iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VIII **Month of publication:** August 2017

DOI: http://doi.org/10.22214/ijraset.2017.8314

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, August 2017- Available at www.ijraset.com

Sensing of Spectrum for SC-FDMA Signals in Cognitive Radio Networks

Vindhya J
Electronics and communication, CMRIT, Bangalore-560037, India

Abstract: ***In wireless communication the efforts are made to increase the rate of transmission and also to make the possibility to get different types of multimedia accommodated without any interruption. The techniques currently in use for sensing of spectrum are Energy identification, Matched filter, Waveform identification, Cyclo-stationary identification, Feature identification. This paper augments a technique for recognizing spectrum of interleaved single-carrier frequency-division multiple access (SC-FDMA) frameworks. A signal detection framework is built based on a metric, which extracts features of cyclo-stationary for interleaved SC-FDMA signals. Two hypotheses indicating absence and presence of primary users are used to inform the availability of spectrum for secondary users. These are represented as H_0 & H_1. The Neyman-Pearson test is used to examine the two hypotheses. This test uses Gaussian approximation for the built metric, to obtain the parameters of the derived metric distributions for both the hypotheses. The validation of Gaussian approximation accuracy is done by comparing simulated and theoretical metric histograms. The performance of proposed method is depicted for both multipath Rayleigh channel and additive white Gaussian noise channel. The number of users, presence of the pilot signals, the metric window length and the block length effects are investigated for detection. The proposed scheme of detection is proved to outperform the other existing systems like, technique dependent upon autocorrelation of cyclic prefix (CP) and energy detection by comparing and evaluating their performances. The complexity of proposed method is lesser than energy detection method and is little more than that of CP detection method, while maintaining almost the same performance of detection as those methods at low SNR.***
Keywords: Cognitive radio, Spectrum sensing, Single-carrier frequency-division multiple access (SC-FDMA).

I. INTRODUCTION

In wireless communication the efforts are made to increase the rate of transmission and also to make the possibility to get different types of multimedia accommodated without any interruption. The spectrum available however makes the Secondary data-rate clients concurrent transmission difficult because of its own limitations. The only best possible solution to overcome this scarcity of available spectrum is to use cognitive radio (CR). This method uses the same spectrum to transmit signals for both Auxiliary users (SUs) or unlicensed clients & elementary users (PUs) or authorized clients whenever the desired band of frequency is available or vacant. To recognize the vicinity of Pus and to determine the availability of spectrum holes, which are needed for transmission, the spectrum sensing is very much necessary.

The number of users, presence of the pilot signals, the metric window length and the block length effects are investigated on the execution about detection. The proposed scheme of detection is proved to outperform the other existing systems like, technique dependent upon autocorrelation of cyclic prefix (CP) and energy detection by comparing and evaluating their performances. At the lower Indicator-to-commotion degree (SNR), almost the same performance of detection as the methods above is obtained, but the complexity of the method proposed is lesser than that of the energy detection method and is little more to that of CP detection method.

The rest of the paper is organized as follows. In section II literature survey is presented. In section III, introduces the detection scheme for interleaved SC-FDMA. In section IV, simulation results are presented, and section V, concludes this paper.

II.LITERATURE SURVEY

Cognitive radio networks cooperation communications [1] has proposed the technology that is emerging to deal with the radio spectrum scarcity and the stringent requirement in the cognitive radio technology. In the design of wireless system, the paradigm shift is represented by this transforming and revolutionary technology, because this offers the distribution terminals, dynamic spectrum sharing, self-adaption, or radio units the capacity of radio sensing for those alarmed and effective use of the radio range. The communication technology paradigm provides with another new technology called cooperative communications and networking which provides with a way to realize a new form for fading channels i.e., space differing qualities will battle those channel's impeding impacts by providing them with distributed terminals so that the networks collaborates with signal processing or

distributed transmission. Utilization of these innovations with range sharing and furthermore range sensing is exploited here. At the specific geographic location and at a particular time identifying the primary (licensed) user's presence over the spectrum's wide range is the challenge for Cognitive radio frameworks. Those unwavering quality from claiming identifying elementary clients is enhanced by considering the applications of agreeable range sensing clinched alongside cognitive radio frameworks. The robust cooperative sensing techniques of spectrum and the description to spectrum sensing for cognitive radios for a specified framework can be described by employing cognitive radios. In wireless relay network spectrum sharing's cooperative communications are investigated. The coding technique of cognitive space-time-frequency can be presented to show the maximum opportunities for spectrum. This technique adapts itself to the dynamic spectrum environment by adjusting the structure of code.

