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BPSK Signal in A Cognitive Radio Atmosphere Detected by Cyclostationary Detection

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ABSTRACT: *Due to fixed available range and the imperfect use of spectrum use require a new communication technology, known as cognitive radio (CR). Cognitive radio is an sharp device which can effortlessly intelligence the accessible channel in an available spectrum. For spectrum sense it essentially use three techniques Energy Detection, Matched Filter Detection and Cyclostationary Detection. In this paper spectrum detection is done by using cyclostationary detection which give improved grades at low down SNR in comparison to other techniques, here BPSK signal is used for finding cyclostationary spectrum and detection at low SNR.*

Keyword: *Cognitive Radio, Spectrum Sensing, Cyclostationary Feature Detection, Spectrum correlation function (SCF).*

I. INTRODUCTION

The most excellent method to resolve the spectrum underutilization is by using cognitive radio (CR) technology. Cognitive radio strategy are pretend to give dependable message for all users which uses wireless system when they necessary and to make easy effectual use of the radio spectrum.One of the most significant request of cognitive radio is spectrum sense. Cognitive radio can sense the obtainable spectrum used for the less important users when main user is not using the chosen frequency spectrum, so that spectrum consumption can be enhanced. Several techniques similar to matched filter, cyclostationary detection, energy detection are used for spectrum sensing. In Matched filter it can sense signal even in low SNR atmosphere but it need a prior knowledge of the primary user signal Furthermore a matched filter requirements a devoted receiver for each primary user class and cannot be browbeaten for blind spectrum sensing . In Energy detector no requirement of former information of main signal. It is the simplest process for spectrum detection. But it have one disadvantage that it perform compact when the(signal to noise ratio) SNR level is low, it is used only for advanced SNR. The wireless communication signals varied with sine, cosine, pulse trains, repeating codes and the signal are cyclostationary because their signify value and autocorrelation functions display periodicity. This periodicity idea is used to perform different signal processing tasks that include detection, recognition and respect of the received signals. Yet this is complex, a cyclostationary characteristic detector is chiefly preferred intended for spectrum sensing in low SNR owing to its strength against noise. Inside this paper, cyclostationary spectrum and Detection of BPSK signal by different SNR and evaluation among Energy detection , Matched filter detection and Cyclostationary detection and the algorithm FFT Accumulation method(FAM), simulation result have
been discuss.

II. PRINCIPAL OF CYCLOSTATIONARITY

In Cyclostationary signals, their denote assessment and autocorrelation function have periodicity. In this paper a signal is engaged which can be called as primary signal:

$x(t)= s(t) + w(t)$ (1)

s(t) is the primary user transmitted signal and w(t) is the Additive white Gaussian Noise signal (AWGN) and fo is a carrier frequency. It has periodic mechanism that can be discover by CR to remove it from noise. The periodicity of the mean and autocorrelation function expressed by the equations are as follows:.

$N_x(t) = E[x(t)] = N_x(t+To)$ (2)

$R_x(t,\tau) = E[(t+\tau/2)x^*(t-\tau/2)]$ (3)

$= R_x(t+To,\tau+To)$

WhereT_0 = 1/fo. Eq.3 indicate that the autocorrelation function is cyclic in time t for each time lag τ. Using the Fourier series, the autocorrelation function can be extended as;

$R_x(t+\tau/2,t-\tau/2) = R_x^{a}(\tau)\, e^{j2\pi\alpha t}$ (4)

Where α is called cycle frequency. The Fourier coefficient can be obtain by;

$R_x^{\alpha}(\tau) = \lim_{T\to\infty} 1/T \int_{-T/2}^{T/2} R_x(t,\tau)e^{-j2\pi\alpha t}\, dt$ (5)

Where, T is the measurement time. Equation (5) will be non-zero when evaluated at α = fo. For still process similar to noise, Eq.5 will be zero-valued for $\alpha \neq 0$. By taking the Fourier transform of the repeated autocorrelation within equation (5), the spectral correlation function can be obtained as:

$S_x^{\alpha}(f) = \int_{-\infty}^{+\infty} R_x^{\alpha}(\tau)e^{-j2\pi f t}\, d\tau$ (6)

2.1 BPSK Signal

usually BPSK modulated signal is definite as follows:

x(t) = a(t)cos(2πfot+φ0)

In equally AM and BPSK modulated signal characteristic using SCF is approximately similar. But BPSK signal detection characteristic is thicker then the AM signal. Now on three axis that is X, Y and Z axis are engaged, at X axis spectral frequency , at Y axis repeated frequency and at Z axis Amplitude of SCF is pinched. Using the autocorrelation function and spectral correlation function intended for a signal, it be able to detect weak wireless signals buried in noise.

