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Comparison & Detection of Power/SNR ratio for Scanned White Spaces over ISM Band: A Review

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ABSTRACT: As there is tremendous increase in the number of active users in wireless communication there occurs a scarcity of spectrum in the available frequency spectrum. As the frequency spectrum available to us is limited so we have to utilize the available frequency spectrum in such an efficient way so that all the user can access the spectrum efficiently. To utilize the unused frequency spectrum concept of white space has been introduced. White Spaces (WS) are vacant frequencies made available for unlicensed use at locations where spectrum is not being used by another individual, such as Wi-Fi, Bluetooth, etc. In this paper, Min-Max algorithm is used for channel allocation. The Min-Max algorithm allocate channel in the available vacant space by calculating the phase, magnitude and probability of the vacant channels. Based on this results availability of vacant channel can be determined. Graphs of various parameters like power, snr will be plotted. Based on these results availability of vacant channels can be determined and using this information data is transmitting on the available channel. This paper proposes an optimal technique for the identification of vacant spaces in the unlicensed ISM (2.4-2.43Ghz) and transmit data on the detected vacant space without inference with the primary user.

KEYWORDS: White space, ISM, min max algorithm, matlab, snr

I. INTRODUCTION

Nowadays, communication in wireless network is the requirement of resources of spectrum. As the naturally available resources of spectrum is limited there is need of utilization of this spectrum resources very carefully in an ntelligent manner .The technique used to find out how much amount of spectrum usage is there is called as spectrum sensing. Spectrum sensing is one of the most important operation of cognitive radios as it impacts on the performance of the secondary users and the performance degradation due interference of the primary users. Cognitive radio is an intelligent device which automatically identify the channels in frequency spectrum mainly wireless then on the basic of detection changes its transmission and reception parameter to allow more concurrent wireless communications in a given spectrum band. For wireless and cellular network the method of allocating communication channels and bandwidth to the base stations, access points and terminal equipment is called as channel allocation. To attain maximum system spectral efficiency by the way of method called as frequency reuse by avoiding co-channel interference and adjacent channel interference. The system spectral efficiency is defined as the measure of the number of users or services in a particular defined geographical area that can be supported simultaneously by an available radio frequency bandwidth.
The information rate that can be transmitted over a given bandwidth in a specific communication channel. The different types of strategy available for channel allocation are Fixed channel allocation(FCA), Dynamic channel allocation or Dynamic Channel Assignment(DCA), Hybrid Channel Allocation schemes(HCA).In FCA each cell is provided with fixed set of frequency channels. Main drawback of FCA is traffic congestion. The problem associated with FCA can be solved using DCA. Whenever a channel is required by a cell, the channel is allocated under the constraint that frequency reuse requirements cannot be violated. FCA performance is better than DCA under heavy traffic. Channel reusability is maximum in FCA. Flexible channel allocation can be easily done with the DCA techniques. There is also another type of scheme called HCA which is combination of both FCA and DCA schemes. The total number of channels available in HCA schemes for service is divided into fixed and dynamic sets. Each cell is assigned with a set of channel on the basis of FCA in fixed set. In dynamic set to increase the flexibility all cell shares the dynamic set. The task of the secondary user is to sense and monitor the radio spectrum environment within their range of operation for detection of frequency bands or time intervals that are not occupied by primary users. The two

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most important parameter of spectrum sensing are accuracy and time. Utilization of spectrum can be efficiently use by making it possible for secondary user to access a spectrum hole unoccupied by primary user. A spectrum hole is a band of frequencies assigned to a primary user, but, at a particular time and specific geographic location, the band is not being used by that user. Due to increase in large number of active user in the wireless communication there occurs a scarcity of frequency spectrum. While the recent studies by FCC have shown that large amount of spectrum is vacant most of time .This portion is use by only licensed user .To overcome this problem of not utilization of frequency spectrum FCC has permitted secondary user to permit secondary user to utilize the licensed band when it is not in used and name it as cognitive radio.

