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Energy Detection and Autocorrelation based spectrum sensing using Multipurpose Lab Station

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Abstract: Spectrum sensing enables cognitive radio systems to detect unused portions of the radio spectrum and then use them while avoiding interferences to the primary users. Energy detection and autocorrelation is one of the most used techniques for spectrum sensing because it does not require any prior information about the characteristics of the primary user signal. Here energy detection and spectrum sensing techniques both are used for spectrum sensing. This technique has helped to identify very low SNR signals.

Keywords: Energy detection, autocorrelation.

INTRODUCTION

The rapid growth in wireless communications has contributed to a huge demand on the deployment of new wireless services in both the licensed and unlicensed frequency spectrum. However, recent studies show that the fixed spectrum assignment policy enforced today results in poor spectrum utilization. To address this problem, cognitive radio (CR) [1,2] has emerged as a promising technology to enable the access of the intermittent periods of unoccupied frequency bands, called white space or spectrum holes, and thereby increase the spectral efficiency. The fundamental task of each CR user in CR networks, in the most primitive sense, is to detect the licensed users, also. known as primary users (PUs), if they are present and identify the available spectrum if they are absent.

The Cognitive radio should be able to identify the white space and allocate the spectrum to the secondary user, hence increase the spectrum utilization. This whole process of spectrum sensing and allocation has to be done by cognitive engine. The cognitive engine has to deal with the real time information over the channel and decide the status of the channel: whether a spectrum hole or occupied with a primary signal. Precisely we can say that spectrum sensing is the capability of the cognitive radio to detect unused band and allot it to a secondary user- Opportunistic Spectrum Access.

The detection of the primary signal is based on the hypothesis [1]

$$H_o : y(t) = n(t) \quad (1)$$

$$H_1 : y(t) = hx(t) + n(t) \quad (2)$$

where x(t) is the primary user's signal to be detected
n(t) is the additive white Gaussian noise,
h is the channel gain
Literature Survey

Energy Detection Technique:

Energy detection is a non-coherent detection method that detects the primary signal based on the sensed energy [3]. This technique does not require a priori knowledge of PU signals, it uses the energy spectra of the received signal in order to identify the frequency locations of the transmitted signal

The detection of the primary signal is based on the hypothesis as explained in Eqn.1 and Eqn 2. Energy detection approach relies only on the energy present in the channel. Energy detection method is a classical method for identifying an unknown signal that quantifies the received signal energy over an observation time window. The detection is performed by taking the average energy level of the samples T and compare with a threshold level

$$T = \frac{1}{N}\sum_{t=1}^{N} |y(t)|^2. \quad (3)$$

Where T is the total energy observed over N samples. The energy detection technique does not work well for low SNR signals and spread spectrum signals. It is dependent on the noise uncertainty.

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PROPOSED METHOD

This technique tries to remove the disadvantage of energy detection.

In this method energy detection is first done to identify whether the channel is vacant or not. If the channel is found to be vacant then autocorrelation based sensing mechanism is applied to detect the low SNR signals. So signals which are of low SNR is very less, as the signal power gets attenuated by noise while travelling in a particular channel. Hence this is a two stage spectrum sensing.

Energy detection is done by Agilent Vee Pro software and the Pfa is determined by Monte Carlo Simulation.

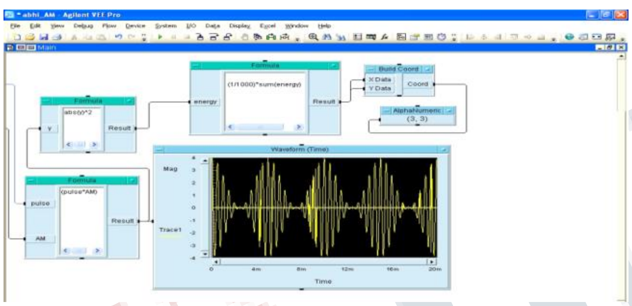


Fig: 1 AM generation using MPLS

The signals are generated for different SNR. It was found that for SNR below -10dB the energy detector could not identify the signal. But when autocorrelation [5][6]is performed the autocorrelation pattern received for different lags show that the a low SNR signal is present.

