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An Efficient Approach for Pilot Design in Cognitive Radio Using BPSO Algorithm

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Abstract: Orthogonal Frequency Division Multiplexing (OFDM) based Cognitive Radio (CR) Licensed users have to be deactivated to avoid interference. In this study, new pilot design method for OFDM based CR system has been proposed. The new optimization problem is formulated to remove the complexity of the existing method. Hybrid of bacterial foraging optimization and binary particle swarm optimization has been proposed to solve the optimization problem. Here, the comparison with the existing method, simulation results obtained by proposed method have been shown.

Key words: OFDM, Cognitive Radio (CR), BFO, PSO optimization, MSE, BER

INTRODUCTION

Today most of the cognitive radio are the MIMO OFDM based. The Cognitive Radio (CR) are the smart and intelligent signal processing wireless systems. The need of these type of system is used due to the demand for higher data rates. Now a days for CR methodology, most suited technique for modulation and transmission OFDM technique is widely due to multicarrier modulation scheme that encodes data in a signal MIMO OFDM system are considered as prime for CR system (Duman and Ghrayeb, 2007). The MIMO technology is the powerful technology which enhance the capability by multipath fading. Almost in wireless applications the first preference is for good quality message transmitted and received for which Bit Error Rate (BER) must be minimum. In this study, optimization scheme based on hybrid of BFO (bacterial foraging optimization) and Binary Particle Swarm Optimization (BPSO) algorithm has been proposed (Hu and He, 2010). This proposed algorithm is used to remove the complexity of existing method by BPSO. The pilot design method is used to lower down the BER (Bit Error Rate) and MSE (Mean Square Error).

MATERIALS AND METHODS

BPSO: BPSO is hybrid optimization technique which couples the BFOA and PSO. PSO has been derived from the concept of swarming habits of animals like bird or fish (Hu *et al*., 2011). As the birds moves in search of food. Particle swarm optimization provides multiple solutions at one time and at each iteration each solution is evaluated to determine fitness. Each particle velocity in PSO is updated by inertia. Inertia is used for the movement of swarm. The best solution is evaluated by calculating the fitness function of each iteration (Ohno *et al*., 2011). The PSO algorithm consists of:

- Fitness function of the each particle
- Global bests
- Velocity and position of each particle (Foschini and Gans, 1998)

Hybrid of partical swarm optimization and bacterial foraging algorithm: Cognitive radio is a knowledgeable radio expertise which is able to detect accessible channels repeatedly in wireless spectrum and consists of adaptable quality parameters which enables more communications to run concurrently and enhance the performance of radio operations. Security is one of the main issues in cognitive radios. Spectrum dynamic radio can performance as a key allowing technology for a change of other reconfigurable radio apparatus's commonly conversed (Mitola, 1999) in the progressive wireless market. While spectrum dynamic radio is not compulsory to implement any of these radio types, the technologies can provide these types of radio with the elasticity necessary for them to achieve their full probable, the benefits of which can help to decrease cost and increase system competences. Nodes in the cognitive radio have no centralized control. These are used to monitor unattended environments and to monitor them. Dynamic topological changes due to the high mobility of the nodes make contests in routing and making secure announcement. There are also white spaces which termed as unused spectrums in the environment in the cognitive radio sensing networks. Due to fading environments the

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signal to noise ratio become less which will degrades sensing capability in unused spectrum which should be minimized. It is radio system in which announcement systems are attentive to their internal state and environment such as position and operation on RF frequency spectrum at that position.

In the proposed method, we have made the architecture of the cognitive radio system in which cognitive radios are deployed and spectrum sensing takes place based on the energy and received signal strength of the cognitive radios. After that we have transmitted subcarriers using OFDM approach in which transmitted data is transmitted with respect to the length of the bits on the basis of which results are evaluated in terms of bit error rate. We have used OFDM technology because it is an efficient technique to send large data using subcarriers which are orthogonal to each other. Using OFDM it reduces the inter-symbol interference which will increase the lifespan of the network. After that we have shown transmission in between the primary users and cognitive radios and on the basis of which they are sensing the spectrum and also the primary user will connected to the that CR which is having high signal strength and having high energies. In the proposed research, we have perform optimization using two robust swarm intelligence approach, i.e., bacterial foraging optimization and particle swarm optimization. We have used their hybrid approach in which the performance is evaluated using mean square error rate and bit error rates. As bit errors are defined as the number of bits losses with respect to the signal to noise ratio. Signal to noise ratio means signal performance in terms of noise, so, the signal is having less bit error rate when the signal to noise ratio is increasing and signal is inversely proportional to the noise levels and as the SNR increases the noise levels will be decreasing that's why there must be less bits losses as SNR increases. Mean square error rates measures the number of deviations. The deviations must be less for an appropriate functioning of the system.