Cyclo-stationarity, energy and matched-filter based performance comparison [2] deals with the comparison of cyclo-stationary based detection, a thorough performance examination for vitality energy detection, matched-filter detection is presented in this paper. These are the three prevalent decisions for range sensing toward cognitive radios. For possible detectors, valid expression for probability detection and fake alarm are formulated. Two structures which display cyclo-stationarity are put forth for detection based on cyclo-stationary: the Magnitude Squared Coherence (MSC) detector and Spectral Correlation Density (SCD). The advantageous play is tendered by the MSC detectors compared to detectors that are existing and 802.22 RF capture database helps in evidencing it. The cyclo-stationary spectrum posses a noise rejection quality and the decision statistic depend on this property of spectrum which makes the cyclo-stationarity based detectors inconsiderate to query in the noise deviation. The optical comparison of the performance is shown among simulation results and theoretical values by plotting receiver operating characteristics.

Constant amplitude zero autocorrelation sequence and constant false alarm rate methods based identification of an LTE sign [3] deals to attain goal of cognitive radio (CR) and to locate the grade client (PU) signal, range sensing is the basic need. The adequate application of the spectrum is witnessed by this. The identification in light of fragmentary Fourier change (FrFT), cyclic prefix detection, vitality identification also the cyclo-stationary detection is the different signal detection methodologies. In this paper an innovative way for identification from claiming long haul advancement (LTE) signals is put forward. The better periodic correlation quality of such signals is made them utilize Constant Amplitude Zero Autocorrelation (CAZAC) sequence, concerning illustration a poly phase code for the location of the LTE signal. A detection threshold is found by the steady false caution rate which decreases effect of noise power. To make the performance feasible the simulation effects of the method proposed is compared for the individuals of other three methods.

Cognitive radios OFDM decentralized sequential detection based on auto-correlation [4] the comparatively simple and effective sensing method of spectrum for primary user signal in light of Orthogonal Frequency Division Multiplexing (OFDM) using co-efficient of their auto-correlation is proposed in this paper. In the low signal-to-noise ratio (SNR) area, maximum possible evaluation of auto-correlation coefficient is the log likelihood ratio test (LLRT). This is shown in the paper proposed. For both the additive white Gaussian noise (AWGN) & multipath channels the local detector performance is analyzed with the help of theoretical analysis. Simulation is used to validate the results obtained. By simulation the local detector performance is studied in the face of shadowing. A same primary user is detected by the number of secondary user cooperation under a proposed scheme known as Sequential Detector (SD). The facility of using simpler local detector and the diversity gains are provided by cooperation of users. The quantity of data required in the underutilized spectrum for identification is reduced along with the delay in Sequential Detection. The fusion center (FC) is the place where the decision statistics from all the individual detectors combine. The execution of the suggested plan will be validated with simulations & analyzed through theory. For the same missed detection probabilities and false alarm the comparison test among Neyman-Pearson and SD scheme is also conducted and is known as fixed sample size (FSS) test.

III. DETECTION SCHEME

Depending on the quasi-periodicity of interleaved SC-FDMA signals, a metric is defined to identify, if the subcarrier specifically provided to PU are free for the SU signals transmission. Both theories H_0 and H_1 metric can be determined by taking help of Neyman-pearson test. PU signals absence and presence is indicated by these two hypotheses. Scenario of one active user metric is explained first for the purpose of simplicity, and later the scenario for multiuser is described with proper preprocessing technique.

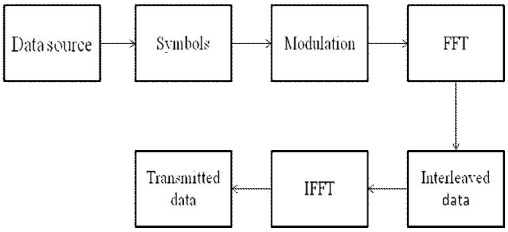
The hypotheses are mentioned below for the scenario of single user, when the *v*th user is active:

Hypothesis one:$H_0 : r_m = z_m$: PU absence

Hypothesis two:$H_1 : r_m = b^v_m + z_m$: PU Presence

For m=0….(MN-1), where z_m represents the AWGN with mean σ^2. b^v_m is transmitted information of the vth client of an interleaved SC-FDMA framework.

