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Enhanced Detection of Cognitive Radio Under Noisy Channels

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***Abstract*—Cognitive radio have been considered as the able-bodied approach with the goal of enhancing spectral efficiency. The prime aim of cognitive radio is spectrum sensing. Spectrum sensing senses the presence of white spaces, but in fading environment unlicensed users are unable to discover the presence of licensed user in the band and this leads to interference. Therefore the aim of this paper is to increase SNR in two noisy environments, AWGN and Rayleigh Fading Environment using matched filter process and to increase lifetime of cognitive radio network using genetic algorithm.**

Keywords- Primary Users, Secondary Users, Matched Filter, Genetic Algorithm.

I. INTRODUCTION

Cognitive radio is a software controlled radio that detects the unused frequency spectrum [1]. Primary user and secondary users are the two type of user in wireless network. Primary users are the licensed one and they have more liberty to use the band [2] than the unlicensed users. CR examines the activities of licensed user by performing spectrum sensing. Spectrum sensing inspects [3][4] all the available channels that are not currently using by primary user and consider them as white spaces [5]. Secondary users can now use these available channels but when primary users move back to the network, secondary users should leave the channel. But in certain circumstances secondary users didn't able to recognise the presence of primary users when they are back to the band due to fading effect. Due to presence of noise in the network, the primary user's signal get scattered and are not detectable to the secondary users. Some secondary users may reliably detect the PUs while others don't due to scattering of PUs.

Our proposed work takes a hybrid method of matched filter detection and genetic algorithm that works in low SNR environment. The goal of this paper is to enhance the strength of primary user's signal by implementing matched filter technique. For optimization we used genetic algorithm.

II. METHODOLOGY

A. Matched Filter

Matched filter is a spectrum sensing technique for signal detection. Matched filter maximizes the signal to noise ratio of the signal received. The matched filter relates the unknown signal [6] with known signal to determine the presence of noise in the unknown signal.

If 'x' is the input signal and the impulse response of the matched filter is 'h' then the output 'y' is given as:

$$Y[m] = \sum_{k=-\infty}^{\infty} h[m-k]x[k]$$

B. Genetic Algorithm

Genetic Algorithm solves the optimisation problems by generating best fitness function that gives best solution by using three operators viz; mutation, crossover, selection [7]. The genetic algorithm works as;

// Start an initial time
t:=0;
// Load the random population
Initial population x(t);
// determine the fitness of populace
Compute x(t);
// examine the time and fitness conditions
// accumulate the time counter
t:=t+1;
// pick a sub population for producing offspring
x^1:=select parents x(t);
// reassemble the selected parents genes
Reassemble x^1(t);
// unsettle and disturb the interlaced population
Mutate x^1(t);
// evaluate the next fitness
Compute x^1(t);
// pick the survivor from the original fitness
X:= survive x,x^1(t);
end

III. RESULT ANALYSIS

Due to fading of PU signal in low SNR environment [8], the strength of PU signal changes with time depending on the conditions of channel. Our proposed work is done in low SNR, where we improved the detection performance by minimising [9] sensing error of secondary users signal. In this work we uses matched filter method and genetic algorithm. The main purpose of this technique is to enhance the strength of the primary user signal in low SNR i.e. in Additive White Gaussian noise and Rayleigh fading, so that secondary user signal may easily detect the presence of PU signal. The parameters that we considered are;

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sensing error, probability of missed detection, path loss, noise power, average delay.
The table given below shows the result comparison of sensing error values. By using our proposed approach the sensing error decreases as compared to the existing approach.