RESULTS AND DISCUSSION

For the demonstration of the proposed design, the simulations were carried out for binary CR MIMO OFDM in BPSO system (Barhumi *et al.*, 2003). Figure 1 primary

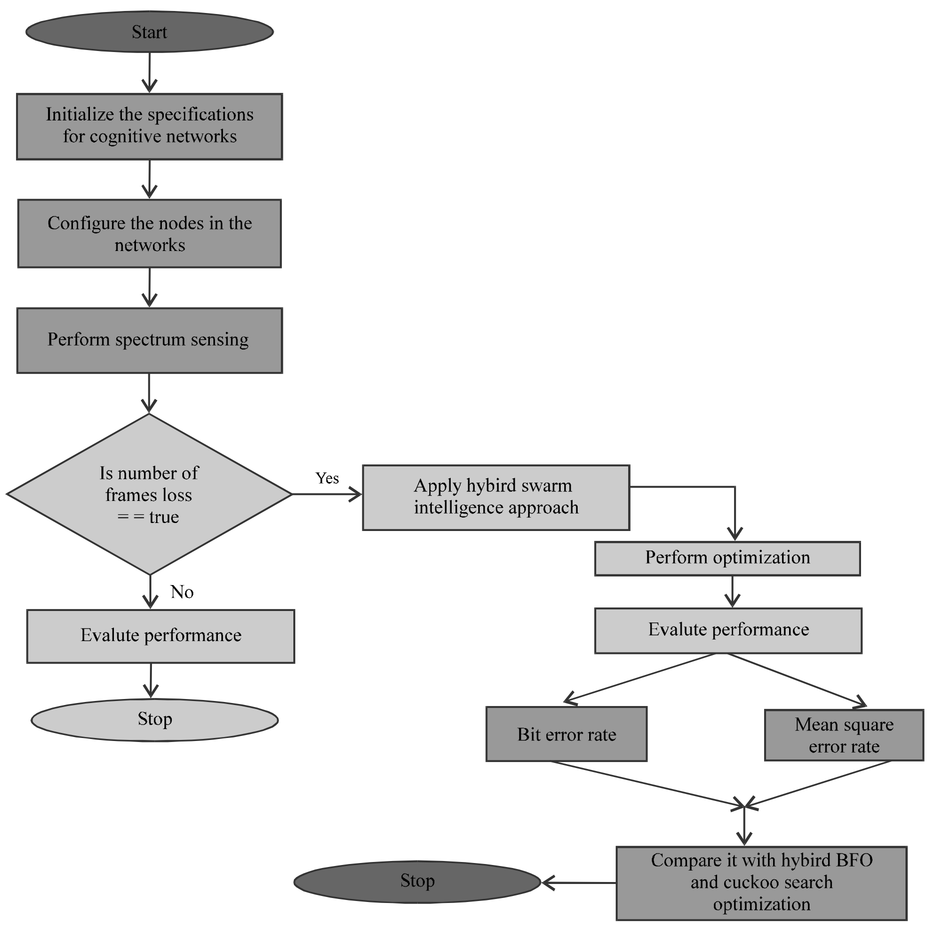

Fig. 1: Transmission between cognitive radios and primary users

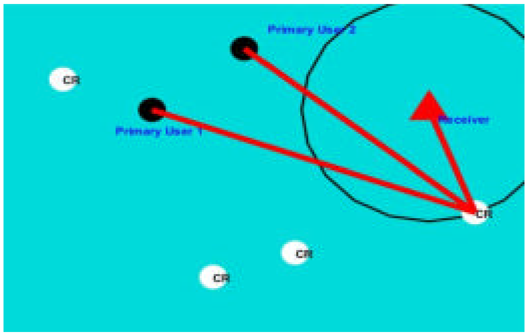

Fig. 2: BER of BPSO

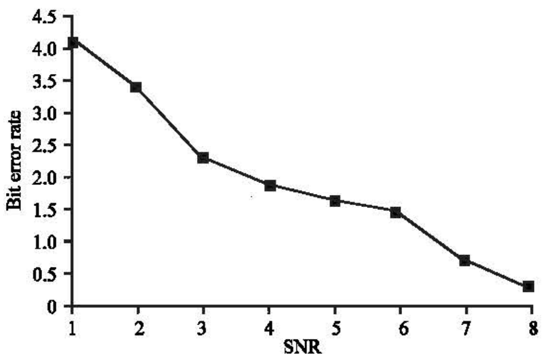

Fig. 3: MSE of BPSO

and secondary users in OFDM system. The users are having mobility as these are not stable at one place. The users move from place to place. Here, the users will transmit the data to that CR who is having more signal strength (Xu *et al*., 2009; Manjith and Suganthi, 2013). Figure 2 shows the transmission of cognitive radio and primary users. On the basis of spectrum sensing users will connect to that CR which is having high signal strength and energies.

SNR means signal performance in terms of noise, so, the above result shows that the signal is having less bit error rate when the signal to noise ratio is increasing and it is showing efficient results because signal is inversely proportional to the noise levels and as the SNR increases the noise levels will be decreasing that's why it is showing less bits losses as SNR increases (Fig. 3 and 4).