III. CYCLOSTATIONARY FEATURE DETECTION

With finding Periodicity inside a received signal it can recognize the occurrence of Primary User. The periodicity is usually embedded in sinusoidal carriers, pulse trains, hopping sequences or cyclic prefixes of the primary signals. Due to periodicity these cyclostationary signals have periodic statistics and spectral correlation which is not create in AWGN noise. Believe a hypothesis test for signal detection:

$$x(t) = \begin{cases} n(t), & H0 \\ s(t) + n(t), & H1 \end{cases}$$

Here x(t) is the signal received by the unlicensed client, s(t) is the signal transmitted by the licensed transmitter, n(t) is the noise introduce with AWGN and is the channel gain.H_0 is the null hypothesis when there is no primary signal and H_1 indicate the occurrence of primary signal. Here Primary consumer signal is detected and if it not uses the available spectrum after that at a particular time it is used by secondary user (Unlicensed user).

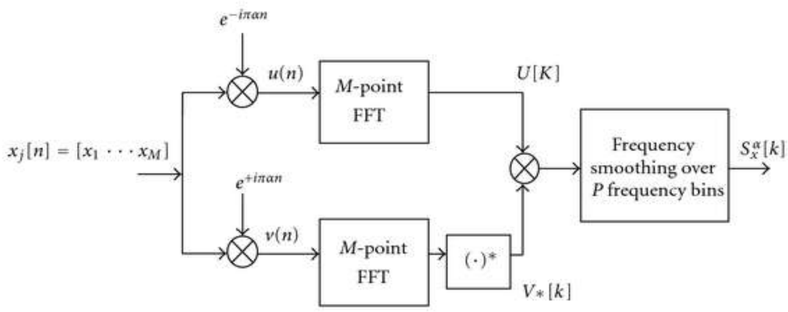

Fig.1 Cyclostationary feature detection

3.1 The algorithm used to calculate the Spectral Correlation Function (SCF) .

1. Read n samples interested in vector z
2. Multiply vector z with exp(-i*pi*alpha*t) store in x (alpha is the repeated frequency) which will take a series of values for each vector z, t is the time.
3. Multiply vector z with exp(i*pi*alpha*t) store in y
4. Multiply x,y with aKaiser-window
5. Take the N-point FFT of x,y (N < n)
6. Conjugate X (the FFT of x)
7. Multiply X* and Y
8. duplicate from 5 until all n samples are process and sum up the results from 7
9. Normalize the result from 8
10. Repeat from 2 util the entire series of alpha-values are processed

Table 1: Comparison of cognitive radio with conventional radio and software radio in application point of view

Conventional Radio	Software Radio	Cognitive Radio
1. Supports a permanent number of Systems.	1. Dynamically support multiple inconsistent systems, protocols and interfaces.	1. Can generate new waveforms on its own.
2. Reconfigurability determined at the time of design.	2. Interface with varied systems.	2. Can negotiate new interface.
3. May support several services, but chosen at the time of design.	3. Provide a wide range of services with changeable QoS (Quality of Service).	3. Adjusts operation to meet the QoS required by the application for the signal atmosphere.

IV. SIMULATION RESULTS

Cyclostationary spectrum and detection is performed by by Kaiser window at -5dB and algorithm for finding SCF. By using FFT Accumulation Method (FAM) make large peak value at $\alpha = 0$ & α= (carrier frequency). BPSK signal is use with carrier frequency (fo) = 30 Hz, sampling frequency fs =100 Hz , cyclic frequency (α)= mfo , m is any integer.

