig.3 represents Simulink model of cyclostationary based detection method. Modulating signal i.e. input signal which has 2 KHz frequency, is given to the AWGN channel.

Additive white Gaussian noise (AWGN) is a basic noise model or also used as channel model that occur in nature with constant spectral distribution. Additive because it is added to any noise. White because it has uniform power across the frequency band. Gaussian because it has a normal distribution in the time domain. The AWGN channel is a good model for many satellite and deep space communication links [6].

After that signal is passed through filter. Here band pass filter is used to pass particular band of frequency and reject the frequencies outside that range. The main function of a filter in a transmitter is to limit the bandwidth of the output signal to the band allocated for the transmission. Then it is converted into the digital signal. Quantizer is the process of mapping a large set of input values to smaller set such as rounding values to some unit of precision. After that signal is passed through the FFT block which convert time domain signal into frequency domain signal. Windowing technique is used for reduce undesirable oscillation in the band.

After windowing function signal is processed for autocorrelation function. In this autocorrelation function signal correlates with itself. For that product block is used in which signal can multiple with its conjugate function. Now absolute value of signal is compared with constant value for detecting the primary user.

V. SIMULINK RESULT

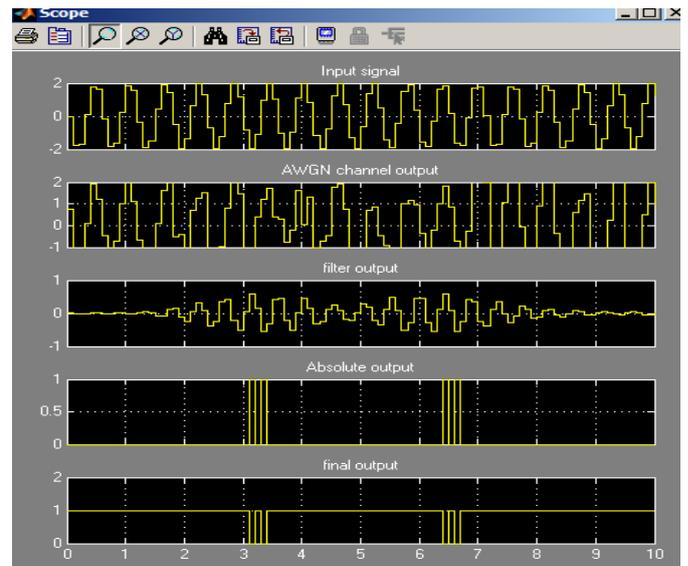


Fig. 4 Simulink result for detecting primary user at 2 KHz with 0.1 time period

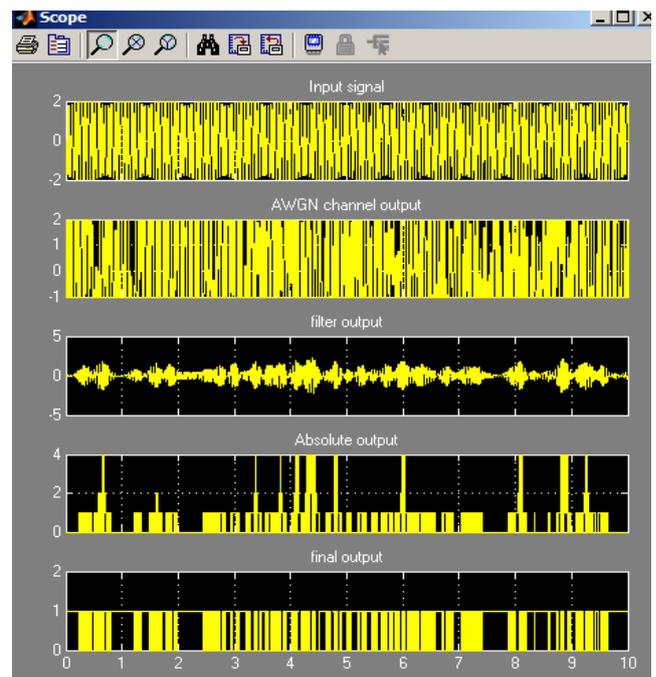


Fig. 5 Simulink result for detecting primary user at 20 KHz with 0.01 time period

Fig.4 & fig.5 represent Simulink result for detecting primary user. For that Input signal is passed through channel, filter, FFT block and windowing technique. After that it takes the absolute value which compares to the constant value through relational operator and generates the result. Final result shows presence and absence of primary user, in which peak value shows presence of primary user.

VI. CONCLUSION

In this paper cyclostationary based detection method for spectrum sensing is implemented in Simulink. Here use of autocorrelation function and AWGN noise is efficiently detecting presence of primary user by comparing it to constant value. Minimum noise is affected by AWGN noise model. The practical network can be designed for maximum utilization of available spectrum using cyclostationary based detection method. This method has its own advantage because other method i.e. matched filter and energy based detection method requires prior knowledge of primary user while this method do not require it. In future bit error rate can be measured for different sensing method in Simulink and compared for better results.

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