The spectrum which has to be sensed belongs to the interested user, which is represented by the parameter v. The complexity and accuracy of the detection process and sensing time trade off is given by the window's length. The PU (vth user) presence is tested by filtering out the specified subcarriers of other users, because this make sure that the user of interest is only associated with the time-domain signals periodicity. Frequency-domain zero-padding or traditional filtering are the two ways to perform this test.



Depending on the quasi-periodicity of interleaved SC-FDMA signals, a metric is defined to identify, if the subcarrier specifically provided to PU are free for the SU signals transmission.

To make a less complex multiple-access, low peak-to-average-power proportion (PAPR) and better executable system the SC-FDMA is used which is the transmission of blocks that effectively displays Fast Fourier transform (FFT).

Both theories H_0 and H_1 metric can be determined by taking help of Neyman-pearson test. PU signals absence and presence is indicated by these two hypotheses.

The spectrum which has to be sensed belongs to the interested user, which is represented by the parameter v.

The PU (vth user) presence is tested by filtering out the specified subcarriers of other users, because this make sure that the user of interest is only associated with the time-domain signals periodicity.

The absence and presence of the primary user signals helps secondary user signals to transmit without any collision.

IV. RESULTS & PERFORMANCE EVALUATION

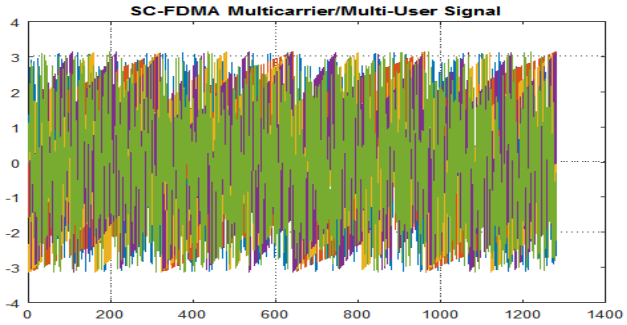


Figure 1. Generated Signal

Figure 1 shows the generated signal for multi users followed by figure 2 which depicts the transmitted signal.

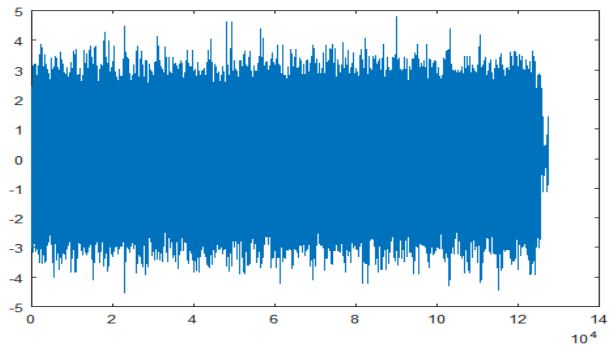


Figure 2. Transmitted Signal

The performance of proposed method is elucidated by a receiver operating characteristic (ROC) methodology. The likelihood of accepting false caution versus the actual detection is demonstrated by ROC curves to both AWGN & multipath Rayleigh channels in Figure 3 with the SNR −21 dB.

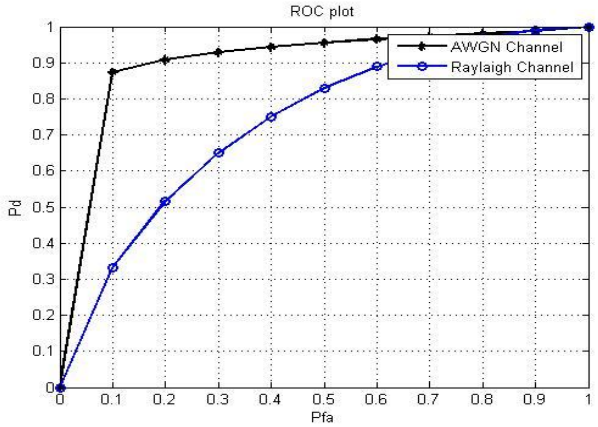


Figure 3. ROC Plot for SNR = -21Db

The performance evaluation of all the possible methods is shown in figure 4. This figure shows that proposed method is lot better compared to lower SNR of 13dB to get the detection probability of 0.9. Between span period of one fourth and one eighth of CP the detection lies between 8 and 11 dB, respectively. With the increase of M, N or the span period in proposed method, the performance improves drastically which is appreciable. With increase in detection window length the detection probability increases in all the methods declared.