TABLE I. Comparison of Sensing Error(AWGN)

Existing Approach	Proposed Approach
0.5	0.002
0.3	0.0015
0.2	0.00129
0.15	0.001

TABLE II. Comparison of Sensing error(Rayleigh Fading)

Existing Approach	Proposed Approach
0.431	0.00034
0.352	0.00025
0.261	0.00019
0.138	0.00015

TABLE III. Results calculated for Path Loss under AWGN and Rayleigh Fading

Rayleigh Fading (db)	AWGN (db)
4.2	10.54
4.63	13.45
4.63	13.45
3.25	11.65

TABLE IV. Results calculated for Total End Delay under AWGN and Rayleigh Fading

Rayleigh (ms)	AWGN (ms)
200	0.2
20	18
150	15
30	68

TABLE V. Results calculated for Noise Power AWGN and Rayleigh Fading

Rayleigh Fading (mJ)	AWGN (mJ)
8	12.5
3.5	8.7
8.2	7.8
4	2.2

In our proposed work we have chosen the matched filter technique in order to increase signal strength in noisy environment for an input signal. The input signal is passed through a band-pass filter. The output value is compared to a threshold value to examine whether primary user is absent or present. The benefit of using matched filter technique is that it require less time for detection. The results are calculated based on the following parameters:

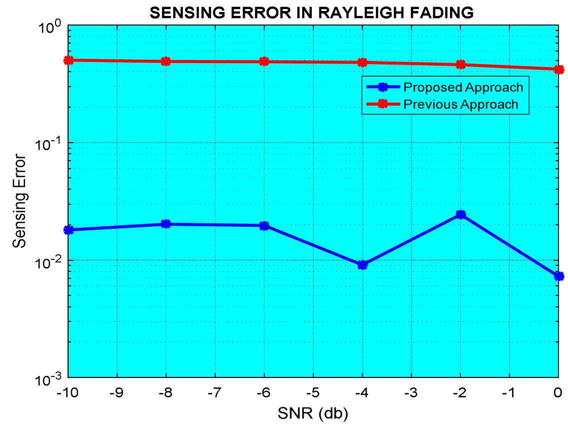

Figure 1.(i) Sensing error in AWGN

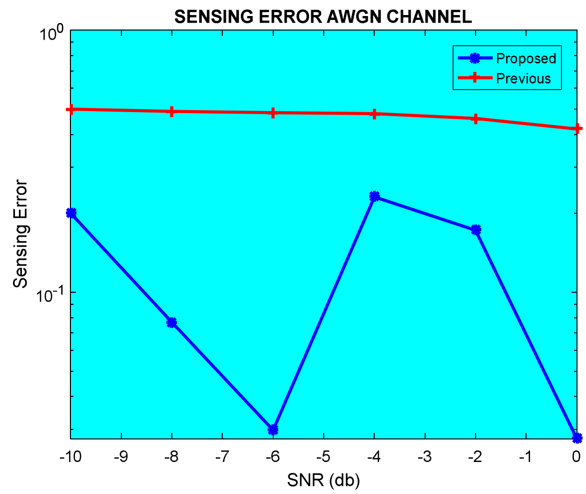

Figure 1.(ii) Sensing Error in Rayleigh Fading

The fig.1 shows (i) the sensing error under additive white Gaussian noise (ii) sensing error under Rayleigh fading comparison between the previous approach and proposed approach and shows that the intelligent radio sensing is taking less error rate for the sensing of the unused spectrum with respect to the previous approach.

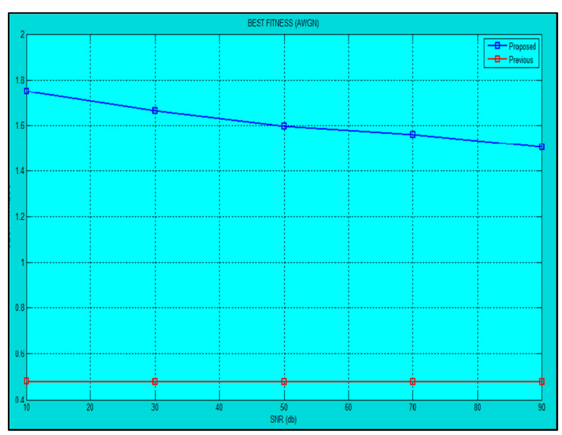

Figure 2(i). Best fitness (AWGN)

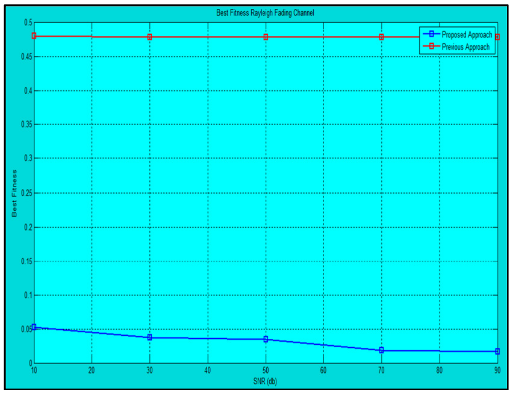

Figure 2. (ii) Best fitness (Rayleigh Fading)

The above fig. shows the comparison between the proposed technique and the previous approach which shows that the fitness values based on the optimization approach which provide the best possible solution under the noisy environment to decrease the loss of bits.

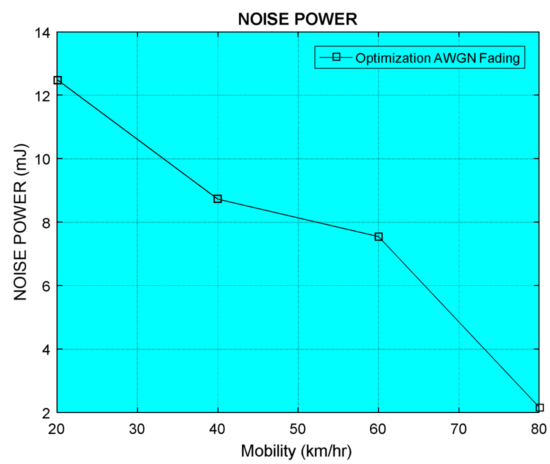

Figure 3. Noise power in AWGN

The above figure shows the noise power under AWGN channel noise which shows that the Noise power is becomes less with implementation of the proposed approach with respect to the mobility of the cognitive radio nodes and shows the effect of the noise hindrance for much AWGN Channel noise.

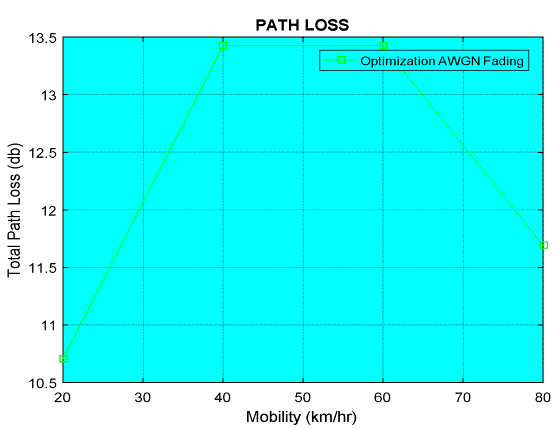

Figure 4. Total path loss under AWGN

The above figure shows the Total path loss under AWGN. The total path loss is very less with respect to the mobility of the cognitive radio. This shows that our proposed approach is well suited for reducing the path loss for the spectrum sensing process.

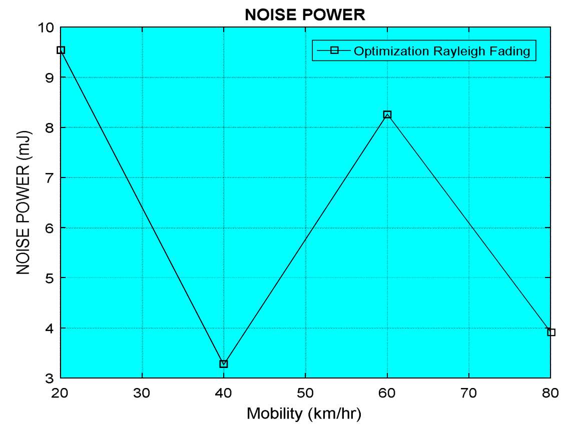

Figure 5. Noise Power (Rayleigh fading channel)

The above figure shows the Noise Power under Rayleigh fading channel and shows that the optimization process that we have used to increase the SNR is well able to reduce the noise power which reduces the chances of distortion for the sensing of the spectrum in cognitive radio networks.

