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Energy Detection based Spectrum Sensing Technique Using different Windowing Techniques

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Abstract –*Cognitive radio is one of the fantastic emerging technologies in the wireless communication in which a network can flexible challenges in transreceiver parameter of the primary user. The major task perform in the cognitive radio is aware, adopt in the spectrum sensing. In the spectrum sensing methods are following which are used widely in nature, that are Energy detection, Matched filter, Wave from based, Cooperative etc. The performance of different spectrum sensing method can be used to find out the performance parameter. In this paper Energy detection based Spectrum sensing with different windowing methods i.e. rectangular and hamming are developed, that uses to detect the energy of the received signal. It is a radiometer is based on the signal detection which does not required the prior information of the primary user or not which is compared with the predetermined the threshold is exceeded. Here we use the energy detection of the primary user signal which gives formation of the Fourier transformer causes the spectrum leaks so in order to overcome the leakage we suppose to use different windowing techniques shows the energy detection provides the better performance using rectangular window.*

Key Words: **Cognitive radio, Spectrum sensing, Energy detection and Window technique etc.**

1. INTRODUCTION

The Cognitive radio [1] is one of the fatalistic technology in the wireless communication spectrum system which leads and itself identified the portion of the vacant spectrum without causing the harmful hindrance to primary user for the flexibility if the radio spectrum. The present scenario is huge demand of the spectrum is turns to provide the scarcity of the available to access the spectrum, dynamically. By these methods we use to detect the availability of the primary user of the radio spectrum environment is called spectrum sensing. There are several methods of the spectrum sensing techniques such as the matched filter, energy detection, cyclosationary detection or future detection.

1.1 Matched filter detection

In this method we required prior information from the primary network as well as the secondary network. The primary network is highly computationally and complex in nature. Each of the receiver required to be synchronizes with secondary network in order to get proper information with receiver.

1.2 Feature detection

In this method, it required the prior knowledge of the primary user signal because of that its sensing performance is very high to detect the signal with very low SNR. It is robust in the presence of the noise uncertainty because of these it is accuracy is very high in nature that results in lower efficiency of the spectrum. These low efficiency is trends to have slow sensing as compared to the energy detection.

1.3 Energy detection

In this method [2] it coherent in the nature i.e. it does not required prior knowledge about the primary network. Its implementation is simple and less complex in nature it is not capable to distinguish b/w the primary signal and the noise. So it does not perform in low SNR. These low SNR is used to assist spectrum is very difficulty here without digital filter we cannot think about communication as noise occur in the channel. These filtering can also be applied to reduce the noise.

Frequency boosting, interference, crosstalk, distortions, equalizer, among the others. Window method is one of the popular techniques used for the designing of the filter. There are the several types of the windowing techniques. They are rectangular window, Hanning window, Hamming window, Blackmann window.

2. RELATED WORK

In the cognitive radio is performance the is best for the use of the spectrum sensing in the cognitive radio system. Basically the cognitive radio is the secondary user which needs to detect the presence of the primary user signal.

Thesis so called spectrum sensing. First paper we has been discussed the fundamental details by S. Hakin [1]. It states that spectrum utilization has been improved significantly by making it possible for the secondary user to access a spectrum hole which are not occupied by the primary user at the particular time and place P.V Lavanya[2] In the wireless communication spectrum is most important parameter for proper utilizing the spectrum is also one of the imp issues. For the better utilization of the spectrum it is very useful. Basically these paper deals with the energy detection and wavelet detection methods in CR. Here in these method comparing the performance of the one method to the other method. These idea is very efficient adjacent the radio operating environment. Ireyuwa. E Igbinose [3] Energy detection based spectrum sensing performance evolution in cooperative cognitive radio network. In paper based on the wireless technologies has put a lot of demand on available spectrum. Here the performance is evaluated on the bases of the energy detection based spectrum sensing nosed in a fading and non fading channelize AWGN. Rayleigh and Nakagami channels. In this it shows that the cooperative detection shows the better performance to the single user in the fading environment.

Manish Pradhan [4] Improved Performance of SCS based spectrum sensing in cognitive radio using different windows techniques. In this paper as the wireless network increase the demand of user is also get increases over the availability of the recourse. In the cognitive radio network two type of the wireless the wireless user are present. In primary user has the highest priority. There can be done in the preferred techniques to get evaluated system performance and sensing the spectrum by using different windowing techniques.

Hameed Ansari [5] Cylostationary method based spectrum sensing and Analysis using Different Windowing method. In this paper it gives idea to utilized the spectrum by providing dynamic allocation method which is employed on the bases of the spectrum sensing in cognitive radio. The performance of the different sensing algorithms is measured in terms of variety of the different performance parameters. In this paper Cyclostationary based spectrum sensing with different windowing methods are developed, that uses the cyclic property of the received signal. Therefore the different windowing techniques are used in order to improve the performance of the system.

3. PERFORMANCE ANALYSIS

The main part of the proposed methodology is to analysis the spectrum through the different windowing techniques. So we use the energy detection method for the detection of the spectrum and in order to optimized the performance parameters.

3.1 Spectrum Sensing Methods through Energy detection

3.1.1 Energy detection

It is the one of the non coherent type of the detection techniques use to detect the licensed user signal [3] [6]. It is the method in which receiver not needs the prior knowledge of the primary user. Here in these method is implemented in which the received signal x9T0 is filtered by using band pass filter then after the signal is pass through the squaring devices, so the signal is became squared then after the signal is pass through the integrator which increase the strength of the signal after that the signal is pass through the threshold value which analysis that whether the signal is present or absent.

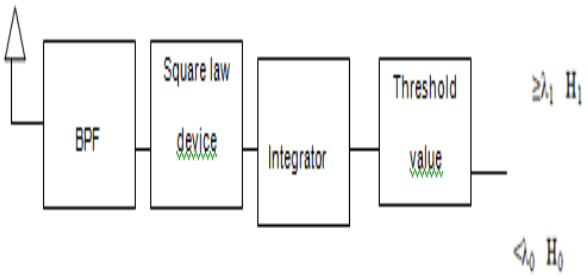


Fig-1: Block diagram of the energy detector

3.1.2 Windowing Methods

The windowing methods [4] [7] are available for analysis and synthesize the signal for various characteristics using different window in order to find out the different parameter for spectrum analysis in the cognitive radio.

3.1.3 Rectangular window

The rectangular window is also known as Dirichlet window which is dynamic in nature. In the rectangular window is window which keeps changing the value except at Zero.

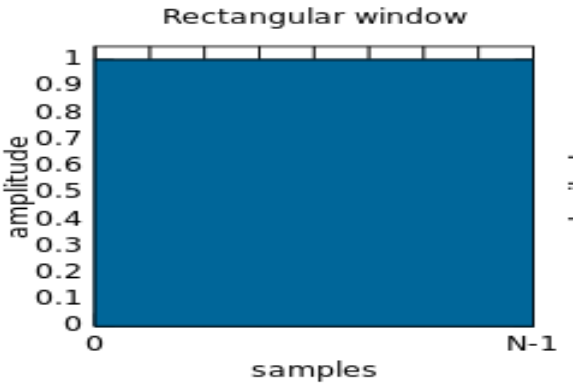


Fig-2: Rectangular Window

3.1.4 Hamming Window

In this window function also known as atomization function or the tapering function that is zero – valued outside the interval. This window is optimized to minimize the side lobe. Giving it a height of one- fifth that of the hann window.

$$w(n) = \alpha - \beta \cos\left(\frac{2\pi n}{N-1}\right),$$

with

$$\alpha = 0.54, \ \beta = 1 - \alpha = 0.46,$$

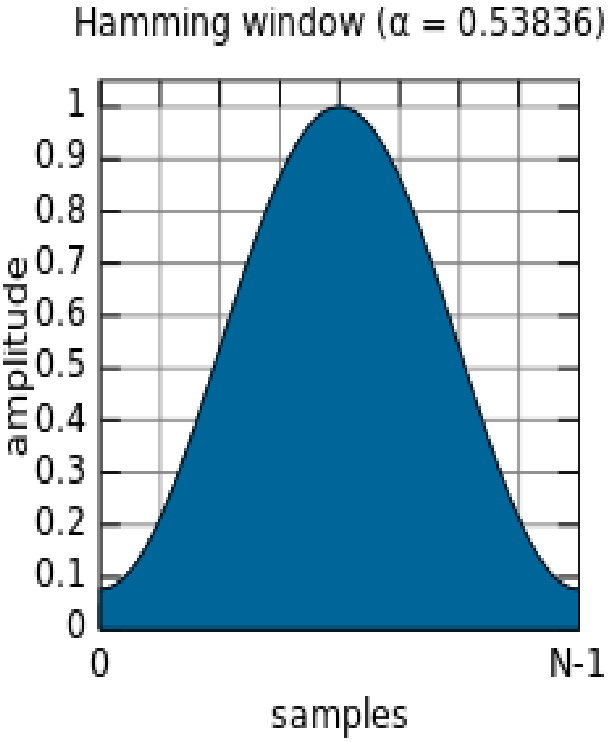
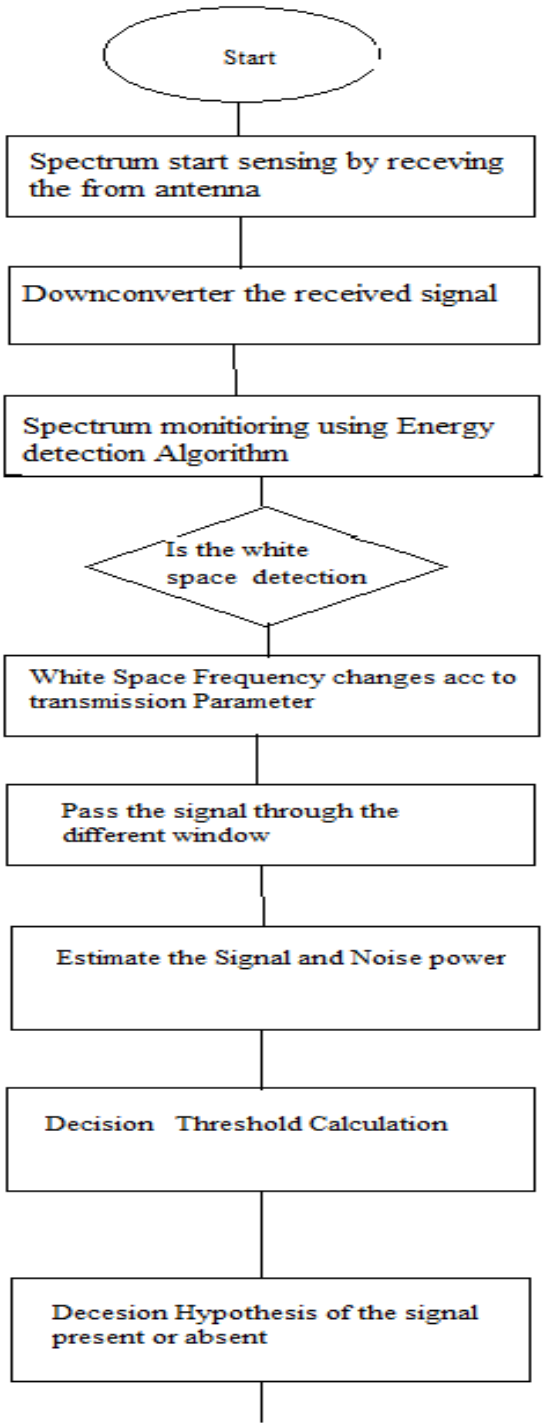


Fig-3: Hamming Window

Used in filtering [8]-[9] and utilizing the signal process for qualitative analysis and our approach is directed towards the utilization of different windowing techniques [10] for the cognitive radio [11].

4. PERFORMANCE EVALUATION ALGORITHM

4.1.1 Various Steps involved in Simulation



Steps are as following

1. Firstly spectrum starts sensing by receiving the signal through antenna.
2. Then after down converter the received signal.

3. Spectrum monitoring using Energy detection algorithm.
4. Whether the white space is available or not and change the transmitting and receiving parameter.
5. Now pass the signal through the different window and estimate the signal and noise power.
6. Then calculating the decision threshold by which we analysis the presence and absent of the signal.