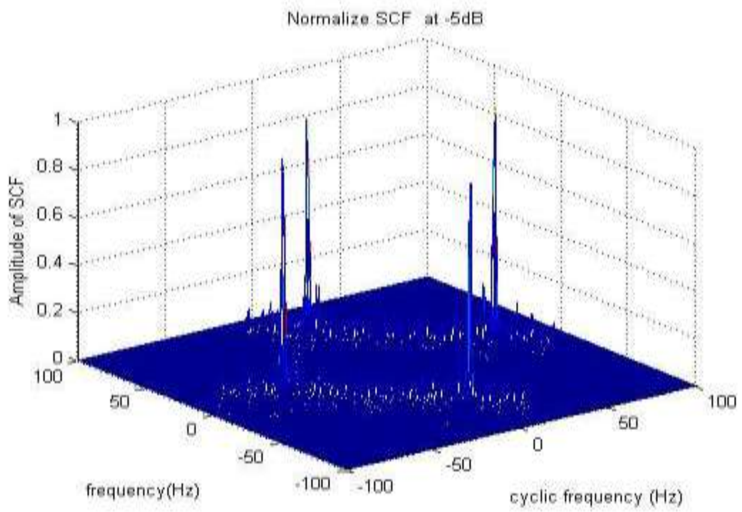

Fig.2. Cyclostationary Spectrum Feature of BPSK signal at -5dB

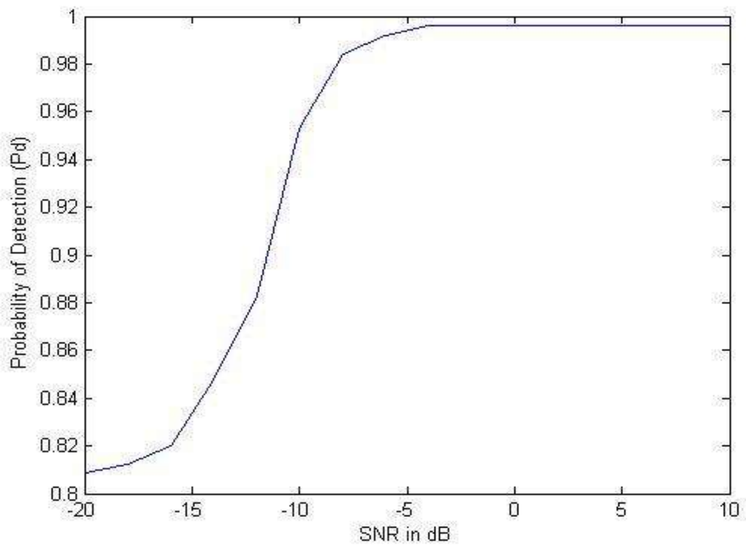

Fig.3 Detection of BPSK signal at 10% False alarm

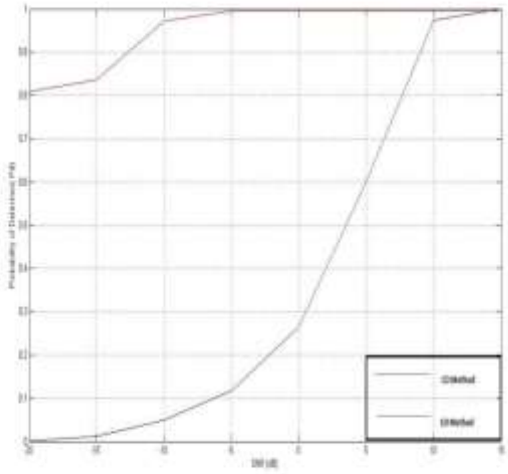

Fig.4. Detection of Primary signal for ED & CD at low SNR

V. CONCLUSION

In this paper study the Algorithm for finding spectrum Correlation function (SCF), Differences between three type of detection techniques shown in Table1, Simulation result to find out SCF of BPSK signal using Kaiser window and Fig.4. shows that Cyclostationary detection (CD) performs well at low SNR in comparison to Energy detection (ED). Here Probability of detection of CD shows good detection capacity at -20 dB in comparison to Energy detection.

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