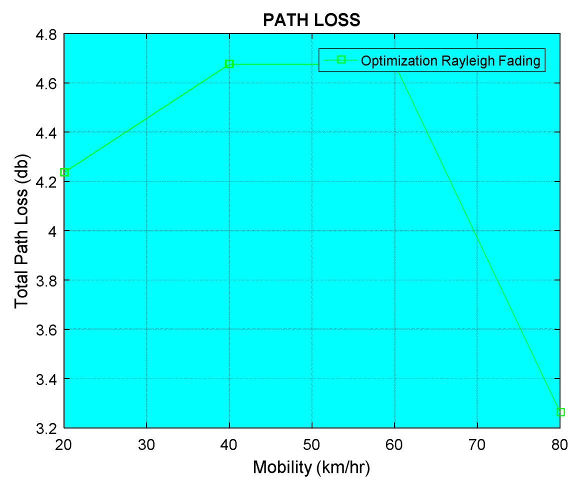

Figure 6. Total path loss for the Rayleigh fading channel

The above figure shows the Total path loss in Rayleigh fading channel and shows that the matched filter process that we have used to increase the signal to noise ratio reduce less path loss which will increase the high efficiency of sensing spectrum under distorted environments.

IV. CONCLUSION AND FUTURE SCOPE

A new technique is planned to increase the accuracy of the cognitive radio network using matched filter and genetic algorithm. We have compared proposed method with previous implemented method. From the results, it has been clearly seen that results for proposed method are good in comparison to earlier method. The future work will be on the security of the cognitive radio network for the secure transmission of packets.

REFERENCES

[1] J. Mitola and G. Q. Maguire," Cognitive radio: making software radios more personal," IEEE Personal Communications, 6(4): pp.13-18, 1999.

[2] Feijing Bao, Huifang Chen, Lei Xie, "Analysis of Primary User Emulation Attack with Motional Secondary Users in Cognitive Radio Networks," IEEE.

[3] T. Yucek and H. Arslan, "A survey of spectrum sensing algorithms for cognitive radio applications," IEEE Communications Surveys and Tutorials, vol. 11, no. 1, pp. 116-130, 2009.

[4] S.Tamilarasan, P.Kumar, "A Survey on Dynamic Resource Allocation in Cognitive Radio Networks", International Journal of Computer Sciences and Engineering, Volume-04, Issue-07, Page No (86-93), Jul -2016

[5] Zhaoyu Gao, Haojin Zhu, Yao Liu, Muyuan Li, and Zhanfu Cao, "Location Privacy In Database-Driven Cognitive Radio Networks: Attacks And Countermeasures," IEEE 2013.

[6] Krikidis, Ioannis, et al. "Cognitive legacy networks via cooperative diversity."IEEE Communications Letters 13.2 (2009): 106-108

[7] Akyildiz, Ian F., et al. "A survey on spectrum management in cognitive radio networks." IEEE Communications magazine 46.4 (2008): 40-48.

[8] Loong Lee, Wasan Kadhim Saad, Ayman Abd El-Saleh, Mahamod Ismail, "Improved Detection Performance of Cognitive Radio Networks in AWGN and Rayleigh Fading Environments." Journal of Applied Research and Technology.

[9] T.Nilavazhaki, G.Sathish Kumar, "Spectrum Sensing Cognitive Radio For Opportunistic Access Environments Based Trust Management", International Journal of Computer Sciences and Engineering, Volume-04, Issue-04, Page No (298-301), Apr -2016

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