Performance Prediction of OFDM-Based Cognitive Radio for Next-Generation Networking Capabilities

Mohamed Bakry El_Mashade, Ehab A. Hegazy

Abstract*: As a pioneering technology, next generation of mobile networks would overcome many problems of daily life activities. This new technology has many challenges that are tried to be destroyed. In this regard, to optimize the utilization of the allowed spectrum, an essential tool such as cognitive radio (CR) must be employed. It provides opportunity to use spectrum in strategic manner to both licensed and unlicensed users in such a way that the available spectrum is exploited in an efficient strategy. Meanwhile, the orthogonal frequency division multiplexing (OFDM) multicarrier transmission mechanism represents one of the more familiar techniques that are widely applied in free space systems of communication. Since this algorithm has the capability of satisfying the prime aspect of CR, which is associated with locally exploiting the unused spectrum autonomously, OFDM procedure is investigated as a CR system's candidate. In other words, it is of interest to study its behavior when it is combined with CR technology. Here, our goal is to treat the problem of spectrum sensing techniques in conjunction with OFDM signal. Simulation results show that OFDM spectral correlation can be enhanced via varying the number of samples. Also, OFDM pilot is mandatory and acts as a flag for OFDM frames. So, it is of importance to boost it for better detection. Additionally, the probability of detection (P_d) is estimated for different values of signal strength when the false alarm probability (P_f) is fixed. Moreover, receiver operating characteristic, which is the variation of P_d as a function of P_f for a fixed SNR, is drawn for two cases; theoretical and simulated. It is found that the two cases are of high degree of coincidence.

***Keywords*: 5G, Cognitive Radio, Spectrum Sensing, OFDM, hypothesis test.**

I. INTRODUCTION

Owing to the increasing interest in wireless services as well as the upward trend of creating new wireless applications, the call for radio spectrum has dramatically increased. On the other hand, the combination of the mobile communication systems and the internet technologies is predicted to be the future of wireless networks for providing users with what they are need from different kinds of services. Additionally, the appearance of new wireless devices as well as the necessity of wideband wireless access is anticipated to continue in the upcoming years. The achievement of these compelling requirements has led to a tremendous augmenting in radio traffic density, and thus a noticeable shortage of available spectrum will be resulted. Furthermore, the increasing request of date rate and service quality leads to quickly developing wireless communication system and to emerging an abundant number of new communication models. These new applications have the need of more employment of frequency bands. However, the spectrum shortage represents the fundamental challenge as an additional bandwidth is needed to be extended [1-5].

For the wireless communication, the radio spectrum represents its essential constituent. The current allocation policy of this spectrum leans on designating channels, for communication, to particular consumers with authorizes specified for technologies and services that are achieved cordless. This means that the appropriate spectrum is statically partitioned into authorized and unauthorized frequency bands. While the occupation of the first type is restricted to authorized operators, the bands of the second category are available for use by the public, subject only to transmission constraints. In other words, the users are classified into licensed and unlicensed when they are viewed as consumers. The former is called primary user (PU) whilst the second is known as secondary user (SU). While the licensed users have the priority to access to their specified portions of the spectrum to transmit/receive their data, the unlicensed ones are forbidden to access to these spectrum portions even if they are unoccupied. As a consequence of this classification, the unlicensed bands may get heavily congested. As the measurements around the world have revealed, it is noted that the authorized spectrum is comparatively idle over many time and frequency slots. Thus, the radio spectrum bands are underutilized and the radio spectrum is inefficiently exploited. Consequently, spectrum holes will be originated due to the unused spectrum portions by their owners as Fig.(1) demonstrates. The white space (or spectrum hole) refers to a PU assigned frequency band that is unoccupied at a specific time and at a certain geographic zone. Hence, a necessary treatment, to ameliorate the access to the underlined spectrum and satisfy a fulfilled network behavior, is needed to overcome the problem of shortage and impairment of the spectrum management. The best solution to this issue is to manage the spectrum in a dynamical fashion by participating the vacant channels with unlicensed clients without influencing the signals of the authorized consumers. In other words, the spectrum allocation problems can be handled through the use of opportunistic spectrum access.

Thus, the dynamic access of spectrum allows it to be equally operated between authorized and non-authorized occupiers, in contrast to the static m allocation. This is the main objective of cognitive radio (CR) strategy which has been highly regarded for spectrum shortage in recent years.

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The principal goal of radio cognitive is to identify the empty parts of the spectrum in any geographic location and at any instant in order to opportunistically employ them in serving secondary consumers without deteriorating the transmission of the primary client information. The technique of this technology is based on observing and learning the surroundings, adapting to the environmental circumstances, and preparing backgrounds in order to functionally exploit the available spectrum. This procedure permits SU to occupy the PU assigned radio band in the case where it is not being used temporally. In other words, it opportunistically introduces the utilization of the radio bands that are not intensely occupied by the allowable users. As a matter of fact, CR is a wireless communication mechanism in which radio frequency transmitter/receiver intelligently detects which spectrum bands are unused and which are in usage. When the detection processing is achieved, it allows the SU's to occupy the vacant bands while avoids the busy ones. Thus, CR promotes open spectrum allocation for radio spectrum usage. However spectrum sensing techniques are needed to detect free spectrum portions [6-10].