5. SIMULATED RESULTS

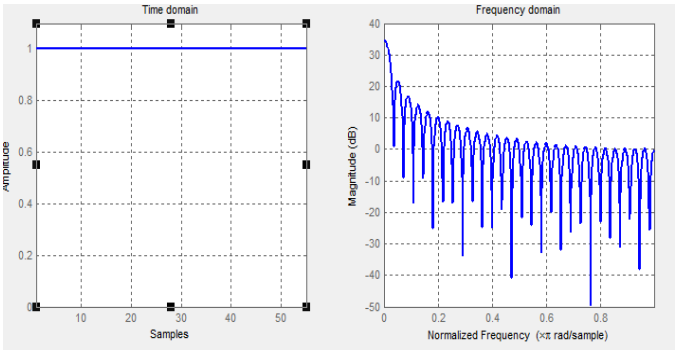


Fig-4: N= 55 with rectangular window

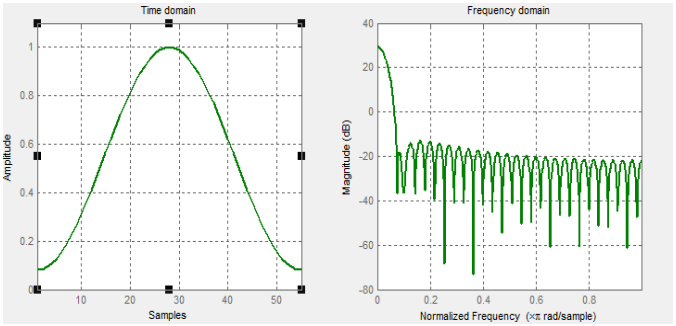


Fig-5: N=55 with hamming window

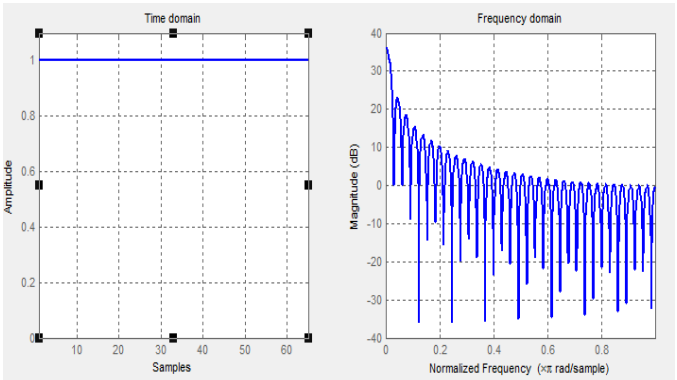


Fig-6: N=65 with rectangular window

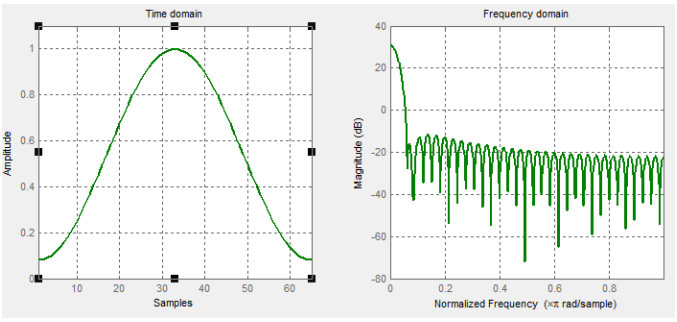


Fig-7: N=65 with hamming window

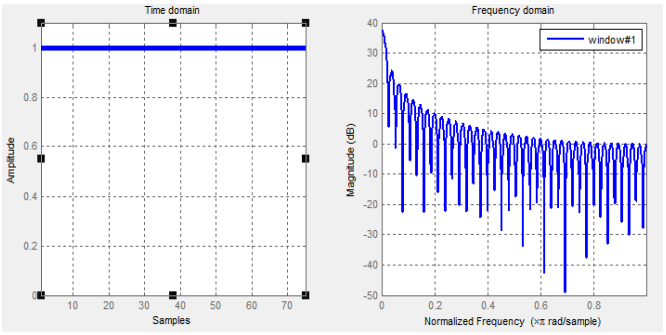


Fig-8: N=75 with rectangular window

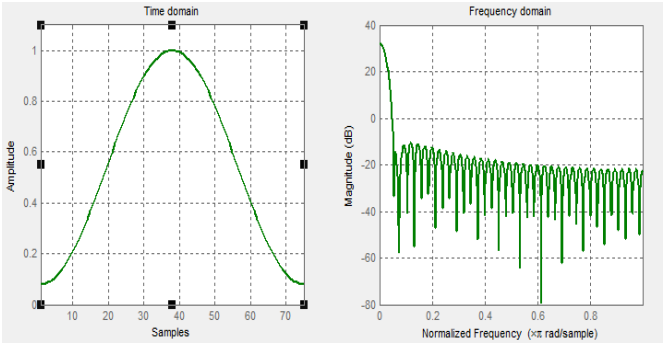


Fig-9: N=75 with hamming window

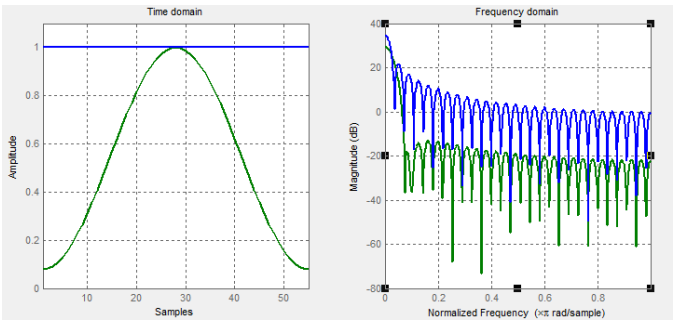


Fig-10:Comparision of bothrectangular and hamming for N=55

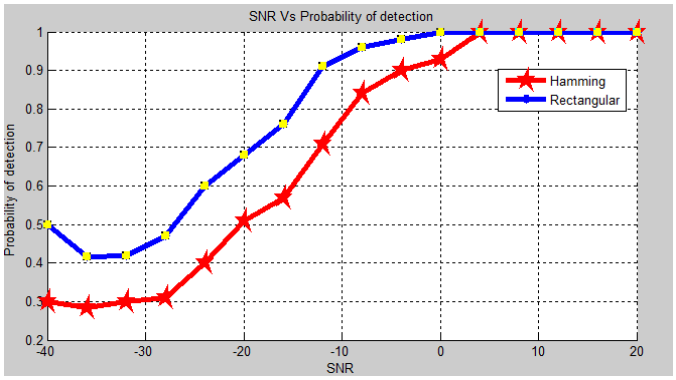


Fig-11: SNR VS Probability of detection

Table-1: Comparison b/w the rectangular and hamming window.

S. No.	Window techniques	Order of filter(N)	Normalized t_x width main lobe	No. of side lobes	Main stop band attenuation and leakage
1	Rect win blue	N=55	0.03125	26	-21dB, 9.21%
		N=65	0.025391	31	-21dB, 9.41%
		N=75	0.023438	36	-21dB, 9.37%
2	Hamming green	N=55	0.04687	25	-53dB, 0.03%
		N=65	0.039063	30	-53dB, 0.04%
		N=75	0.033203	35	-53dB, 0.04%

The above table shows rectangular and hamming window by N=55.65.75 on the basis of these, analysis the normalized tx width of main lobe, No of side lobe Min stop band attenuation and leakage. In the table shows that as the order of the filter increases the number of the side lobes also increases and width of the main lobe is decreased, that it is tending to sharp cutoff that is the width of the main lobe decreased. If the width of the main lobe reduces then the number of the side lobes gets increased. So there should be compromise between attenuation of side lobe and width of main lobe.

The simulation of above results mentioned that a new approach using two different windows in matlab. We get the different result by performing the multiple execution operation in each window. In the above figure is representing the decision accuracy verses SNR using different channel. Here in the above results are shows that very smoothly with minimum value of 0.5 at -40 SNR. At the same time Hamming show the result of 0.3 respectively.

6. CONCLUSION

An effective frequency spectrum sensing technique energy detection which may be utilized for the cognitive radio for the specified range of SNR. By this paper we analysis the performance of the energy detection using different windowing technique as well as analysis performance of the windowing by resizing the order of the performance of the radio spectrum sensing techniques to increase the utilization of cognitive radio using different windowing techniques.

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