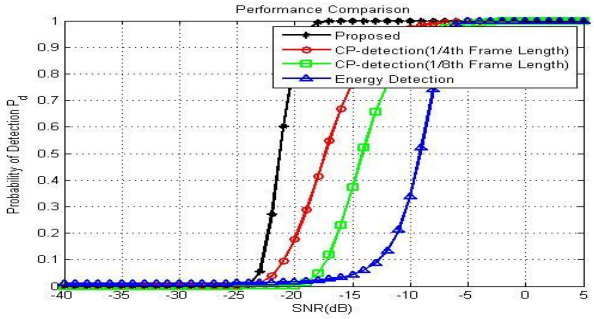


Figure 4. Performance Comparison

TABLE 1. Comparison of Performance of Different Methods

SNR (dB)	**PROBABILITY DETECTION**			
	CP detection L_{cp} = 1/4frame	CP detection L_{cp} – 1/8frame	Energy detection	Proposed Method
-35	0	0	0	0.02
-30	0	0	0	0.03
-25	0	0	0	0.09
-20	0.05	0	0	0.75
-15	0.3	0.09	0.05	1
-10	0.98	0.58	0.3	1
-5	1	0.99	0.99	1
0	1	1	1	1

V. CONCLUSION

In the paper, a scheme of detection for interleaved SC-FDMA signals is established. The quasi-periodicity of these signals creates a metric for detection. To inspect the vicinity and non vicinity of the PUs, the parameters of metric distribution like number of users, presence of pilot signals, the metric window length & the block length are obtained. The exact picture of the determined parameters is examined through simulation. The identification scheme is illustrated for AWGN and multipath Rayleigh channels. The execution is verified for different Square lengths, various clients and also different data rates. The performance and the intricacy of the suggested methods are compared with energy detection, CP detection (L_{cp}=1/4), CP detection (L_{cp}=1/8) schemes of SC-FDMA. The suggested detection technique proved better than these techniques by providing higher probability detection as the value of SNR increase.

The detection scheme can be improved more by increasing the window length of the given spectrum and by increasing the number of users.

VI. ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of people who made it possible, whose consistent guidance and encouragement crowned our efforts with success. I express my gratitude to Principal Dr. SANJAY JAIN, CMRIT, Bengaluru for having provided me the golden opportunity to undertake this project work in their esteemed organization. I sincerely thank Mrs. PAPPA M, Prof. and HOD, Department of Electronics and Communication Engineering, CMR Institute of Technology for the immense support given to me. Last but not the least, heartful thanks to my parents and friends for their support. Above all, I thank the Lord Almighty for His grace on me to succeed in this endeavor.

REFERENCES

[1] S. Chaudhari, V. Koivunen, and H. V. Poor, "Autocorrelation based decentralized sequential detection of OFDM signals in cognitive radios," IEEE Trans. Signal Process., vol. 57, no. 7, pp. 2690–2700, Jul. 2009.

[2] Z. Tian and G. B. Giannakis, "A wavelet approach to wideband spectrum sensing for cognitive radios," in Proc. 1st Int. Conf. CROWNCOM, Jun. 2006, pp. 1–5.

[3] K. Choi, W. Jeon, and D. Jeong, "Sequential detection of cyclostationary signal for cognitive radio systems," IEEE Trans. Wireless Commun., vol. 8, no. 9, pp. 4480–4485, Sep. 2009.

[4] Y. Zeng and Y. C. Liang, "Covariance based signal detections for cognitive radio," in Proc. IEEE 2nd Int. Symp. New Frontiers DySPAN, Apr. 2007, pp. 202–207.

[5] M. M. Sebdani and M. J. Omidi, "Detection of an LTE signal based on constant false alarm rate methods and constant amplitude zero autocorrelation sequence," in Proc. IEEE ICIAS, Jun. 2010, pp. 1–6.

[6] K. B. Letaief and W. Zhang, "Cooperative communications for cognitive radio networks," IEEE Trans. Wireless Commun., vol. 97, no. 5, pp. 878– 893, May 2009.