In CR system, since the PU has the priority in using the frequency band whilst the SU can only opportunistically occupy the hole portions of the spectrum, the cognitive user must monitor the state of the spectrum from time to time. This process of monitoring is known as spectrum sensing in the literature. This spectrum sensing has common scenarios involving matching filtering, cyclostationary and energy detection. The first technique provides the best detection, however, it requires parameter of the PU to be satisfactory operated. As of primary user privacy concerns, it is practically very hard to convey parameter of licensed user to the cognitive user. Owing to the hardness of its computation complexity, cyclostationary technique is unable to real-time search white space in wireless spectrum band. Thus, energy detection is the most common procedure due to its simplicity of implementation along with higher speed of operation. However, a slight variation in noise power can deteriorate its detection behavior. Performance of such procedure leans mainly on sensitivity and specificity which are in turn dependent upon the estimated value of the threshold that is established to differentiate between the presence and absence of the authorized user. Hence, a careful trade-off must be taken into account in setting the detection threshold. In this regard, there are two standard algorithms for this threshold setting. The former is associated with targeted spectrum re-use probability of the empty portion of the spectrum. In this case, the rate of false alarm (P_{fa}) is kept constant at a small value and the detection probability (P_d) is tried to be maximized. This process is dealing with what is known as constant false alarm rate (CFAR) detection technique. The other one is followed in the situation where it is needed to guarantee a given probability of non-interference. In this state, miss probability of detection (P_m) is set at a minimum value, or equivalently P_d is fixed to a high value, and P_{fa} is tried to be minimized. This approach is termed as constant detection rate (CDR) principle. However, the operation of these processors is dependent upon predefined value of the parameters. For real time application, performance of all static threshold schemes degrades as the environmental circumstances are dynamically changing [11-16].

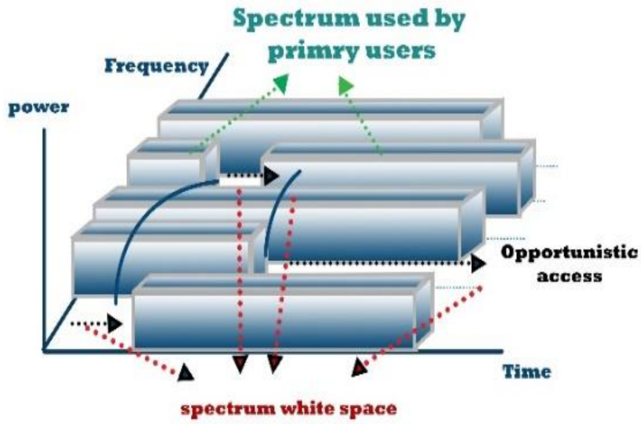

Fig.(1) Spectrum white space model

In modern systems of wireless communication, an orthogonal frequency division multiplexing (OFDM) technique is a multicarrier model of transmission that represents one of the most widely used technologies. In other words, OFDM is a modulation algorithm which is capable of solving many of high bit rate communication problems in which time dispersion represents the biggest one of them. Owing to its attractive features, this scenario of multicarrier has been successfully used in various technologies of wireless communications. Therefore, OFDM is probably the best technology of transmission. Owing to its sensing and spectrum shaping capabilities, this procedure of multiplexing is the most convenient algorithm for CR systems due to its flexibility and adaptivity. In this regard, OFDM has the possibility of satisfying the main aspect of CR which is associated with locally exploitation of the unused spectrum for the spectral efficiency to be enhanced. From this point of view, it is predicted that OFDM will play an interesting part in realizing CR objective. For this reason, OFDM procedure is investigated as a CR system's candidate in our research. The rest of the article is organized as follows. In section II, the background of the spectrum sensing along with its techniques of achievement is discussed. The underlined problem is formulated in section III. Section IV is concerned with OFDM and cyclostationary feature detection in CR Systems. In section V, simulation results for a proposed spectrum sensing technique through the using of OFDM signal are displayed. Our concluded remarks are summarized in section VI.

II. BACKGROUND AND MOTIVATION

The current strategy of the allocation policy of radio spectrum is set upon specifying channels to private users with licenses for distinctive wireless technologies and services. These licensed clients have the facility of accessing their spectrum sections to transmit/receive their desired data, whilst others are unauthorized even though these sections are idle.

Thus, designated spectrum parts are not busy all the time by their owners (PUs), and due to this un-occupation, spectrum holes will be created. In this regard, a spectrum hole denotes an assigned PU frequency band that is not being used at a specified instant of time and a certain geographic location. The spectrum sensing is the process of discovering these holes. These holes can be opportunistically allocated to another type of clients called cognitive users. Owing to the presence of these voids, the radio spectrum is inefficiently exploited. Therefore, a new treatment is needed to improve the accessing of radio spectrum and satisfy high network efficiency. The best solution to this problem is to dynamically managing the allowed spectrum. This requirement can be achieved by allowing void frequency bands to be available for unlicensed users (SUs), taking into consideration that their using to these bands don't make any interference with the signals of the original users. As a consequence of this processing, the underlined spectrum will be accessible by primary and secondary users, where the allowable spectrum is partitioned into numerous bands; each one of them is devoted to one or more dedicated users.

CR is a recent strategy of adapting and learning the operating environment and has the capability of adjusting the network parameters to optimize the utilization of the electromagnetic spectrum while providing flexibility in wireless access. In other words, CR can be defined as a modern technology of efficiently detecting and accessing the under-utilization spectrum. For attaining this objective, spectrum sensing, spectrum decision, spectrum sharing and spectrum mobility, as four processing functions, are proposed for CR systems [17-20]. Fig.(2) shows these principal roles of CR. Throughout CR operation, spectrum sensing is the starting action that is concerned with detecting all available under-utilized spectrums (white spaces). After the detection of voids, the second step is to making a decision about the selection of the best white space which is convenient for instantaneous transmission. The next action after taking a decision is the spectrum sharing which is concerned with providing coordination or scheduling for participating the spectrum bands with other SUs and/or CR users. Finally, the mobility function of the spectrum permits SU to smoothly release the underlined band back to its owner, PU, once detected and shift to another available white space.

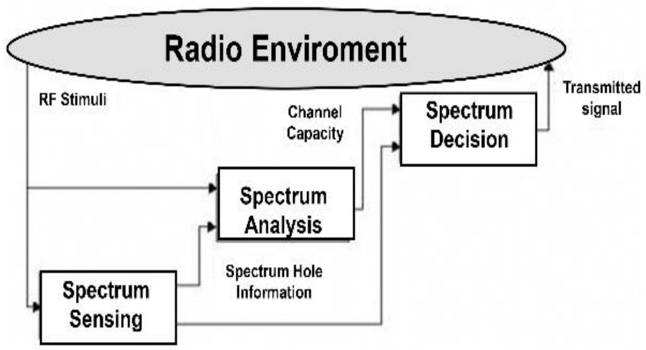

Fig.(2) Cognitive radio cycle

A most important challenge in cognitive radio is that the SU is demanded to identify the existence of PU in its allowed spectrum and to quit the frequency band as quickly as possible for interference avoidance with PU. In the proposed work, we will introduce a spectrum sensing through OFDM technique. For this proposed system, there are several non-cooperative sensing algorithms that act as the major approaches to control and define the signal presence. They include cyclostationary detection, energy detection and matched filtering [7-10].

In cyclostationary detection, by analyzing the cyclostationary features of received signals, the PU transmissions can be detected. These features can take the form of periodicity in the mean value and autocorrelation function of the tested signal. They have the ability of single out the noise from PU signal. In this procedure of detection, if the autocorrelation of the received signal vanishes, it points out the absence of PU which means that the associated band contains only noise. Generally, cyclostationary is a complex mechanism of detection. In the 2nd type of detection algorithms, CR user senses the presence of PU by analyzing the energy of the received signal. If the energy of this signal is greater than the threshold, then PU is existant otherwise PU is inattentive. In this situation, the threshold value is established based on the state of the channel information. The last scenario of detection maximizes the SNR and achieves optimal detection in additive white Gaussian noise (AWGN) situation. Prior knowledge of signal is needed in matched filter feature algorithm, in which the received signals are compared with those of PU. The main merit of this procedure is that it necessitates less time to attain high processing gain. If the prior knowledge, such as modulation type, pulse shape, or packet format, is incorrect then the matched filtering strategy performs poorly.Commonly, cyclostationary mechanism has a superior performance, especially in weak signal strength (low SNR), than the energy detector even the last methodology has simple structure. A trade-off between SNR and a priori knowledge must be taken into account in cyclostationary detection, which necessitates knowledge of the modulation type of the signal and postulates that the signal exhibits cyclostationarity. In other words, this scenario of signal detection is a random process for which the statistical specifications such as the mean value and autocorrelation function are periodically varied as a function of time. This technique of vacant detection hasn't the ability of real-time searching of white space in wireless spectrum band since its computation complexity is too high [21-25].

Cyclostationary procedure can be employed, in an OFDM based cognitive radio system, to address a number of issues related to synchronization, blind channel identification, spectrum sharing and network coordination. Therefore, it is possible to design cyclostationary principals as well as its corresponding spectral correlation estimators for various situations and applications.

III. PROBLEM FORMULATION

In cognitive radio networks, spectrum sensing process is very important and it is necessary to be performed before permitting SU the right of using an unoccupied licensed channel.

The spirit of this signal processing scenario is the binary hypothesis-testing formulation. Mathematically speaking, it takes the form:

$$y(n) = \begin{cases} w(n) \quad n=1,2,........,N & under\ H_0 \\ s(n)+w(n) & under\ H_1 \end{cases} \quad (1)$$

In this expression, y(n) denotes the n^{th} sample of the received signal, s(n) refers to the n^{th} sample of the tested signal, whilst w(n) symbolizes the n^{th} sample of the AWGN. H_0 hypothesis represents the absence of the examined signal and H_1 is an indication of its presence. Thus, if s(n) = 0, it signalizes that there is no transmission from the primary user side.

The key performance indicator in spectrum sensing is the probability of correct detection. Additionally, two types of errors may be occurred. Firstly, when the channel is vacant (H_0) but the spectrum sensor decides the channel is employed. The probability of this situation is what is known as probability of false alarm (P_f).The second error happened when channel is busy (H_1) and the spectrum sensor indicates that the channel is unoccupied. The probability of this instance is known as the probability of misdetection (P_m).

The signals employed in many communication and control systems have the features that involve some form of periodicity processing operation. Additionally, noise in the communication system can be treated as wide-sense stationary process. This type of stochastic processes has time invariant autocorrelation function. Thus, if y(t) is a wide-sense stationary process, its autocorrelation function becomes:

$$R_y(t,\tau) = E\{y(t)\, y^*(t-\tau)\} = R_y(\tau), \quad \forall t \quad (2)$$

In Eq.(2), E{.} symbolizes the expectation operator and the upper scripted symbol * denotes the complex conjugate.

Manmade signals, on the other hand, are not wide-sense stationary. However, some of them can be appropriately modeled by random processes that are cyclostationary, i.e., processes having statistical parameters, such as mean and autocorrelation, that are periodically fluctuated with time. In other words, a cyclostationary process is associated with signal possesses statistical properties which are cyclically varied with time. If y(t) is a cyclostationary process, it has an autocorrelation function of temporal periodical form. Thus,

$$R_y(t,\tau) = R_y(t+T_0,\tau) \quad (3)$$

T_0 is the temporal period. The cyclic autocorrelation function of y(t) is defined as:

$$R_y^{\alpha}(\tau) = \lim_{T\to\infty} \frac{1}{T} \int_{-\frac{T}{2}}^{\frac{T}{2}} y\left(t+\frac{\tau}{2}\right) y^*\left(t-\frac{\tau}{2}\right) e^{-j2\pi\alpha t}\, dt \quad (4)$$

In the above formula, α represents the cyclic frequency. If α_0 denotes the fundamental cyclic frequency of y(t), then $R_y^{\alpha}(\tau)$ is nonzero only for integer multiples of α_0 and identically zero for all other values of α. On the other hand, the spectral correlation function of y(t) can be obtained by calculating the Fourier transform of Eq.(4) which yields:

$$S_y^{\alpha}(f) = \int_{-\infty}^{\infty} R_y^{\alpha}(\tau)\, e^{-j2\pi f\tau}\, d\tau \quad (5)$$

It is of importance to note that when α is zero, Eq.(5) tends to the power spectral density (PSD) of the random process y(t). It is worthwhile to note that both $R_y^{\alpha}(\tau)$ and $S_y^{\alpha}(f)$ can be used as features to detect y(t). Assuming that s(t) denotes the signal and w(t) represents the AWGN, the received signal y(t) is equal to s(t) + w(t). Taking this form of y(t) into consideration, the test statistic for the optimal cyclostationary detector, as a function of spectral correlation function, can be formulated as:

$$z = \sum_{\alpha} \int S_s^{\alpha *}(f)\, S_y^{\alpha}(f)\, df \quad (6)$$

IV. CYCLOSTATIONARY DETECTION TECHNIQUE

Cyclic detector has better performance in low signal to noise ratio. OFDM has many features including the periodicity. cyclostationary exploited this feature in its spectrum sensing. To apply the principle of such technique, it is necessary for the process to be periodic. Since the OFDM technology possess this property, it is evident that the application of cyclostationary becomes an easy task. Conversely, the detector’s performance deteriorates in the situations of timing and frequency jitters [20-22].

In OFDM, multiple carriers are used to handle the sending of data. From binary phase shift keying (BPSK) to N-QAM, each one of these carriers could be modulated. In this regard, frequency division multiplexing (FDM) is used to assign different data channels. OFDM, on the other hand, multiplexes in frequency too but it uses all the carriers in order to transmit data from one channel. The idea is to fragment the data to be transmitted over multiple lower rate channels, making it more forceful and getting higher bit rates in the overall transmission.