II. RELATED WORK

We are currently facing a problem of spectrum scarcity to overcome this problem a concept named Cognitive radio (CR)technology has been introduced .The basic idea of cognitive idea is access of unused frequency spectrum by secondary or unlicensed users (SU).The unused licensed frequency spectrum is called as spectral hole or white space. Cognitive radio technology gives an opportunity to unlicensed user to utilize this spectrum holes. The standards for utilizing these white spaces in the TVUHF band is provided by Wireless Regional Area Network (WRAN).For spectrum sensing the one method which is available is energy detection method. The threshold set by the system plays a very important role in success of this method. In this paper [1] using energy detection method a new threshold formulation for efficient spectrum sensing has been proposed by the author. An algorithm using new threshold formulation for spectrum sensing in cognitive radio has been proposed .Minimization of false detection probability increase the spectrum sensing efficiency. Energy detection method is independent of modulation used for transmission of signal, phase or any other parameter. In this method number of users with frequencies and power of used channels got in frequency domain analysis. In TVUHF average accuracy of spectrum sensing is 96.56% and that for Wi-Fi radio is 98.16%.This method is not able to distinguish between primary and secondary user.

The most common and simple spectrum sensing scheme available is energy detection method .Energy detection method does not require an information regarding the parameters of primary signal. The data obtained in field measurement campaigns is used to compare two detection algorithms for cognitive radio, spectral covariance sensing and the energy detection in [2]. Testing of algorithm was done by evaluating their performance in terms probability of false alarm, robability of detection and probability of misdetection. At different geo-positioned points experimental data consists of received signal measurements. Conclusion carried out from this is that noise uncertainty caused severe degradation to energy detector. There should be a proper balanced maintained between the probability of false alarm and probability of detection and value of threshold should be properly chosen. The spectral covariance sensing is highly resistant against noise uncertainty; this algorithm exploits the different statistical correlations of the received signal and noise in the frequency domain. Better detection performance has been achieved by spectral covariance sensing as compared to energy detector. To use the available licensed bandwidth effectively there is no proper framework for mobile CRs. For a realistic mobile environment the smooth random mobility model has been considered [3]. Coordination of all CRs has been done by a cognitive base station. On the basis geographical placement the nodes are grouped into clusters. To access the spectrum CRs used Transform Domain Communication System, (TDCS). The double threshold energy detection method is used each CR user as the sensing technique. For dynamic spectrum access a suitable spectrum approach is required over ISM band. Author has proposed a robust spectrum sensing method for identification of white space in the unlicensed 2.4GHz ISM band where radio transmission technologiescoexist [4].Because of the design parameters collocated networks have different levels of spectrum access priority. In the ISM band apart from using a predetermined radio channel in the ISM band and to take advantage of spectrum holes which are found during transmissions of collocated networks a device has perform dynamic spectrum access using a frequency agile radio thus improving the access of interference free ISM band. This paper proposed a dual spectrum sensing strategy for capturing spectrum holes that are wide sufficient to accommodate the transmissions of a device .Here a dual spectrum sensing method has been proposed which a combination of both the convergence-cluster and the power threshold methods. In power-threshold method a fixed threshold value is set and power at each narrow slice in the spectrum is evaluate with the threshold power value .If the power in a part of spectrum is greater than the power threshold value then the spectrum is consider to be occupied In this method decision making is done only on the basic of power threshold this method is simple to implement .The power threshold method is unable to identify the start/end of the occupied part of the spectrum. On the other hand convergence cluster method correctly detects the occupied part of the spectrum which is depending on the gradual power variation. By combining the above two methods dual spectrum sensing cope with

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the drawbacks of these two methods and provides the most robust results. In this method, in the form of gradually changing power values as well as sharp rise/fall edges in the detection of occupied parts of the spectrum variation in power has been handle .To access the ISM band large amount of white space is exist to enable frequency agile IEEE 802.15.4-based devices. In this paper [5]author has mainly used a technique called energy detection technique for spectrum sensing Signals undergo several impairments while signal travels through wireless medium due to various channels like additive white Gaussian noise and Rayleigh fading etc .Here to access over his two channels energy detection technique is used. Various methods of spectrum sensing are Energy detection, Matched Filter detection and Cyclostationary detection. Due multiple path propagation fading occurs .At the receiver the signal comes from different paths having different delays and path gains. Probability of miss detection is known as the probability that shows that primary user is inactive although it is active. The main cause behind Rayleigh fading is multipath reception of transmitted signal. Match filter method is the method which is used when the transmitted signal is known .Less time taken by this method to compute probability of detection. One of best method available for spectrum sensing is energy detection method because of its low implementation and computational complexities. No information regarding primary user is required in this method that is reason why this method is appropriate to used for spectrum sensing. Result shows that this technique works better when the wireless channel is AWGN rather than when it is Rayleigh fading channel. In this paper [6] spectrum sensing is performed using the feature detection method. Here the main task is to identify the free space and for the availability of free spectrum continuous monitoring is done. The different statistical correlations of the received signal are exploited by the feature detection algorithm. In time domain, white space is used. As congestion problem in existing network occur in situations like Terrorist attack, large number of RF devices work at same time, heavy rain fall and some other situation. As in this situation late reception of urgent confidential message leads to worst situation. In this paper an optimal way has been proposed that enable a good performance in existence of heavy Traffic in industrial, scientific, and medical radio band(ISM band) interference. On the basis of real life network traces statistical analysis a prototype model of a spectrum sensing and sharing has been developed which uses the covariance of the partial spectrum of the received signal to accurately characterize the white space in Wi-Fi traffic or incomplete ISM band. The spectrum hole changes swiftly in time, space and frequency in ISM bands. In the ISM band the characteristics and patterns of frequency hopping is mainly studied. The feature detection algorithm will make us enable to identify arbitrary signals by properly selecting parameters which is depended on the features of used signals and also it will help in avoiding interference with the authorized user.

For any good signaling scheme it is important to use bandwidth efficiently. There occur a problem of ISI arise which leads to distortion of transmitted signal which results in istorted signal reception. In vacant space for establishing communication a method called signaling also known to as correlative coding. In correlative coding introduction of some controlled amount of ISI into the data stream instead of completely eliminating it. Here in this paper [7] with a view to reduce ISI and increase the efficiency in vacant spread spectrums. Here text has been taken as input-output messages. With the help of ASCII equivalent the text message is converted into digital form and then it is given to the Correlative encoder. Encoding of the bit stream is done by Correlative encoder and passed to the rectangular filter. For the representation of the band limited channel Rectangular filter is used. This information is then passed on to modulator followed by channel and then again carried forward to demodulator. The information is then provided to correlative decoder from the demodulator and it is again converted to text form in which it was transmitted. Correlative scheme help in establishing communication through vacant space along with removal of ISI.By using correlative coding scheme a transmission of better quality signals which results in fine signaling scheme. For achieving higher data rate transmission in band limited spectrum and for optimization of transmission power of antenna in digital coding system this method can be used.

Cyclostationary feature detector is one the optimal method for detection of primary user detection because its stoutness to noise uncertainty. Although it is able to detect the primary user but detection time taken by this method is large because of its complexity. As the detection time plays a crucial role in wireless communication as here detection time is more so this degrades the spectral efficiency. The author has proposed a method in [8] which sequential detection frameworks apply to the Cyclostationary feature detector .Sequential detector time is random variable. A sequential detector has been proposed here which take account of both magnitude and phase. Along with that a multiple hypothesis test has been proposed where the signal-present hypothesis is broken into the multiple hypotheses with different signal assumptions. Simulation result shows that detection time taken by this method is less than one half of that of fixed singlecycle detector (SCD). Author has proposed a multiple hypothesis test, named the multiple hypothesis sequentialsingle-cycle detectors (MH-SSCD) where the signal-present hypothesis is broken into the multiple hypotheses with different signal assumptions. The simulation results show that the expected detection time of the proposed sequential detector is less than one-half of that of the fixed time SCD. Cooperative spectrum sensing is the

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method which improves sensing performance by many cognitive users rather than only one user at time like other methods. Here in [9] each cognitive user perform individual spectrum sensing any of the method available. By extenuating effect of fading and shadowing the accuracy of spectrum sensing can be improved. This algorithm requires knowledge of signal or noise or both. In this paper author has give detailed information about blind spectrum sensing based on QR decomposition and linear prediction and apply it to Cooperative spectrum sensing. This method does not need knowledge of signal and noise.

Simulation results show that the proposed method outperforms conventional energy based cooperative spectrum sensing under noise uncertainty. Comparison of this algorithm has been done with blind source separation method and noteworthy improvement in performance has been observed. In blind spectrum sensing there is no knowledge of noise or channel is required .The input to the algorithm is cyclostationary in nature. This algorithm is mainly depending on the utilization of linear prediction and QR decomposition. Statics of signals statics of two receive signals are commuted and based on the ratio of these statics presence or absence of user is determined. The principle of this method is based on the verity that the samples of the signals show very strong correlation properties but noise does not show the same. At low SNR also this property enables sensing .Utilization of blind sensing in cooperative sensing improve reliability of spectrum sensing. Cognitive Radio (CR) users ameliorate spectrum efficiency by Opportunistic spectrum access when the primary users (PUs) do not occupy the licensed spectrum. To avoid interference with the primary users Cognitive Radio users sense the spectrum and vacate on detection of primary users. To ensure priority of primary users Cognitive Radio users uses a common medium for the control message exchange. In this paper [10] author proposed a algorithm named Vacate on demand. This algorithm allows dynamic spectrum access and ensures to vacate the assigned channel in case of PU activity and move the CR user to some other vacant channel to make spectrum available to PUs as well as to CR users. The basic idea is to use a ranking table of the available channels on the basis of activities of primary users detected on each channel. In the ranking table based on the activities of PR users order is decided. On the top channel having less PU activity is placed and channel with more PU activity is placed at the bottom There are two main features of The VD algorithm (a) in case of PU activity vacate the assigned channel, (b) in least promising time move the CR user to some other vacant channel. As number of active users are increasing their occur a scarcity of frequency spectrum so there is an need to utilize this spectrum in a efficient way .In wireless media there is a method called cognitive radio which provides a efficient spectrum utilization. The main goal of cognitive radio is sensing of spectrum. Energy based Detection, Matched Filter based Detection, and Cyclostationary Feature Detection are the main methods available for spectrum sensing. In this paper [11] author has used energy detection for sensing the spectrum. During spectrum sensing, cooperative analysis of multi CRs has been done .With increase numbers of CRs the evaluation of performance of cooperative Spectrum Sensing had been done. An evaluation and comparison of performance of selected relay based on Maximum value SNR and SNR of other relays .MATLAB software is used for performance analysis. In cooperative Spectrum Sensing analysis every relay can sense the presence and absence of primary user by using various sensing techniques. In this paper Energy Detection technique for spectrum sensing had been used .To maximize the spectrum sensing maximum SNR path relay is selected. For selection of maximum SNR total SNR of the channel in different paths has been calculated and relay with maximum SNR has been selected. Channel sensing performance is done on the basis of two parameters probability of detection and probability of false alarm. Result shows that with increase in number of cognitive radio there is an increase in the performance of sensing. The analysis on various sensing methods based on energy detection and covariance based detection [12]. In energy detection method there require a prior information of noise but this method undergo problem of noise uncertainty Covariance based detection exploits space-time signal correlation that does not require the knowledge of noise and signal power. For detection of signals covariance method is used because the covariance of signal and noise are different. Though there are not many studies that show the viability of the detectors and analyze their performance under fading channels. Here analysis of performance of detector exploiting TV white space in Rayleigh and Rician fading channel by setting probabilities of false alarm and probability of detection measurement. On the performance of covariance based detector the effect of smoothing factor and overall correlation coefficient has been analyzed. Under the time-varying fading channels Covariance based detector shows good results as compare to the energy detector with noise uncertainty. Energy of the receive waveform is compare with the set threshold value in energy detection method. knowledge of noise signal is requiring for signal detection in energy detection method. Because of uncertainty of the measurements and of the time variation of noise power uncertainty always exists in practice. Because of this uncertainty in noise, the estimated noise power is different from the actual noise power.CAV (Covariance Absolute Value) is a blind detection method which does not need any information of noise and signal power. The covariance's of signal and noise are generally different .To differentiate the signal component (PU) from the background noise CAV method used this difference. This method uses space-time signal correlation for the detection of signal. To evaluate the

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performance energy detection method and CAV.For the evaluation of energy detection method and CAV method simulations based on Digital Video Broadcast– Terrestrial (DVB–T) signals have been performed. From the simulation result it is shown that energy detection method with accurate noise power can be applied for signal detection and shows good results as compare to the covariance method. But in covariance based detection with noise uncertainty present in case of fast and slow time-varying channels shows good results as compare to energy detection method. There is degradation in performance of covariance based detection. In covariance based detection the probability of detection improves as there occur an increase in smoothing factor and overall correlation coefficient.

III. PROPOSED SYSTEM

In the proposed method using Min-Max algorithm allocation of channel will be done .After the allocation of channel using Matlab software the vacant space in frequency is shown by various graphs of power and SNR based on threshold value power it will be decided that which channel is free for data transmission. Using FPGA controlling of RF module will be done .This RF module will transmits and receive data in the available white space which we get after performing spectrum sensing.

A.*SPECTRUM SCANNER:*

The function of spectrum scanner is to scan the spectrum available for transmission of data in the vacant space. As it is necessary to first scan the channel which is not used by the primary user and make it available to the secondary user .Spectrum scanning is first and one of the most important task.

B.*CONTROLLER PORT (ALGORITHM):*

This block is mainly used for channel allocation .This channel allocation is based on the calculation of magnitude, phase and probability of the channels .Based on this calculation, whether the channel is vacant or not can be suggested.

C.CONTROLLER PORT (DEVICE):

This block is used for controlling the antenna module used for transmission of data over the available vacant space. This controlling is based on the result available from various Power and SNR graphs which will give information regarding availability of channel.

D.POWER UNIT MODULE

This block is used for plotting of graphs of power and SNR. Based on this availability of channel can be determined

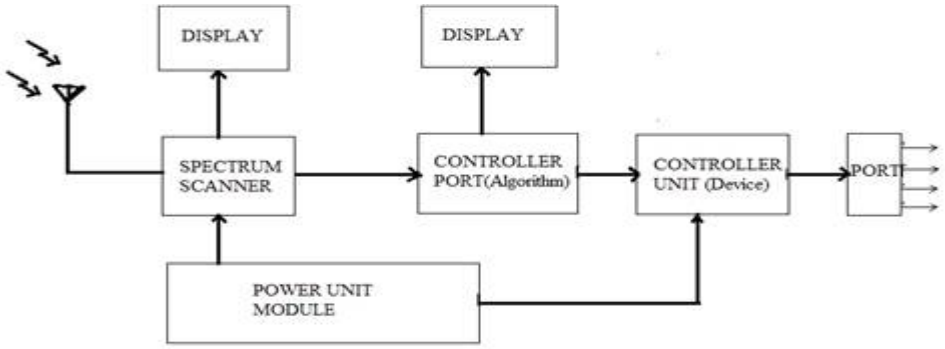

Figure1: Propose block diagram for power ratio optimization antenna unit

IV. CONCLUSION

This paper gives a comparative study of various spectrum sensing techniques. Every method has its own advantages and some disadvantages. Energy detection method is not dependent on the modulation used for signal transmission, phase or other parameter. This method is easy to implement and is having low computational complexities. This method is not able to differentiate between interference of noise and primary users. Do not work satisfactorily in low SNR values. Matched Filter Detection is the one of the best method available for spectrum sensing when the information about transmitted signal is known .Detection of primary user is done by correlating the earlier detected

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primary signals .It takes help of probability of detection and probability of false alarm. It can detect primary user at low SNR and require less sample of received sample .But it also has high complexity in implementation and high power consumption. Cyclostationary Feature Detection require partial knowledge of primary user which give it edge over MFD which require large amount of information regarding primary users .It has ability to differentiate between noise and primary user .It has noise immunity. But it has high computational complexity and high cost and it required long detection time. The CAV method as covariance of signal and noise are different so this is considered for detection. In CAV smoothing factor and overall correlation coefficient are studied .It shows good result in fast and slow time-varying channels when compare with energy detection. In Cooperative sensing detection time is reduced. It has good accuracy of signal detection. Cyclostationary Feature Detection has edge over the spectrum sensing methods because of its noise immunity ability. Although it has high computational complexity this method gives better result in comparison with other spectrum sensing methods.

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