



# **Advanced Genetic Algorithms for Spectrum Sensing Techniques for Cognitive Radio Communications**

R. Venkata Siva Harish

Junior Engineer, 4D Research Labs (Formerly ABE, Chennai), Ashok Nagar, Chennai, India

**ABSTRACT:** In this proposed system, considering the fascinating scenario for the cognitive radios spectrum sensing, where the power ID and RSSI of the primary user treated as an important parameters for the detection. With prior knowledge of the accurate RSSI and power ID, we propose the new technique so called Advanced Genetic Algorithms Spectrum Sensing (AGAS) which can be categorized as the one of the blind spectrum sensing techniques in cognitive radio networks. In this mechanisms, Advanced Genetic Algorithm (GA) based estimator has been implemented and the simulation results confirms that the estimation are accurate.

**KEYWORDS:** AGAS, Spectrum sensing, Cognitive Radio networks, Genetic Algorithms (GA)

## **I. INTRODUCTION**

Due to the increase in demand of High Quality of service applications, severe shortage in frequency spectrum. To manage this issue, cognitive radio has been proposed as an attractive technique to improve spectrum utilization for future wireless systems. Therefore, cognitive radio [1], [2] arises as a realistic solution to the mentioned spectral congestion problem by introducing the opportunistic usage of the frequency bands that are not heavily occupied by licensed users [3], [4].

Cognitive radio (CR) that provides more reliable communication by permitting secondary users to utilize the unused spectrum segments. In order to achieve this, spectrum management has to be done efficiently in cognitive radio networks. There are four steps involved in the spectrum management, are defined in [5]: sensing, decision making, sharing, and mobility. Among these, the spectrum sensing and decision making are the most important steps for the establishment of cognitive radio networks. Cognitive users or secondary users should detect the primary user networks to discover the spectrum holes or the unused spectrum to exploit them efficiently for cognitive access. By that time, CR users should prevent interference to the primary users due to their cognitive access of the channels.

## **II. RELATED WORK**

**Zhi Quan:** analyzed the effect of the spectral features on the spectrum sensing performance. Through the optimization analysis, he obtains useful insights on how to choose effective spectral features to achieve reliable sensing. In that , Simulation results show that the proposed sensing technique can reliably detect analog and digital TV signals at SNR levels as low as  $-20$  dB.

**Amir Mahram** proposed a novel method to sense the spectrum. They used sample Entropy as a complexity criterion to detect the primary user's signal in the spectrum. In this proposed method, blind in the sense that it doesn't require any information from the primary user's structure, noise and channel. If the estimated complexity of the signal is higher than a pre-defined threshold, then it will be treated as a noise signal, otherwise, it will be treated as primary user's signal. simulation results show that this proposed method can be employed in lower values of SNR and has better performance in comparison with other detection methods.

# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirce.com](http://www.ijirce.com)

Vol. 4, Issue 12, December 2016

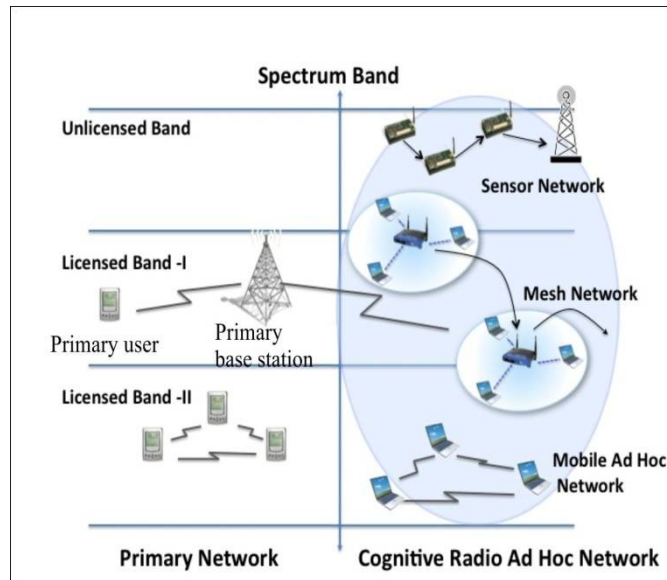


Fig: 1 Spectrum Band in CR

## III. PROPOSED WORK

### 3.1. Background work:

Genetic algorithm is the true optimization algorithm to find the solution for the various problems and having the advantage of multi object handling capability. The GA computation starts from the selection of the few randomly generated populations of individuals known as chromosomes that reveal definite characteristics and follows during the generation. The fitness of each individual in a population is evaluated based on the crossover and the mutation, thus producing the new population which with expects the population of new generation is evaluated based on crossover and mutation.