In the proposed research, we have perform optimization using two robust swarm intelligence approach, i.e., bacterial foraging optimization and particle swarm optimization. We have used their hybrid approach in which the performance is evaluated using mean square error rate and bit error rates. As bit errors are defined as the number of bits losses with respect to the signal to noise ratio. Signal to noise ratio means

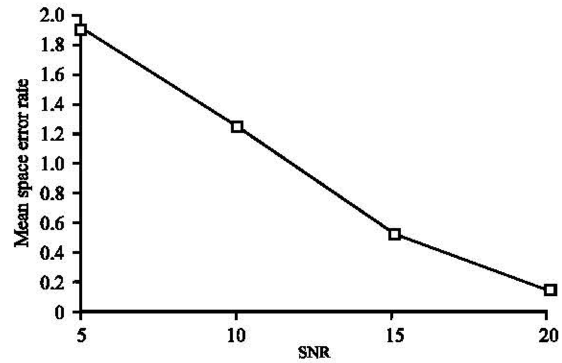

Fig. 4: MSE of BPSO

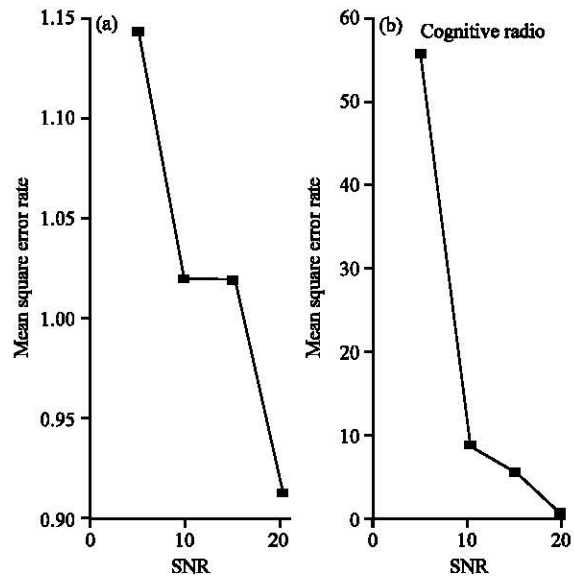

Fig. 5: Comparison of mean square error; a) Using HBFOMCS and b) Using BPSO

signal performance in terms of noise, so, the signal is having less bit error rate when the signal to noise ratio is increasing and signal is inversely proportional to the noise levels and as the SNR increases the noise levels will be decreasing that's why there must be less bits losses as SNR increases. Mean square error rates measures the number of deviations. The deviations must be less for appropriate functioning of system.

Figure 5 shows the comparison results in terms of mean square error rates. Rate with respect to the signal to noise ratio and shows that how much the mean error is taking by your cognitive network in terms of total loss of bits in the network which must be low to increase the lifespan of the network. In Fig. 5 we can clearly see the mean square error rate of the proposed research is coming less, i.e., 0.18 as compared to base approach which is 0.93 which is high.

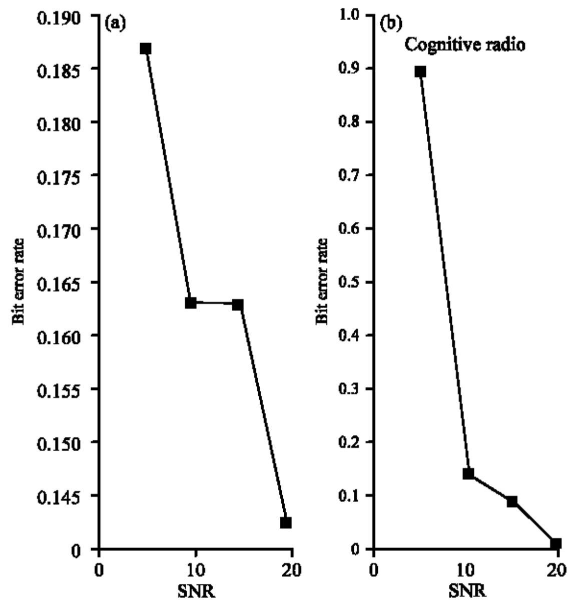

Fig. 6: Comparison of bit error rate; a) HBFOMCS and b) Using BPSO

Figure 6 shows the comparison results in terms of bit error rates. In Fig. 6, we can clearly see the bit error rate of the proposed reasearch is coming less as compared to base approach.

CONCLUSION

In this study, a scheme using BPSO optimization has been proposed. A design for channel estimation in CR system has been presented. The channel estimation results shows that the simulations of proposed method is better than existing. The bit error rate is also, lower and the subcarriers transmitted in OFDM is also better. The signal strength of the CR is good, so, it can transmit more data accurately.

REFERENCES

Barhumi, I., G. Leus and M. Moonen, 2003. Optimal training design for MIMO OFDM systems in mobile wireless channels. IEEE. Trans. Signal Process., 51: 1615-1624.

Duman, T.M. and A. Ghrayeb, 2007. Coding for MIMO Communication Systems. John Wiley & Sons, England, UK., ISBN:9780470028094, Pages: 366.

Foschini, G.J. and M.J. Gans, 1998. On limits of wireless communications in a fading environment when usingmultiple antennas. Wireless Personal Commun., 6: 311-335.

Hu, D. and L. He, 2010. Pilot design for channel estimation in OFDM-based cognitive radio systems. Proceedings of the 2010 IEEE Conference on Global Telecommunications (GLOBECOM'10), December 6-10, 2010, IEEE, Miami, Florida, ISBN:978-1-4244-5636-9, pp: 1-5.

Hu, D., L. He and X. Wang, 2011. An efficient pilot design method for OFDM-based cognitive radio systems. IEEE. Trans. Wirel. Commun., 10: 1252-1259.

Manjith, R. and M. Suganthi, 2013. A sub-optimal PTS algorithm based on bacterial foraging optimization technique for papr reduction in Mimo-Ofdm system. J. Theor. Appl. Inf. Technol., 57: 261-268.

Mitola, J., 1999. Cognitive radio for flexible multimedia communications. Proceedings of the 1999 IEEE International Workshop on Mobile Multimedia Communications, November 15-17, 1999, IEEE, San Diego, California, ISBN:0-7803-5904-6, pp: 1-12.

Ohno, S., E. Manasseh and M. Nakamoto, 2011. Preamble and pilot symbol design for channel estimation in OFDM systems with null subcarriers. EURASIP. J. Wirel. Commun. Netw., 2011: 1-17.

Xu, P., J. Wang and F. Qi, 2009. Pilot-based angle-domain channel estimation for MIMO-OFDM systems. Proceedings of the WRI International Conference on Communications and Mobile Computing (CMC'09) Vol. 1, January 6-8, 2009, IEEE, Yunnan, China, ISBN:978-0-7695-3501-2, pp: 47-50.