A Comparison Algorithms for Sensing the Spectrum Using Deep Learning Techniques

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Abstract - In 5G Wireless communications Spectrum sensing is a key function of cognitive radio to prevent the harmful interference with licensed users and identify the available spectrum for improving the spectrum's utilization. In this paper a deep learning-based approach is introduced to sense the spectrum for availability of the primary user. If the primary user is absence, then a secondary user can be allocated in the spectrum. In ultra-dense networks and in dense network traffic conditions there is a scope for continuous utilization of the spectrum by the licensed user. Along with this approaches we will implement spectrum sensing using Energy detection technique, Entropy technique, and optimized features. Telecommunications can expand its services to huge volume of users without any disturbances. This process will show better results when compared to state of art methods.

Index Terms – Five G, Spectrum sensing, Cognitive radio, Energy detection, Entropy technique

I. INTRODUCTION

A cognitive radio (CR) is a radio that can be programmed and configured dynamically to use the best wireless channels in its vicinity to avoid user interference and congestion. Such a radio automatically detects available channels in wireless spectrum, then accordingly changes its transmission or reception parameters to allow more concurrent wireless communications in a given spectrum band at one location. This process is a form of dynamic spectrum management. In response to the operator's commands, the cognitive engine is capable of configuring radio-system parameters. These parameters include "waveform, protocol, operating frequency, and networking". This functions as an autonomous unit in the communications environment, exchanging information about the environment with the networks it accesses and other cognitive radios (CRs). A CR "monitors its own performance continuously", in addition to "reading the radio's outputs"; it then uses this information to "determine the RF environment, channel conditions, link performance, etc.", and adjusts the "radio's settings to deliver the required quality of service subject to an appropriate combination of user requirements, operational limitations, and regulatory constraints". In this study [1] consider the problem of detecting whether a frequency band is being used by a known primary user. We derive fundamental bounds on detection performance in low SNR in the presence of noise uncertainty — the noise is assumed to be white, but we know its distribution only to within a particular set. For clarity of analysis, we focus on primary transmissions that are BPSK-modulated random data without any pilot tones or training sequences. In this study [2] present a simple technique for detection of primary users in cognitive radio networks with unknown noise and interference levels. We will show that the likelihood ratio test for detecting the primary user can be approximated to a formulation that compares the estimated entropy of the received signal to a suitable threshold. This formulation is also intuitive since for a given variance, the entropy of a stochastic signal is maximized if it is Gaussian. In this study [3] presents a comprehensive performance comparison of energy detection, matched-filter detection, and cyclostationarity-based detection, the three popular choices for spectrum sensing by cognitive radios. Analytical expressions for the false alarm and detection probability achieved by all the detectors are derived. For cyclostationarity based detection, two architectures that exploit cyclostationarity are proposed: The Spectral Correlation Density (SCD) detector, and the Magnitude Squared Coherence (MSC) detector . In this study [4] Sensitivity to noise uncertainty Isa fundamental limitation of current spectrum sensing strategies in cognitive radio networks (CRN). Because of noise uncertainty, the performance of traditional detectors such as matched filters, energy detectors, and even cyclostationary detectors deteriorates rapidly at low Signal-to-Noise Ratios (SNR). To counteract noise uncertainty, a new entropy-based spectrum sensing scheme is introduced in this letter. In this study [5] the distribution of the ratio of extreme eigenvalues of a complex Wishart matrix is studied in order to calculate the exact decision threshold as a function of the desired probability of false alarm for the maximum-minimum eigenvalue (MME) detector. In contrast to the asymptotic analysis reported in the literature, we consider a finite number of cooperative receivers and a finite number of samples and derive the exact decision threshold for the probability of false alarm. In this study [6] Owing to no need for prior knowledge of signal, blind spectrum sensing has received wide attention. Covariance Absolute Value (CAV) detection algorithm, one of the most popular blind sensing algorithms, considers the correlation of signal samples. However, its detection performance is restricted by the uncertain threshold calculation. In this study [7] Spectrum sensing is a key problem in cognitive radio. However, traditional detectors become ineffective when noise uncertainty is severe. It is shown that the entropy of Gauss white noise is constant in the frequency domain, and a robust detector based on the entropy of spectrum amplitude was proposed.In this study [8,] the evaluation of a spectrum sensing strategy based on the Frequency Domain Entropy applied to cognitive radio networks is presented. Entropy estimation is performed using Bartlett periodogram. A tradeoff between variance and the spectral resolution for Bartlett periodogram is figure

II. EXISTING METHOD

II Energy Detection: In this process the data is received from the signal is check with the pre estimated with cut off rang and detect the existence of the user. This threshold can be selected either statistically or dynamically. But this method shows degraded results when noise and interference is high. But to provide high bit error rate the threshold is select dynamically using the noise level present in the signal.

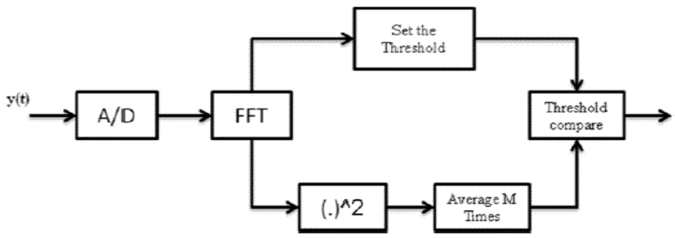


Fig1.FFT-Based Energy Detector

III. .PROPOSED METHOD

Proposed Method-1

Spectrum sensing can be modeled as a binary hypothesis test problem. The hypotheses under test are:

H 0 : x (n) = ω (n) …… (1)

H 1 : x (n) =s (n) +ω (n) …. (2)

n = 0,1…. N-1, Hypotheses H0 and H1 is for idle and busy frequency band respectively. In (1) and (2), x(n), s(n), ω(n) correspond to the received signal, the modulated signal, and the noise samples respectively. Shannon's entropy, denoted by H, is a measure of the uncertainty present in the random variable. It can be quantified by the following equation:

$$H(X) = -\sum_{i=1}^{L} \frac{n_i}{N} log_2 \frac{n_i}{N}$$

$$\lambda = H_L + Q^{-1}(1 - P_{fa})\sigma_n$$

….. (3,4)

$$H_L = \ln\left(2^{-1}/2L\right) + 2^{-1}\gamma + 1$$

λ- Threshold

Pfa-Probability of false alarm is set as 0.2 in our paper

γ - Euler-Mascheroni constant

Q-1-Inverse Q function

σn -Standard deviation

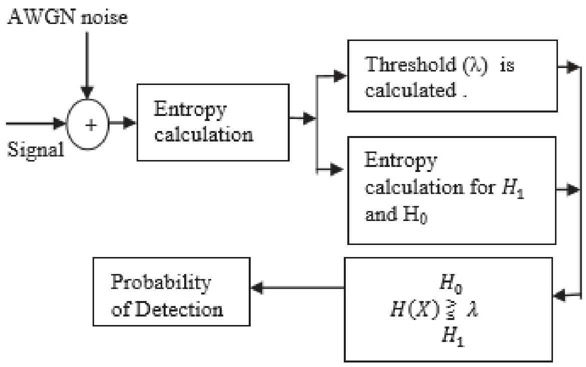
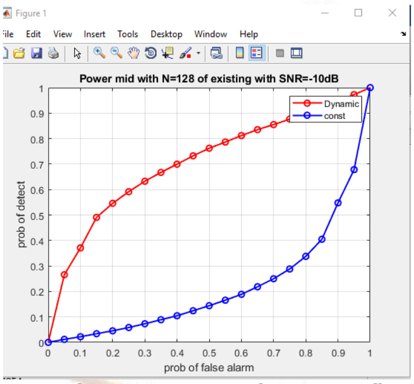


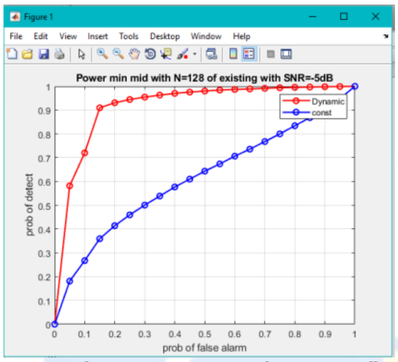
Fig 2: Block diagram of proposed method

IV. RESULTS

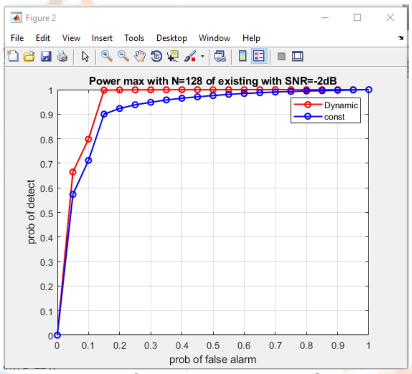
Method 1



Power mid N=128 existing with SNR = -10db

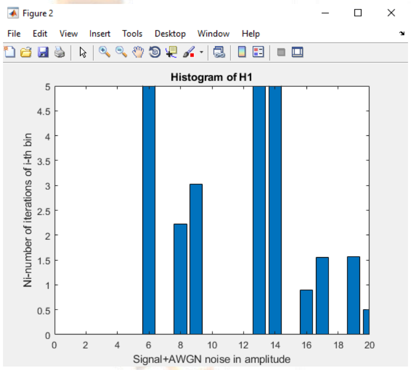


Power mid N=128 existing with SNR = -5db

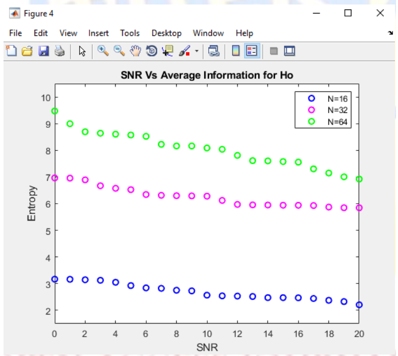


Power mid N=128 existing with SNR = -2db

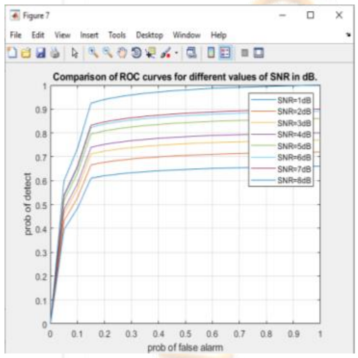
Method 2



Histogram of H1

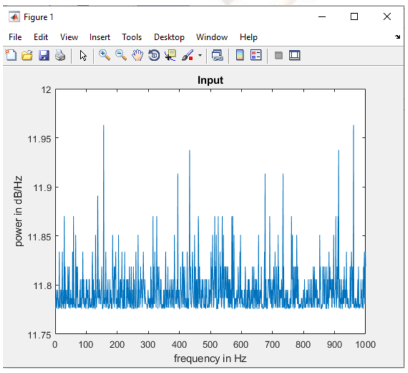


SNR vs average information for H0

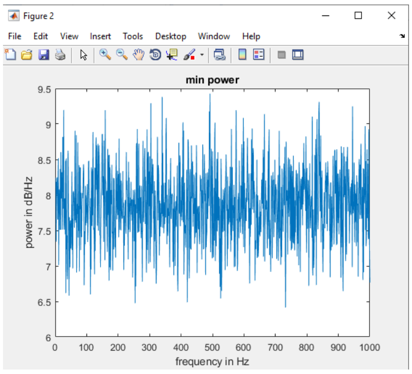


Comparision of ROC curves for different values of snr in db

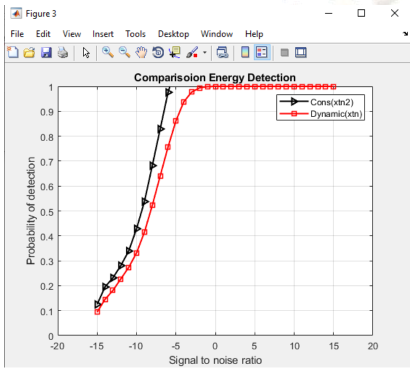
Method 3



Input

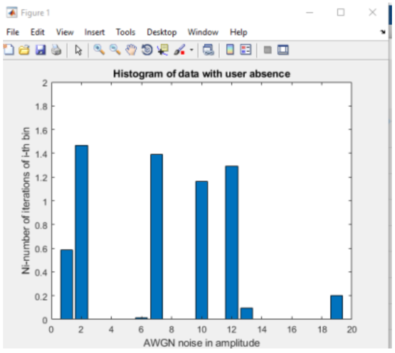


Min power

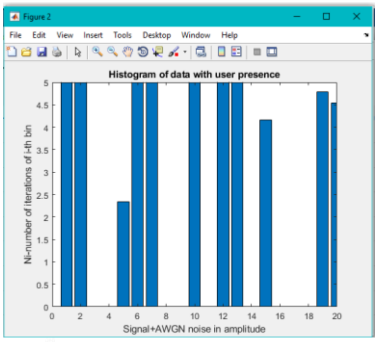


Comparision energy detection

Method 4



Histogram of data with user absence



Histogram of data with user presence

V. CONCLUSION

In this work, the average information-based spectrum sensing is proposed. Histogram is used to find the number of samples in each bin. This method is used to detect the presence of primary users. Presence of primary user can be detected by considering the entropy value. If the entropy is higher, then the primary user is absent. If the entropy value is lower, then the primary user is present. The entropy for 16QAM modulation is calculated and it is found that entropy decreases as SNR increases. Simulations have been done for different signal lengths N=16, 32, 64 for 16QAM.The probability of the detection is significant even from low SNR of -8dB. Thus, the probability of detection is good even at lower SNR for average information-based spectrum sensing technique.

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