### 3.2. AGAS Algorithm for spectrum sensing:

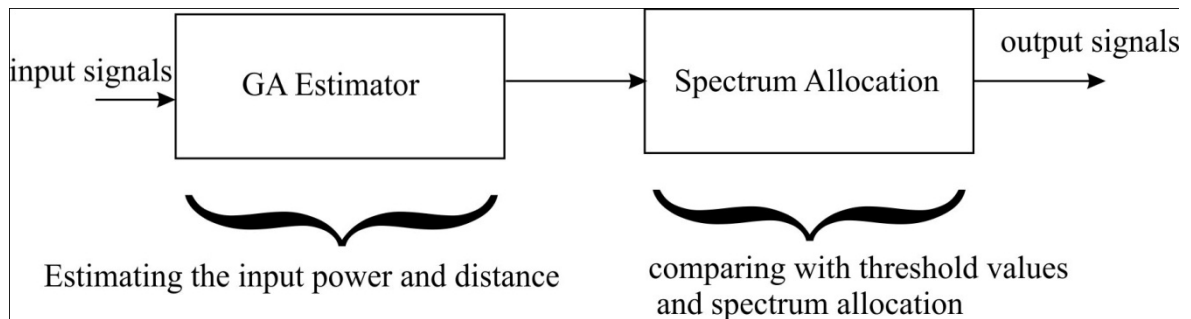


Figure 1 working of AGAS Algorithm for spectrum sensing

AGAS algorithm works as two tier architecture as follow as

1. Estimation of the power levels and the RSSI between the users and cognitive station (Radio).

In this work, both the power level and RSSI are taken as the important criteria for the estimation of the channel selection.

# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijircce.com](http://www.ijircce.com)

Vol. 4, Issue 12, December 2016

START BIT	SA	DATA	P	DIS	DA	STOP BIT
-----------	----	------	---	-----	----	----------

Figure 2. Data frame format to be extracted

Where

- SA- Source address
- P- Power level (ID)
- DIS- RSSI
- PA- Destination address

In above mentioned frames have been used for extraction of the details of the primary users.

Order	1	2	3
power(dB)	-2dBm	-4dBm	0

Figure 3. Power gene representation:

Order	1	2	3
Distance	1m	3m	5m

Figure 4. RSSI gene representation

Considering the cognitive wireless networks with the operating frequency of 2.4GHz, one chromosome structure with two gene formation such as the RSSI and the power which are shown in figure 3 and 4 respectively.

## IV. OVERALL PERFORMANCE IN SENSING EVALUATION USING AGAS

In the previous method, the first generation populations of the chromosomes have been generated. Now next step is to obtain the fitness evaluation of each chromosomes in the population. In this paper assumptions have been made that fitness functions are equally dependent on two parameters which are defined above.

In the above equation, the results have been taken as the major role which has been calculated on the basis of cumulative sum of individual fitness of all genes.

$$f_i = \begin{cases} \frac{w_j \cdot |x_j - x_j^d|}{x_i^d} & \text{if } |x_j - x_i^d| < x_j^d \\ w_j & \text{otherwise} \end{cases} \quad \text{--- (1)}$$

$$F = \sum_{j=1}^4 f_i \quad \text{--- (2)}$$



# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirce.com](http://www.ijirce.com)

Vol. 4, Issue 12, December 2016

Second step includes the decision making process and also selects the best among the population of chromosomes and transfers to the next generation.

As the next step selection of the best chromosomes and to perform the cross-over operation. As the final step selecting the best chromosomes will be allocated with the spectrum for the user.

## V. ALGORITHM MECHANISMS

Our research focuses on the spectrum sensing where two parameters are considered to be most important discussion for the spectrum management. The implementation of GA on this methodology makes to find the accurate level of the estimation.

1. Cognitive Radio (CR) Networks gets the signals and the extracts the power level and the RSSI along with the signal strength from the incoming signal using GA estimator.
2. Compare with the threshold set points. If it matches, the primary users spectrum will be allocated.

## VI. RESULTS AND DISCUSSION

Figure 5 shows the allocation of AGAS spectrum for the different users depends on the power and RSSI. The graph clearly shows the number of uses increases when the threshold limit has been set as the  $P=10W$ ,  $P=200W$ ,  $P=330W$  and the performance remains to be maintained at th constant rate.

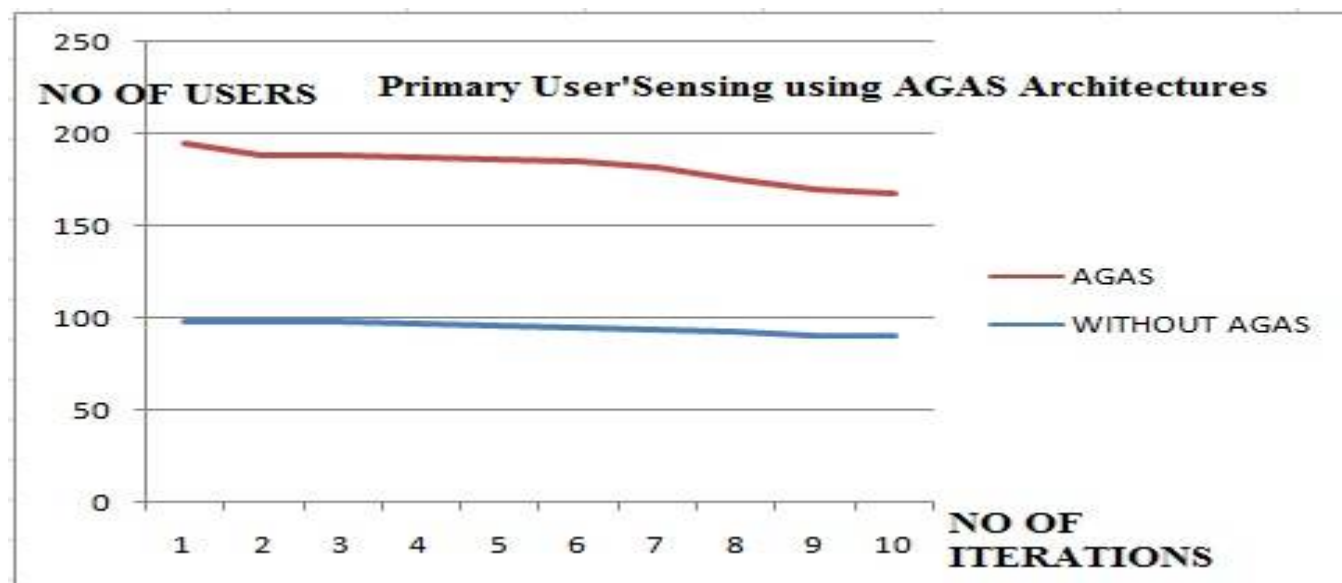


Figure 5

Figure 6 shows the implementing the GA for the spectrum sensing proves to be efficient method when compared to the other algorithms.



# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirce.com](http://www.ijirce.com)

Vol. 4, Issue 12, December 2016

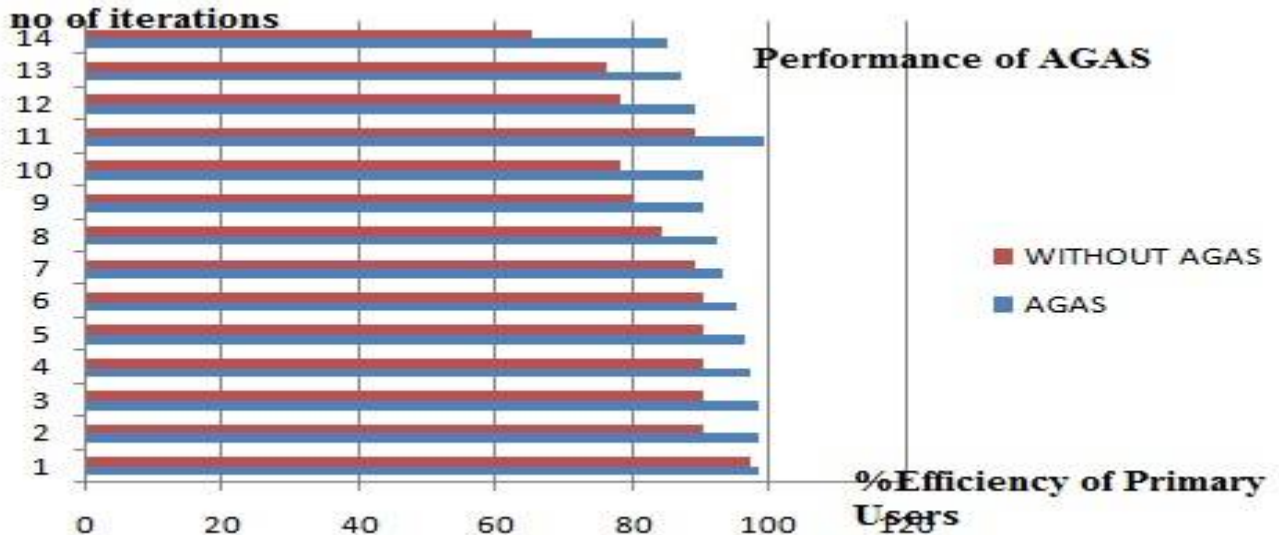


Figure 6

## VII. CONCLUSION

In this paper, we have proposed a Genetic algorithm estimator for spectrum sensing in cognitive radio networks, where the power and RSSI of the primary user treated as an important parameters for spectrum detection. With knowledge of the accurate RSSI and power level we propose the new technique so called Advanced Genetic Algorithm Spectrum Sensing (AGAS) which takes best threshold level with the implementation of GA algorithms estimator for the spectrum detection and sensing. Better optimization can be obtained by when algorithm can be further improved in future.

