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A Review of Dynamic Spectrum Detection based on Bi-Level for CR Networks

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Abstract— Cognitive radio communication has emerged as an efficient mean of utilization of spectrum for wireless communication. In cognitive radio communication the energy detector logic for spectrum estimation is the most eminent part for estimation of used spectrum over unused spectrum. The estimation error rate for such a system is dependent on the probability based hypothetical estimation approach. Wherein conventional energy detectors make the probability estimation based on derived threshold, the error rate is purely dependent on the accuracy of the threshold limits. In this paper a bi-level threshold modeling is proposed. The bi-level estimation approach presents an approach for non-linearity factor consideration for secondary users in Cognitive Radio communication. The obtained simulative observation illustrates the significance of bi-level estimator logic over conventional estimator logic.

Keywords— Cognitive radio, spectrum estimation, energy detector, bi-level limits.

I. INTRODUCTION

In modern competitive world the wireless networks are assigned by a fixed spectrum policy. Though a hefty portion of the spectrum is made available for the geographical variations. The assigned spectrum utilizes range from 15% to 85% with a high variance in time for the periodically and geographical variations. Due to the limited availability of spectrum and inefficient usage of the spectrum led to a new communication to exploit the existing wireless spectrum. This new communication model is referred to as Dynamic Spectrum Access (DSA) or cognitive radio (CR) networks. A cognitive radio is defined as a transceiver which helps in detecting the availability of the channel in the spectrum and correspondingly changes its transmission or reception parameters in a given spectrum band. The theory of CR is first introduced in [1], in which the secondary (unlicensed) users consume the licensed frequencies when the primary (licensed) user is absent or not fully utilizes the spectrum. In order to achieve this, the secondary users require sensing property in the spectrum environment in its surroundings in order too decide the absence and presence of the primary user. Many spectrum sensing methods are proposed [2], in which the energy detector has a simple structure and quick spectrum sensing property. For signals corrupted by Gaussian noise the energy detector is very useful and act as a non-coherent detector [3]. It measures the energy of the existence signal and compared with the preset threshold value. No channel state information is required for the measurement and the comparison. Because of its simple structure and sensing property the energy detector has been widely used in communication system.

Dealing with the anonymous deterministic signals masked with Gaussian noise an energy detector [3] is proposed. For detecting the random signals corrupted by the Gaussian noise the extension the energy detector is used in [4] and [5]. Though the results obtained are based on the likelihood ratio test method and the likelihood ratio test method is maximized in [6]. In many communication applications, there is a possibility of the errors might occur, so the probability of erroneous detection or the probability of correct detection is of more interest. The energy detector has the ability to maximize the generalized likelihood function may not be the same in minimizing the probability of erroneous detection by maximizing the probability of correct detection. This gives motivation to explore the energy detectors much better than those proposed in [1], [4], [5]. In [7] based on the updation of square value to an arbitrary constant value 'p' for the signal amplitude, a new approach energy detector is proposed for improving the accuracy. In real time environment uncertainty in the channel exist, in this work uncertainty in the channel is not considered. So there is a need for modification in the proposed approach for uncertainty condition. For this reason, in this paper a bi-level threshold approach for energy detection is proposed. In [8], [9] for energy detection a 2 level thresholding approach is recently been used. This approach integrates the uncertainty condition in CR communication.

II. SYSTEM MODEL

In cognitive radio systems, cooperative spectrum sensing has been widely used to detect the primary user with a high agility and accuracy. Every cognitive user conducts its individual spectrum sensing using some detection method and then sends a binary local decision to the common receiver. Usually, the local decision is made by comparing the observation with a pre-fixed threshold. For example, the energy detection for the ith cognitive user is illustrated in Fig. 1(a). When the collected energy Oi exceeds the threshold λ, decision H1 will be made which assumes that the primary user is present. Otherwise, decision H0 will be made. Compared to the conventional method, the system model of our interest is shown in Fig. 1 (b). Two thresholds λ1 and λ2 are used to measure the reliability of the collected energy. "Decision H0" and "Decision H1" represent the absence and the presence of primary user, respectively. "No Decision" means that the observation is not reliable enough and the ith cognitive user will send nothing to the common receiver.

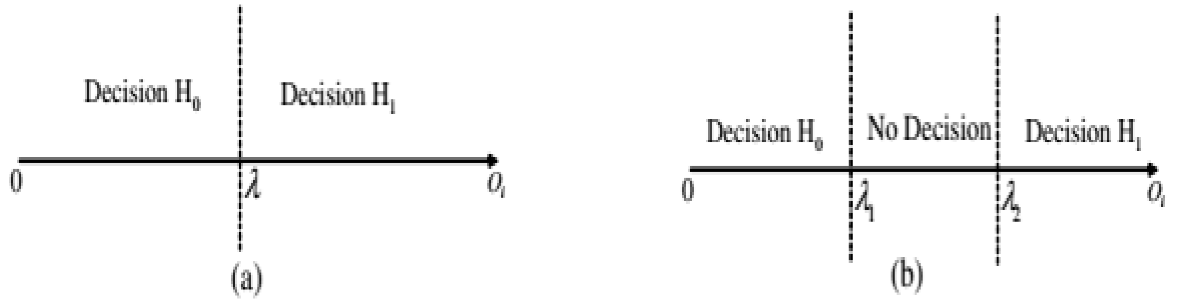

Fig.1(a) Conventional detection method with one threshold for ith use (b Censoring detection method with bi-thresholds for ith user

Based on the above censoring method, cooperative spectrum sensing can be performed as follows 1) Every cognitive user i, for i = 1, · · · ,N, conducts spectrum sensing individually and collects the energy Oi. If the energy Oi is located in the "No Decision" region, i.e., λ1 < Oi < λ2, then the ith cognitive user sends nothing. Otherwise, it will report to the common receiver a local decision Di, which is given by

$$D_i = \begin{cases} 0, & 0 \le O_i \le \lambda_1, \\ 1, & O_i \ge \lambda_2. \end{cases} \quad (1)$$

Note that given an instantaneous SNR γ, Oi follows the distribution [13]

$$f(O|\gamma) \sim \begin{cases} \chi^2_{2u}, & H_0, \\ \chi^2_{2u}(2\gamma), & H_1, \end{cases} \quad (2)$$

Where γ is exponentially distributed with the mean value γ ¯, u is the time bandwidth product of the energy detector, χ2 2u represents a central chi-square distribution with 2u degrees of freedom and χ2 2u(2γ) represents a non-central chi-square distribution with 2u degrees of freedom and a non-centrality parameter 2γ.

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2) Assume that the common receiver receives K out of N local decisions reported from the cognitive users, it then makes a final decision H according to the fusion function ψ, as follows

$$H = \psi(\hat{D}_1, \hat{D}_2, \cdots, \hat{D}_K), \qquad (3)$$

where D ˆ1,D ˆ2, · · · ,D ˆ K denote the decoded signals of D1,D2, · · · ,DK after passing through the reporting channels, respectively. To further limit the interference to the primary user, the spectrum is assumed to be available only when all the K reporting decisions are 0. Thus, OR-rule is used in the common receiver.Let K ¯ denote the normalized average number of sensing bits, i.e.,

$$\bar{K} = \frac{K_{avg}}{N}, \qquad (4)$$

where K avg is the average number of sensing bits. Let TK and ¯T (N−K) represent the event that there are K cognitive users reporting and (N − K) users not reporting to the common receiver, respectively. Then P{TK} = (1 − P{λ1 < O < λ2})K and P{T ¯(N−K)} = P{λ1 < O < λ2}(N−K), where P{·} stands for the probability. Further let P0 = P{H0} and P1 = P{H1}. Then, Kavg can be calculated as

$$K_{avg} = P_0 \sum_{K=1}^{N} K \binom{N}{K} \mathrm{P}\{T_K|H_0\}\mathrm{P}\{\bar{T}_{(N-K)}|H_0\} + P_1 \sum_{K=1}^{N} K \binom{N}{K} \mathrm{P}\{T_K|H_1\}\mathrm{P}\{\bar{T}_{(N-K)}|H_1\}. \quad (5)$$

Consequently, the normalized average number of sensing bits is

$$\bar{K} = 1 - P_0\Delta_0 - P_1\Delta_1, \qquad (6)$$

Where Δ0 = P{λ1 < O < λ2|H0} and Δ1 = P{λ1 < O < λ2|H1} represent the probability of “No Decision” for one cognitive user under hypothesis H0 and H1, respectively. From (6), it can be seen that, due to the factors Δ0 and Δ1 the normalized average number of sensing bits K ¯ is always smaller than 1. Therefore, in our proposed method, the average number of sensing bits of the cooperative spectrum sensing is decreased as opposed to that of the conventional method.

III. P-POWER ENERGY ESTIMATOR

In past area the fundamental energy recognizing model for a sign is exhibited under two suspicions H0 and H1 individually. In this segment attempting to figure the edge keeping in mind the end goal to figure out if they got sign is under hypothesis0 or Hypothesis1. This should be possible as takes after Denote as the probability of false alarm and as the probability identification. The discovery edge can be dictated by Using (4). As per the Neyman Pearson principle as Where k and speak to the shape and scaling parameters individually. The energy detector can boost the summed up probability capacity in (2 and 3) as seen in [9] and may not be the same in minimizing the probability of false caution or incorrect discovery by augmenting the probability of right identification in (5).

IV. IMPROVED BI-LEVEL ESTIMATOR

Bi-level estimator rationale is exhibited in figure.1. In [13], a two level limit methodology is exhibited. In two level edge approach the energy detector works by considering discrete specimens of the spectrum and procedure them to shape a test measurement, and later these test insights are contrasted with a pre-computed edge, where is characterized as far as possible for the sign limit energy detectors and are for the bi-level edge ones. At the point when E` ≥ `it means that the channel is occupied which the theory is H1. Else, it speaks to channel is free or recreation which is the theory. The customary bi-level estimator rationale is appeared in fig.1. In the proposed bi-level-edge energy detector demonstrated infig.2, under the condition when E`>ǫ0 , it shows the theory H1,

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and when E≤ ϱ1 , it demonstrates the Speculation H0. At the point when ϱ0<W`≤ ϱ1 demonstrates the indeterminacy locale. So in (4) and (5) the false-alert probability PF, location probability Pdis same. There is a miss probability Pmin nearby bi-level-edge energy detector can be characterized as

$$P_m = Pr\{\delta_0^{'} < E^{'} < \delta_1^{'}\}$$

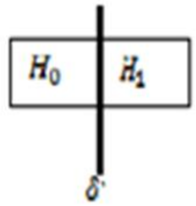

Fig.2Conventional Approach for Energy Estimator

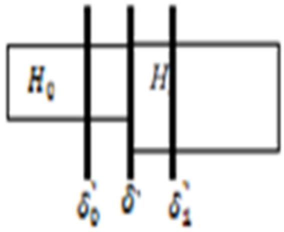

Fig.3 Proposed Bi-level Energy Estimator

Here we are interfacing the camera to the ARM controller. The USB camera will capture IRIS image of the person and send it to the PC Database, comparison will be done. Controller will recognize the iris of the particular person from the image. If they match then it will display the data on the display unit, and then a 6 digit code is messaged (OTP) to the customers' registered mobile number through GSM module connected to the ARM. It is only after entering this valid OTP that the user is allowed for making further transactions. For providing security to the ATM terminal from thieves we include a vibration sensor in the system. The vibration sensor will sense the position of ATM, in case of robbery the position of the ATM is changed then the sensor will automatically generate an alarm signal and will shut down the shutter of the ATM center. The turn off of the shutter will be done using a DC motor. By using the concept of Internet of Things (IOT),we can observe the authorize or Unauthorized Access of user Remotely

V. EXPECTED RESULTS

1. Comparison of the bit error rates for the improved energy detector at n=10 & n=20.
2. Comparison of the ROCs for the conventional energy detector and the new energy detector n=10 for different values of ý.
3. Pm versus Pf in two kinds of spectrum sensing for p=0.1 & P=0.01
4. Probability of detection versus signal to noise ratio at p=2, p=2.25.

VI. CONCLUSION

A bi-level thresholding approach for energy detection is proposed. The conventional approach of single thresholding approach is improved by the usage of two threshold limits under variant channel conditions. The estimation accuracy to such approach is observed to be improved due to the utilization of improved thresholding with bi-level thresholding. The uncertainty of detection of PU under secondary user presence is developed and evaluated in this work. From the results observed it is proved that with the usage of bi-level thresholding provides better estimation at any range of SNR as in comparison to conventional approaches.

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