The enhancement of such scheme of modulation is satisfied by defining orthogonality between the used carriers, allowing them to be closer to each other and thus decreasing the needed bandwidth. OFDM has many decades of existence but the current technology available for digital signal processing allows realizing such multi-carrier modulation on the digital domain meeting the real-time requirements. It is worth noting that the using of the fast Fourier transform (FFT) makes OFDM implementation more convenient [16,17]. Fig.(3) illustrates the flow chart signifying a primary user who employs OFDM based signal for the purpose of being detected.

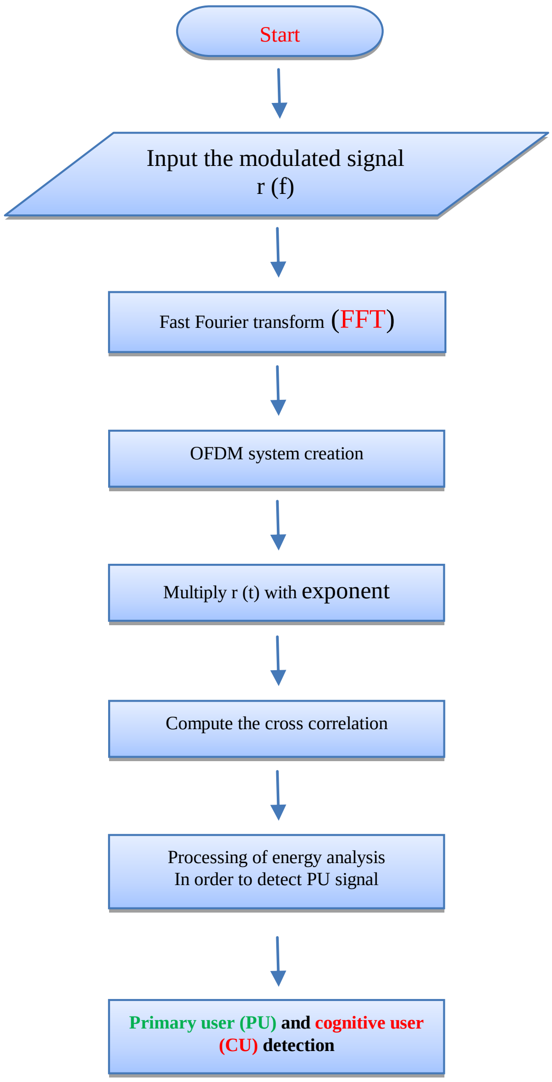

Fig.(3) Proposed algorithm flow graph

A known bit about the PU's signal structure is regularly quite. In this regard, the data rates, the modulation type, the carrier frequency, and location of guard bands may be designated. Digital modulated forms of signals have periodic features that may be implicit or else explicit. For this type of signals, the carrier frequency and symbol rate can easily be estimated through the use of square-law devices.

In some standard forms of mobile networks, the primary user network employs a pilot tone frequency with which the SU may be exploited. Additionally, the using of a cyclic prefix leads also to periodic structure of signals. The correlation and means sequences of such signals show periodicity and for this reason, they are called cyclostationary signals [18-20]. Generally, the test statistic in a cyclic detector takes the form:

$$S(f,\tau) = \frac{1}{N}\sum_{n=1}^{N} y(n)\, y(n+\tau) e^{-j2\pi f n} \qquad (7)$$

Here, it is assumed that the received signal s(n) can be formulated as:

$$s(n) = \sum_k s_k(n)\, e^{j2\pi f_k n} \qquad (8)$$

In the above formula, $s_k(n)$ is mutually independent zero-mean wide-sense stationary process. Thus, for a large N, the test statistic of the underlined detector can be reconstructed as:

$$S(f;\tau) \approx \sum_k R_k(\tau)\, e^{j2\pi f_k \tau}\, \delta(f - 2f_k) \qquad (9)$$

Based on orthogonal division modulation, inverse fast Fourier transform (IFFT) and fast Fourier transform (FFT) play a crucial rule in the smooth deployment of this kind of detectors. In the transmitting part, IFFT processing is used to generate the OFDM baseband signal. In the receiving part, on the other hand, FFT will be implemented for extracting the required information [25].

In the detection theory of signals, any detector is characterized by two important parameters. These parameters are known as false alarm and detection (P_f, P_d) probabilities. Taking into account that P_m=1-P_d, these probabilities can be defined as [20]:

$$\begin{aligned} P_f &= \Pr ob\{decide\ H_1/H_0\} \quad \& \\ P_m &= \Pr ob\{decide\ H_0/H_1\} \qquad (10) \end{aligned}$$

V. SIMULATION RESULTS

The spectral correlation is one of the most important characteristics of cyclostionary algorithm. From this point of view, spectral correlation function (SCF), as a generality of the power spectral density (PSD), can be considered as a backbone of this algorithm. In recent times, several types of modulated signals have highly distinct this important function of correlation. As a consequence of these verities, signal detection can be achieved by essentially exploiting an estimated version of SCF.

Table I Parameter values for simulation

Parameters	value
Channel Mode	ITU-R m.1225
Number of samples	8
Number of symbols	32
Number of subcarrier	4096
Data subcarrier Modulation	64QAM
FFT size	512
Pilot boost up level	2.5dB and 10dB
Cyclic prefix	1/8

The OFDM scenario of modulation has some features such as periodicity or else symmetric in frequency domain. Hence, it has the capability of matching the concept of cyclostionary. In further words, the main merit of implementing signal detection through cyclostionary manner is its dependent on the feature of modulated signal and its characteristics. The outcomes of this dependency are methodically verified using the mathematical model of the OFDM detection scheme via the use of a code in Matlab-2015 program.

Now, let us go to display some numerical results that explore the SCF of OFDM signal to see to what extent this function can affect the behavior of OFDM system. Fig.(4) shows the SCF of OFDM signal with two samples per symbol. To see the influence of increasing the size of samples on the spectral characteristics of OFDM, Fig.(5) illustrates the same thing as Fig.(4) for eight samples/symbol.

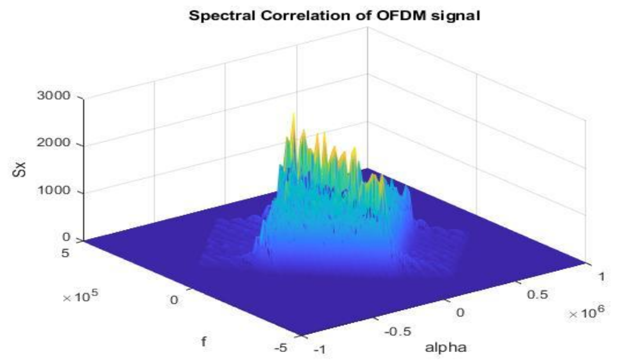

Fig. (4) OFDM spectral correlation with 2 samples per symbol

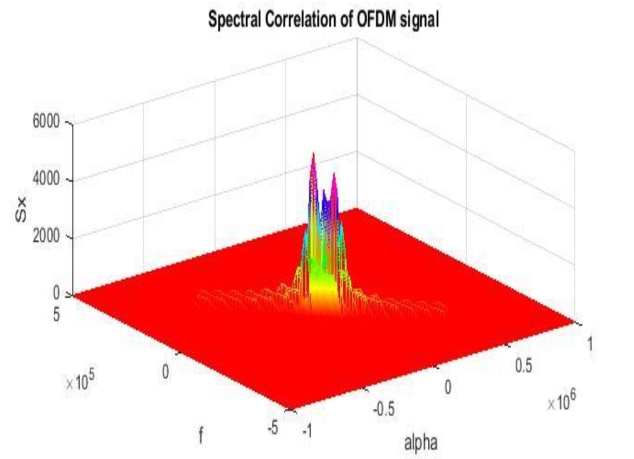

Fig.(5) OFDM spectral correlation with 8 samples per symbol

According to simulation outcomes presented in both figures, it is evident that the spectral correlation improves as the symbol size of samples is increased. Based on this behavior, eight samples per symbol is considered in our upcoming results. In the following part, we will simulate another significant factor in the transmitted OFDM signal which is termed as pilot. A pilot is a mandatory element in OFDM signal structure for achieving better reception or signal detection. Therefore, pilot flags must be implanted in the information at the transmitting end for the ability of the channel information to be gotten up. Meanwhile, the receiver has the capability to collect the channel information via the use of such pilot mark.

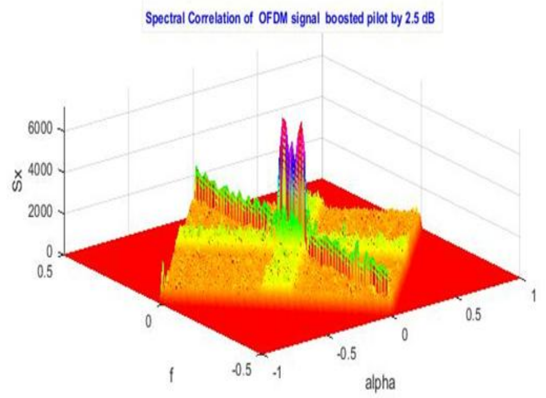

Fig. (6) SCF of OFDM signal with 2.5dB boosted pilot subcarrier per symbol

Fig.(6) displays the spectral correlation of the examined algorithm when it is operated with 2.5dB boosted pilot, whilst Fig.(7) illustrates the same thing except that the pilot is boosted with 10dB instead of 2.5dB.

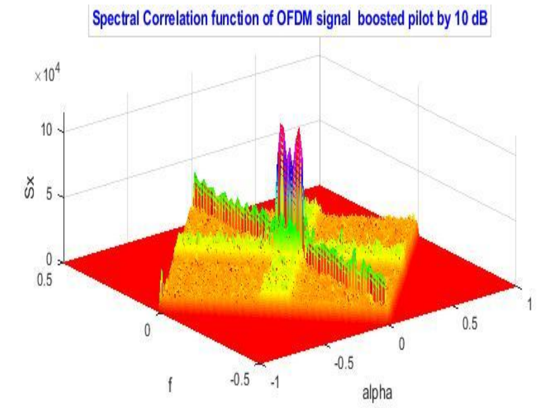

Fig. (7) SCF of OFDM signal with 10dB boosted pilot subcarrier per symbol

Usually, the pilot's subcarrier in OFDM structure is selected from carriers with fixed spacing in order to assure the periodic feature of OFDM signal. So, the main key point from boosting the pilot is to support the separation or give more clarification for the pilot carrier from the baseband signal.

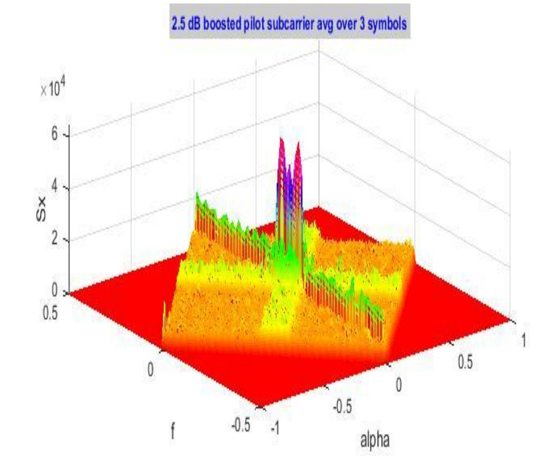

Fig. (8) SCF of 3-symbol averaged OFDM signal with 2.5 dB boosted pilot subcarriers

Pilot schemes have various techniques such as some of them use pseudo-random values to escape spectral lines, some others spread over the tones at the same spectral spot every OFDM symbol, and another ones exchange the pilots between symbols to predetermined locations. In common situation, pilot carriers are located in the same position of each symbol in OFDM frame structure. The OFDM symbol is used to modulate all the carriers simultaneously. Averaging over multiple symbols will attain more enrichment to locate the pilot. Figs.(8 & 9) present OFDM spectral correlation with pilot boosted by 2.5dB for an averaging over 3 and 5 symbols, respectively.

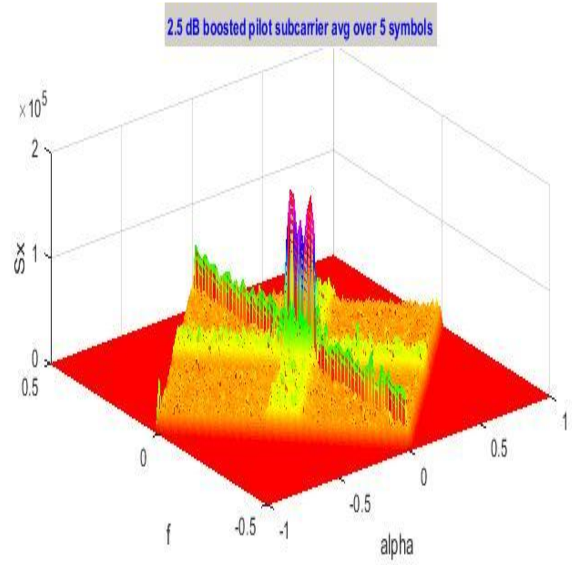

Fig. (9) SCF of 5-symbol averaged OFDM signal with 2.5 dB boosted pilot subcarriers

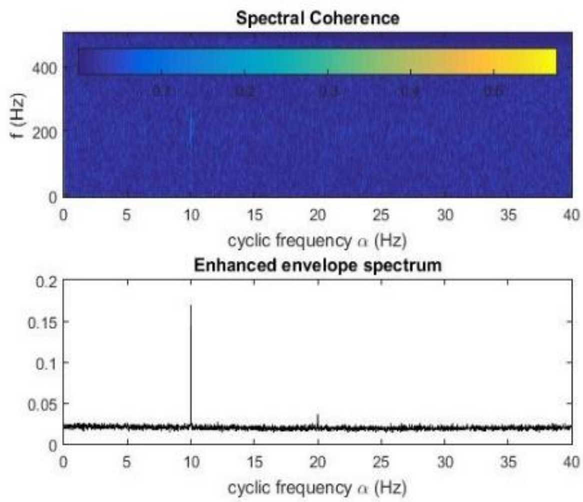

Fig. (10) Spectral coherence of OFDM signal

In cyclostationary processing applications, the parameter α designates the separation frequency and the symbol f denotes the location frequency to define the spectral components of the tested signal at f + α/2 and f - α/2. If there is correlation in a signal's spectral components at these frequencies defined by α and f, the signal has cyclostationary, at cycle frequency α and spectrum frequency f. In this regard, Fig. (10) shows the spectral coherence of OFDM signal.

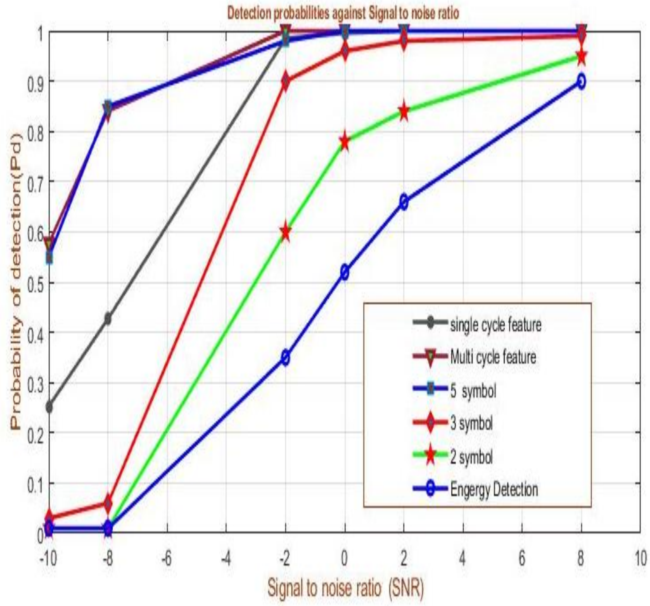

Fig. (11) Probability of detection versus SNR for P_{fa}=10%

The detection probability is evaluated through different SNRs when a given rate of false decision is guaranteed. The obtained results for the proposed scheme is presented in Fig. (11). Meanwhile, receiver operating characteristics (ROCs), which describe the variation of P_d as a function of P_f when the SNR is kept constant, are simulated for both cases; theoretical and simulated. Fig.(12) illustrates the ROC of the proposed model for several values of signal strength. It is evident that the two cases are coincident as it was predicted.

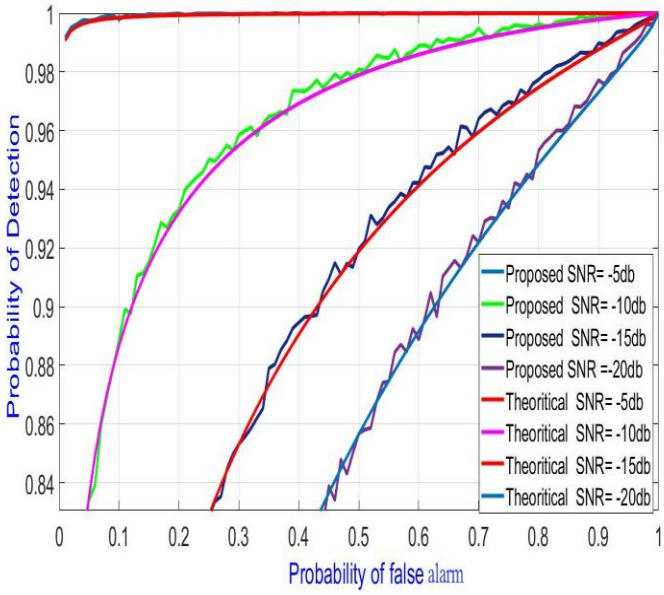

Fig. (12) ROC of the proposed technique for different SNR

As point out in the above portion, software simulation are deployed in order to validate the key performance of the obtainable cyclostationary technique for orthogonal frequency division multiplexing signal. So, our proposed design is implemented under some parameter values such as number of multi-carriers of 4096, channel model ITU-R m.1225 and different spectral correlation for the OFDM signal with pilot boosting level of 2.5dB and 10dB.

VI. CONCLUSION

Cognitive radio technology is needed and must be employed, if wireless society search is to maximize the utilization of the available spectrum. The setup of cognitive radio network is based on CU, via instantly sensed the spectrum and decided to recognize if the licensed user is busy or not. Characteristics of spectral correlation in the cyclostationary signals enrich the domain of signal detection scheme. Next generation of mobile communication is coming in the near future and one of its most challenges is the satisfied use of the current spectrum. This research is interested in proposing the cyclostationary procedure for OFDM signals. Outcomes of this scenario are: CFD is fast, precise, well-organized and it has the ability to work in low SNR conditions. Cognitive radio can be considered as a backbone for the incoming generations of mobile communication systems.

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