## REFERENCES

- [1] Y.-C. Liang, H.-H. Chen, J. Mitola, P. Mahonen, R. Kohno, J. H. Reed, and L. Milstein, Guest editorial - cognitive radio: Theory and application, *IEEE J. Sel. Areas Commun.*, vol. 26, no. 1, pp. 1–4, May 2008.
- [2] L. Zhang, Y.-C. Liang, and Y. Xin, Joint beamforming and power allocation for multiple access channels in cognitive radio networks, *IEEE J. Sel. Areas Commun.*, vol. 26, no. 1, pp. 38–51, January 2008.
- [3] T. Yucek and H. Arslan, A survey of spectrum sensing algorithms for cognitive radio applications, *IEEE Commun. Surveys & Tutorials*, vol. 11, no. 1, pp. 116–130, March 2009.
- [4] Amr. A. El-Sherif, "Joint Design of Spectrum Sensing and Channel Access in Cognitive Radio Networks " IEEE-2011
- [5] S. Haykin, Cognitive radio: Brain-empowered wireless communications, *IEEE J. Sel. Areas Commun.*, vol. 3, no. 2, pp. 201–220, Feb. 2005.
- [6] A. Sahai, N. Hoven, and R. Tandra, Some fundamental limits on cognitive radio, in *Proc. Allerton Conf. Commun., Control, Comput.*, Monticello, IL, Oct. 2004.
- [7] A. Ghasemi and E. S. Sousa, Collaborative spectrum sensing for opportunistic access in fading environments," in *Proc. IEEE Symp. NewFrontiers in Dynamic Spectrum Access Netw.*, Baltimore, MD, Nov.8–11, 2005, pp. 131–136.
- [8] D. C. Oh and Y. H. Lee, Energy detection based spectrum sensing for sensing error minimization in cognitive radio networks, *Proc. Int. J. Commun. Netw. Inf. Security*, vol. 1, no. 1, Apr. 2009.
- [9] Y. Zeng, C. L. Koh, and Y. C. Liang, Maximum eigenvalue detection: Theory and application, in *Proc. IEEE Int. Conf. Commun.*, May 19–23, 2008, pp. 4160–4164.
- [10] M. Maida, J. Najim, P. Bianchi, and M. Debbah, Performance analysis of some eigen-based hypothesis tests for collaborative sensing, in *Proc. IEEE Workshop Statistical Signal Process.*, Cardiff, U.K., 2009, pp. 5–8.
- [11] Y. Zeng and Y. C. Liang, Eigenvalue-based spectrum sensing algorithms for cognitive radio, *IEEE Trans. Commun.*, vol. 57, no. 6, pp. 1784–1793, Jun. 2009.
- [12] E. Hossain and V. Bhargava, *Cognitive Wireless Communication Networks*. New York: Springer-2007.
- [13] Y. H. Zeng and Y. C. Liang, Spectrum sensing algorithms for cognitive radio based on statistical covariance, *IEEE Trans. Veh. Technol.*, May 2009.
- [14] M. Ghoszi, F. Markx, M. Dohler, and J. Palicot, Cyclostationarity based signal detection of vacant frequency bands, in *Proc. IEEE Int. Conf. Cognitive Radio Oriented Wireless Netw. Commun. (Crowncom)*, Mykonos Island, Greece, Jun. 2006, pp. 1–5.



ISSN(Online): 2320-9801  
ISSN (Print): 2320-9798

# International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijircce.com](http://www.ijircce.com)

**Vol. 4, Issue 12, December 2016**

- [15] A. Tkachenko, D. Cabric, and R. W. Brodersan, Cyclostationary feature detector experiments using reconfigurable BEE2 in *Proc. IEEE Int. Symp. New Frontiers in Dynamic Spectrum Access Netw.*, Dublin, Ireland, Apr. 2007, pp. 216–219.
- [16] Y. Xiao and F. Hu, *Cognitive Radio Networks*. Boca Raton, FL: Taylor & Francis, CRC, 2009.
- [17] T. Yucek and H. Arslan, A survey of spectrum sensing algorithms for cognitive radio applications, *IEEE Commun. Surveys Tutorials*, vol.11, no. 1, pp. 116–130, First Quarter 2009.
- [18].Y. H. Zeng and Y. C. Liang, Covariance based signal detections for cognitive radio, in *Proc. IEEE DySPAN*, Dublin, Ireland-2007.