Algorithm

Step 1 Perform energy detection

Step 2: if channel is predicted occupied then channel is occupied

Step 3: If channel is predicted vacant then perform autocorrelation

Step 4: If the autocorrelation Rxx(0) ≈Rxx(1) then channel is occupied with low SNR signal

Step 5: if autocorrelation Rxx(0) ≠Rxx(1) then channel is vacant

It is found that Probability of detection of low SNR signal is more for energy detection clubbed with autocorrelation

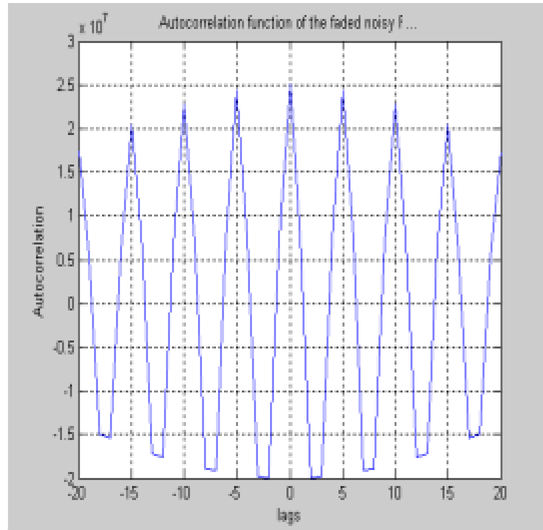


Fig.2. Autocorrelation of AM Signal with noise

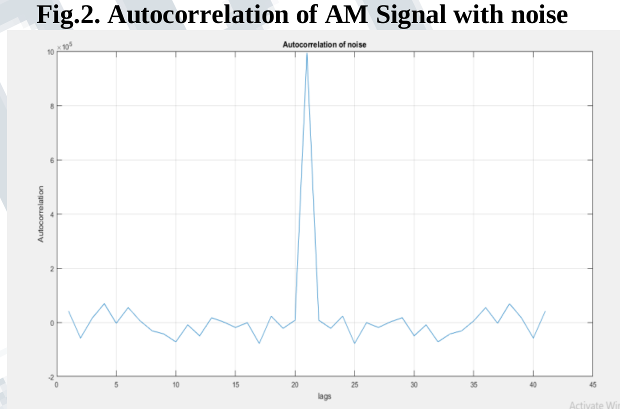
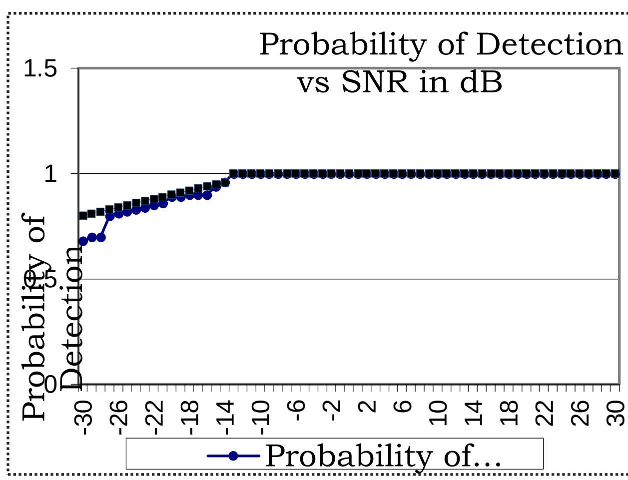


Fig 1. Autocorrelation of Noise



CONCLUSION

It is found that the performance of energy detection enhances when we apply autocorrelation along with it. The probability of detecting low SNR signals is more

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