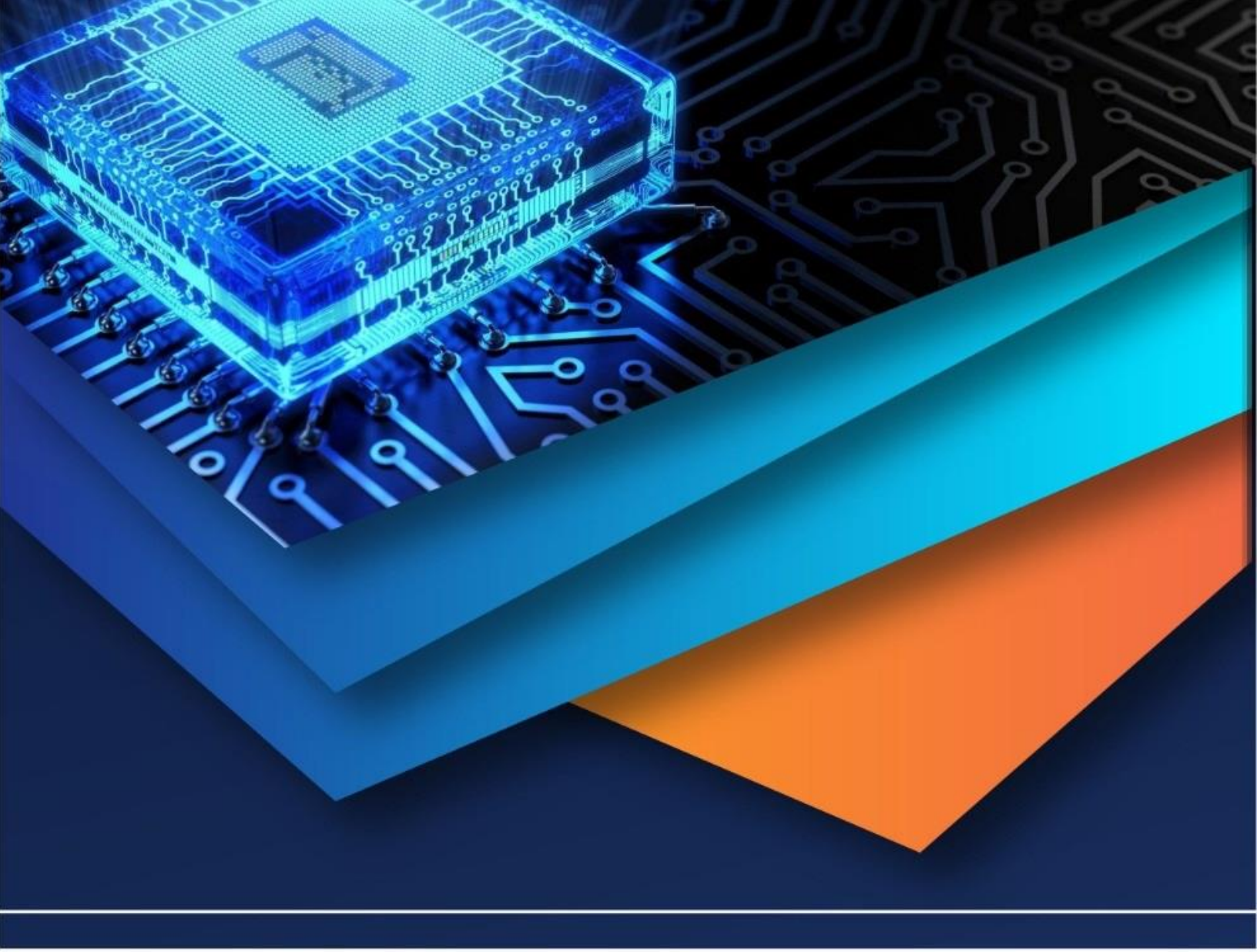
[7] Z. Lei and F. Chin, "Sensing OFDM systems under frequency- selective fading channels," IEEE Trans. Veh. Tech., vol. 59, no. 4, pp. 1960– 1968, May 2010.

[8] Y. Zhang, Q. Zhang, and S. Wu, "Entropy-based robust spectrum sensing in cognitive radio," IET IEEE Commun., vol. 4, no. 4, pp. 428–436, Mar. 2010.

[9] W. Zhang and Y. Sanada, "Low-complexity cyclostationarity feature detection scheme of localized SC-FDMA uplink system for application to detect and avoid," in Proc. ISCIT, Oct. 2010, pp. 962–967.

[10] D. Bhargavi and C. R. Murthy, "Performance comparison of energy, matched-filter and cyclostationarity-based spectrum sensing," in Proc. IEEE 11th Int. Workshop SPAWC, Jun. 2010, pp. 1–5.

[11] Y. Zeng, Y. C. Liang, and R. Zhang, "Blindly combined energy detection for spectrum sensing in cognitive radio," IEEE SignalProcess.Lett.vol.15,pp.649–652,Oct.2008.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY