iJRASET

International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VII **Month of publication:** July 2017

DOI:

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 VII, July 2017- Available at www.ijraset.com

A Novel Alternative Signal Generation for PAPR Reduction in OFDM using Shift Value Set for CSS

B.Nagababu[1], J. Ravindranadh[2]
[1]M.Tech, Communication & Singal Processing , [2]Associate professer, ECE Department
R.V.R&J.C College Of Engineering, Guntur, Andhra Pradesh (522019), India

***Abstract:** The implementation of the orthogonal frequency division multiplexing (OFDM) in a wireless communications domain has introduced the world a new communication model which can offer 100 Mbps speed with minimum disadvantages. The transmit signals in an orthogonal frequency-division multiplexing (OFDM) system can have high peak values in the time domain since many subcarrier components are added via an inverse fast Fourier transformation (IFFT) operation. As a result, OFDM systems are known to have a high peak-to-average power ratio (PAPR) when compared to single-carrier systems. In fact, the high PAPR is one of the most detrimental aspects in an OFDM system as it decreases the signal-to-quantization noise ratio (SQNR) of the analog-digital convertor (ADC) and digital-analog convertor (DAC) while degrading the efficiency of the power amplifier in the transmitter. The PTS scheme is considered as the best PAPR reduction technique and the cyclic shifted sequences (CSSs) scheme evolved from it has achieved the significant. The concept of CSS is to cyclically shifted the OFDm sequences to and then combined to generate the alternative signal sequences and the accuracy of the CSS scheme les in the careful selection of the shift value (SV) sets which directly related to PAPR reduction. In simulation results, the SV sets are carefully selected and its validation is approved by performing the simulations on the Selected SV sets.*
***Index Terms:** Communication, OFDM, PAPR, PTS, CSS, SV sets*

I. INTRODUCTION

Communication industry has grown enormously in the past six decades and supports various applications belong to different research fields. Wireless communication is a major constituent of communication industry which has 75% of total market share. Wireless communication takes the communication domain to the next level in terms of reliability and performance. Mobile data transmission is considered as a 21st century system which offers higher data rate but suffers from complexity. It is well known that there is unmanageable growth of users in telecommunication industry. So the user's requirements become high for ubiquitous access, high data rate. Therefore, energy consumption in wireless communication has been increasing. As a result, CO2 is emitted which makes the atmosphere polluted and become an obstacle in the development of wireless communication. According to Survey, ITU has submitted that the ICT industry produces 2% - 2.5% of total greenhouse gas emission. That includes PC 40%, data centers 23%, telecommunication 24% and printers 6%. So, out of all we are concentrating on telecommunication to reduce emission of CO2. So to overcome this emission in telecommunication, energy efficiency has become a global trend in future wireless telecommunication networks.

OFDM is known as multiplexing/modulation scheme and it acts on the "orthogonality principle". OFDM offers high data and supports advance applications. Although OFDM have advantages over traditional communication models frequently suffer from timing jitter, relative fading, distortion and PAPR. The presence of PAPR results in Gaussian distributed output samples in OFDM. Inter-modulation among sub-carriers and undesired Out-of-Band Interference (OBI) are the resultant of PAPR. PAPR presence has been an area of concern in OFDM and vast amount of research has been carried out using different techniques like Clipping and Filtering (CF), Tone Reservation (TR), Companding Transform (CT), etc. But none of the above techniques succeed in achieving the desired result. Clipping and filtering technique architecture remains easy to tackle the issue of PAPR but presence of significant OBI, in-band distortion and nonlinear processing make this technique unused in real time. Compared to in-band distortion, OBI is more critical because it severly interferes with the radio communications in adjacent channels.

II. ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM)

Orthogonal frequency division multiplexing (OFDM) and compatible usage in wireless standards like DVB, WIMAX, IEEE802.11a and LTE has been gained interest from worldwide research organizations. Recently an international meeting has conducted in order to discuss importance of orthogonal frequency division multiplexing (OFDM) and its usage in advance wireless standards makes Orthogonal frequency division multiplexing (OFDM) as an emerging technology to meet the requirements in practical scenario.

Orthogonal frequency division multiplexing (OFDM) has high data rates compared to traditional communications systems and it suited well for frequency selective channels. Large delay spreads is a drawback which commonly occurs in the high speed wireless communication system and orthogonal frequency division multiplexing (OFDM) modulation scheme has ability to transform the wide frequency selective channel to narrow ones which creates the robust environment to resists against occurrence of the large delay spreads and preserves the Orthogonality in a perfect way in the frequency domain. Orthogonal frequency division multiplexing (OFDM) has one more unique advantage to reduce the complexity in the system by introducing the cyclic prefix at the transmitter end and performing scalar equalization at the receiver end in the wireless standards like WIFI and WIMAX.

In 21st century, the role of the technology to offer high data rates and mobility is crucial and the technology is changing its face every other because of immense research work carried out on the advance wireless communications. Actually the research on parallel data transmission is traced out in the mid 1960's but it takes 25 long years to make it compatible to real time applications. The OFDM gradually seen its presence in the various application and now various international standards consider it as promising modulation scheme which initially supports wireless standards like WIFI, WIMAX, LTE etc. The two important parameters required better transmission of data from one entity to another are data rate and the modulation scheme should support different channel conditions to obtain better spectral efficiency.

The evolution of the third Generation Partnership Project (3GPP) development based on the Long term evolution (LTE) supports two networks namely Radio access network (RAN) and core network. The transformation of the 3G to 4G observes the changes in terms of data rate and spectral efficiency. International Telecommunication Union Radio communication Sector (ITU-R) initialized a set of requirements for the 4th generation cellular system and requirement of the high data rate is specified by International Mobile Telecommunications Advanced project (IMT-Advanced) for 4G. OFDM is a modulation scheme which is one of the techniques employed in LTE to enhance the data stream.

III. PROPOSED METHODOLOGY

A. PAPR

The PAPR of OFDM signal represented in (1) is given by:

$$\text{PAPR}=\frac{\text{Peak power}}{\text{Average Power}}=\frac{max|x(t)|^2}{E[|x(t)|^2]} \quad (1)$$

Where E [·] denotes expected value. The value of PAPR is required to be as low as possible else the orthogonality of the signal gets destroyed

B. Cyclic Shifted Sequences (CSS)

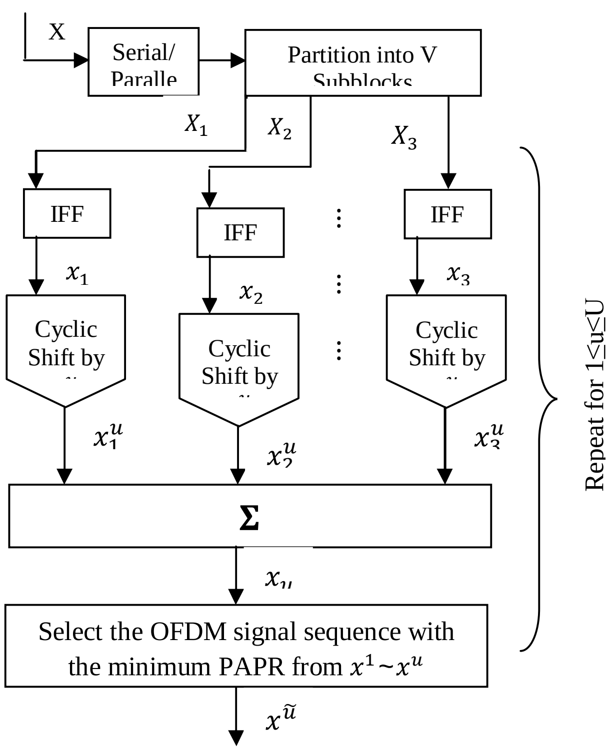


Fig.1: shows a block diagram of the CSS scheme

Inside the CSS scheme, *X* is divided via a sure partitioning pattern into *V* disjoint subblocks, input symbol subsequences *X1*, *X2*, . . . , *XV*. Then IFFT converts the *V* sub blocks in frequency area to the V OFDM sign subsequences in time area x1, x2, . . . , xV, where as *xv = xv(0), xv(1),. . . , xv(N − 1), 1 ≤ v ≤ V.*

For simplicity, we are going to assume both *N* and *V* are integers of power of two. After that, the *V* OFDM signal subsequences are cyclically shifted and combined for further processing onto make the u-th (*1 ≤ u ≤ U)* alternative OFDM signal sequence as,

$$x^u = \sum_{v=1}^{V} x_v^u \quad (2)$$

Where, x_v^u denotes the leftward cyclically shifted version of xv by some integer τ_v^u (1 ≤ v ≤ V). That is,

$$x_v^u = \{x_v(\tau_v^u), x_v(\tau_v^u + 1), \ldots\ldots, x_v(N-1), x_v(0), \ldots.., x_v(\tau_v^u - 1)\} \quad (3)$$

The cyclic shift operation does not destroy the orthogonality between the input symbols X(k)'s because, as we all know, cyclic shifting in time domain is equivalent to multiplying a corresponding linear phase vector in frequency domain. As the SLM or PTS schemes, the candidate with all-time low PAPR, $x^{\tilde{u}}$, is chosen by thoroughgoing hunt for transmission with $\log_2$ U bits facet info. By mistreatment some extra techniques at the receiver, the facet info are often recovered.
In proposed paper we are denoting τ_v^u as a shift value as well as $\bar{\tau}^u = \{\tau_1^u, \tau_1^u, \ldots, \tau_V^u\}$ is the SV set for u-th alternative OFDM sequence. With the help of this we have to construct U SV sets as $(\bar{\tau}^1, \bar{\tau}^2, \ldots, \bar{\tau}^U)$ to implement the CSS.
CSS scheme will use 3 partition strategies, i.e., random, adjacent, and interleaved partition strategies. It is widely considered that the random partition technique offers the simplest PAPR reduction performance among them whereas the interleaved partition method offers the worst PAPR reduction performance however it wants the lowest machine quality.

C. Desirable Shift Value Sets in the CSS Scheme
In the CSS scheme, the PAPR reduction performance depends USV sets. The CSS theme is to minimize the probability of the PAPR prodigious some threshold level rather than to reduce the PAPR of each alternative OFDM signal sequence itself, we've got a bent to may say usually that U SV sets that build alternative OFDM signal sequences as statistically independent as possible can perform well.

D. Desirable Shift Value Sets of OFDM Signal Subsequence Components
In fact, the elements in an OFDM signal subsequence don't seem to be mutually independent, which can be shown within the next subdivision. However for currently, we have a tendency to assume that the components within the OFDM signal subsequences are unit reciprocally freelance for simplicity. That is, we have

$$E\left[x_{v_1}(n_1).\{x_{v_2}(n_2)\}^*\right] = \begin{cases}\sigma^2, & v_1 = v_2 and n_1 = n_2 \\ 0, & otherwise\end{cases} \quad (4)$$

where σ^2 represents component power of an OFDM signal subsequence and $\{.\}^*$ denotes the complex conjugate.

We denote the correlation between the nth component of the ith alternative OFDM signal sequence and the mth component of the jth alternative OFDM signal sequence as

$$\rho_{i,j}(n,m) = E[x^i(n).\{x^j(m)\}^*] \quad (5)$$

It is shown that the correlation in (6) only depends on the time difference between n and m. That is, (6) can be expressed as

$$\rho_{i,j}(n,m) = E[x^i(n).\{x^j(n-\delta mod N)\}^*] = \rho_{i,j}(\delta) \quad (6)$$

where $0 \le \delta \le N-1$.

In this case, we have

$$x^1 = \left\{\sum_{v=1}^{V} x_v(0), \sum_{v=1}^{V} x_v(1), \ldots, \sum_{v=1}^{V} x_v(N-1),\right\} \quad (7)$$

Also, using (4), x^2 by the SV set is expressed as

$$x^2 = \left\{\sum_{v=1}^{V} x_v(\tau_v^2), \sum_{v=1}^{V} x_v(\tau_v^2 + 1\, modN), \ldots, \sum_{v=1}^{V} x_v(\tau_v^2 + N - 1\, modN)\right\} \quad (8)$$

$$\rho_{1,2}(\delta) = E[x^1(n).\{x^2(n-\delta modN)\}^*] using (6)$$

$$= E[x^1(0).\{x^2(-\delta modN)\}^*]$$

$$= E\left[\sum_{v=1}^{V} x_v(0).\left\{\sum_{v=1}^{V} x_v(\tau_v^2 - \delta modN)\right\}^*\right] using (7) \& (8)$$

$$= \sum_{v=1}^{V} E\left[x_v(0).\left\{\sum_{v=1}^{V} x_v(\tau_v^2 - \delta modN)\right\}^*\right] using (4) \quad (9)$$

where the value of n does not affect $\rho_{1,2}(\delta)$, and thus we use n = 0. Using (4), the inner term in the equation (9) becomes

$$E[x_v(0).\{x_v(\tau_v^2 - \delta modN)\}^*] = \begin{cases}\sigma^2, & \tau_v^2 = \delta \\ 0, & otherwise\end{cases} \quad (10)$$

Then, using (9) and (10), we have

$$\rho_{1,2}(\delta) = \alpha_\delta \sigma^2 \quad (11)$$

E. ACF of OFDM Signal Subsequences

The v-th OFDM signal subsequence is x_v And then S_v is the discrete power spectrum of that OFDM signal. It is represented as below

$$S_v = \{p(0), p(1), \ldots, p(N-1)\} \quad (12)$$

Where p(k) =$E[|X_v(k)|^2]$, and the value of p(k) will have the worth of zero or one. Because the modulation order of all the sub-carriers of the signal are equal. And also the average power is set to one. If we consider one example, if the interleaved partition is employed, $S_1 = \{10101010\}$ *and then* $S_2 = \{01010101\}$when N=8 and V=2.

After applying inverse discrete Fourier transform (IDFT) to the S_v. We will get ACF $R_{x_v}(m)$ and the X_v is considered as the input symbol sequence and it is having N-N/V zeros in a certain pattern and with respect to this ACF $R_{x_v}(m)$ is going to have a specific shape. Here we are going to calculate only the magnitude of the ACF because in the OFDM signal sequence, high peak is closely related to the magnitude of the components.

1) For Interleaved Partition: Here S_v becomes as an impulse train having an interval of V. Then, the ACF will become change as the impulse train as [8] .

$$|R_{x_v}(m)| = \begin{cases}\frac{\sqrt{N}}{V} & if\ m = 0\ mod\ \frac{N}{V} \\ 0 & otherwise\end{cases} \quad (13)$$

2) For Adjacent Partition: Here S_v becomes as a rectangular function having a width of N/V. Then the ACF will becomes the function as [14].

$$|R_{x_v}(m)| = \begin{cases} \frac{\sqrt{N}}{V} & if\ m = 0 \\ \frac{\sin(m\pi/V)}{\sqrt{N}\sin(m\pi/N)} & if\ m \neq 0. \end{cases} \quad (14)$$

3) For Random Partition: here S_v Can be represented as a binary pseudo random sequence. Then the ACF is going to have the same shape of a delta function, but the components are close to zero except m=0.

In Fig. 2 we can see the example of the magnitudes of ACFs with respect to the following spectrum when N=32 and V=2; $S_1 = \{1010 \dots 1010\}$ For an interleaved partition; $S_1 = \{11 \dots 1100 \dots 00\}$ For an adjacent partition; $c = \{1001011001111100011011101000000\}$For a random partition, which is a one zero padded m-sequence with length 31; Clearly, S_2 is a complement of S_1In every partition and the shapes of $|R_{x_v}(m)|$ For v=1 and v=2 are same.

IV. RESULTS

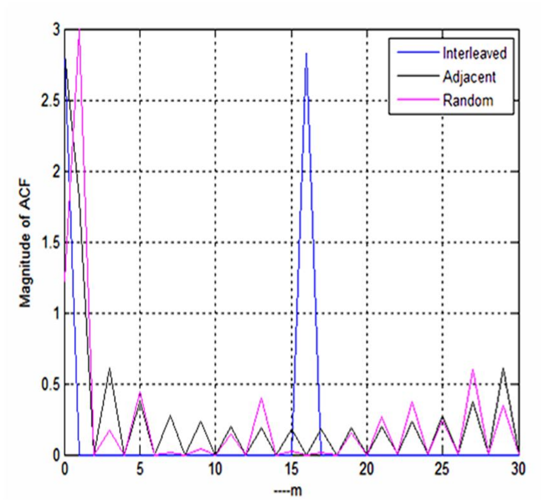


Fig.2: Comparison of the PAPR reduction performance of the CSS scheme for three partition cases

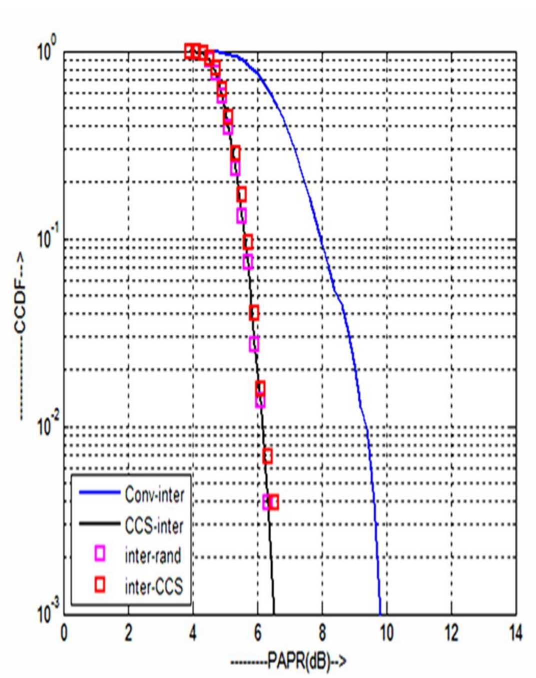


Fig.3: Comparison of the PAPR reduction performance in terms of CCDF and PAPR

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 VII, July 2017- Available at www.ijraset.com

The Fig.3 says that the conventional PTS and CSS are compared for better PAPR Reduction. So CSS is much better comparing to conventional PTS. But the Random and Interleaved partions are used in both the schemes i,e (PTS & CSS).

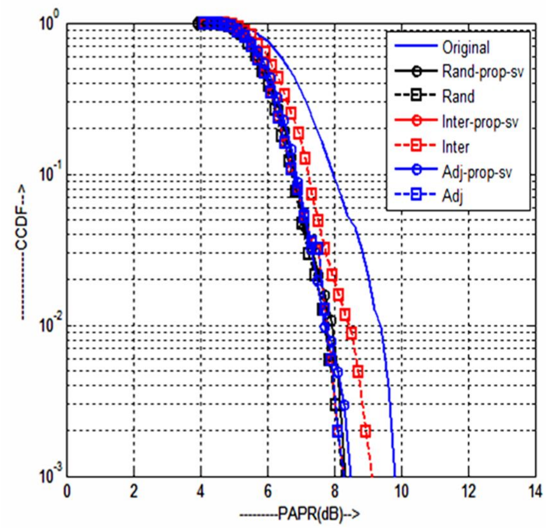


Fig.4: Comparison of the PAPR reduction performance of the CSS scheme for three partition cases, which are random, interleaved, and adjacent partition cases, according to the used SV sets.

The Fig.4 says that by comparing all the signals with the original signal finally the random partion have minimum PAPR reduction performances.

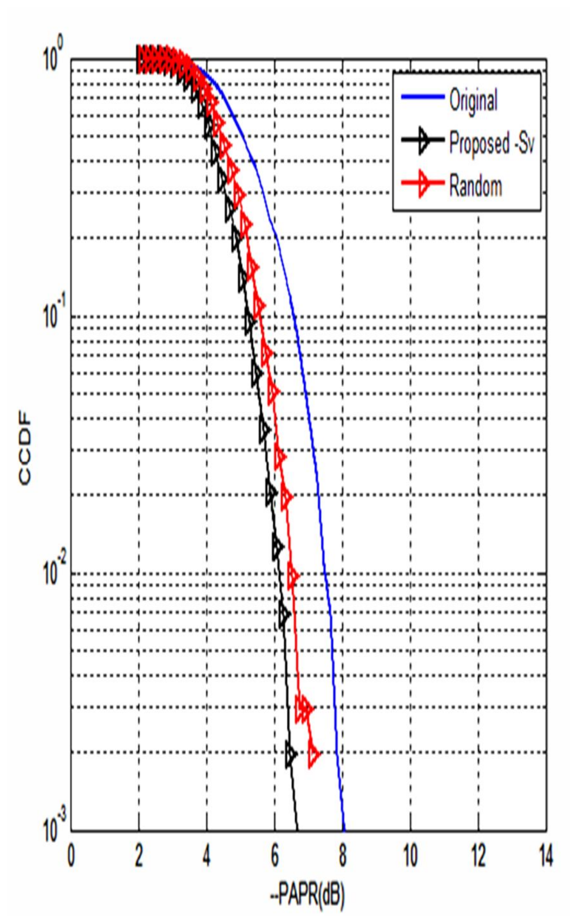


Fig.5: The optimality of the proposed SV sets

The Fig.5 says that the proposed SV sets have the best PAPR reduction performance

V. CONCLUSION

PAPR Reduction is a challenging task in the orthogonal frequency division multiplexing, in our proposed method CSS scheme to reduce the PAPR.For better PAPR reduction further we implemented piecewise linear transform.

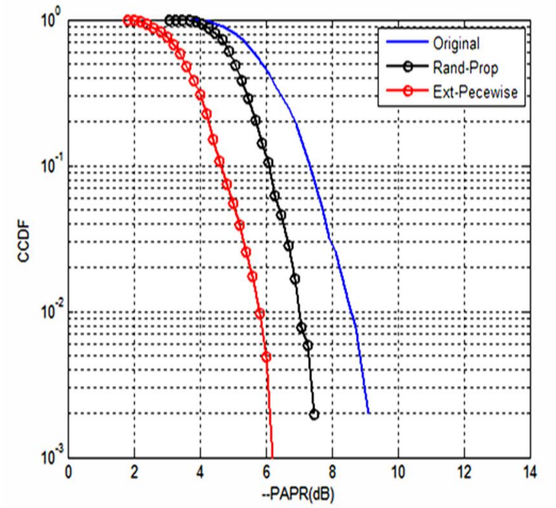
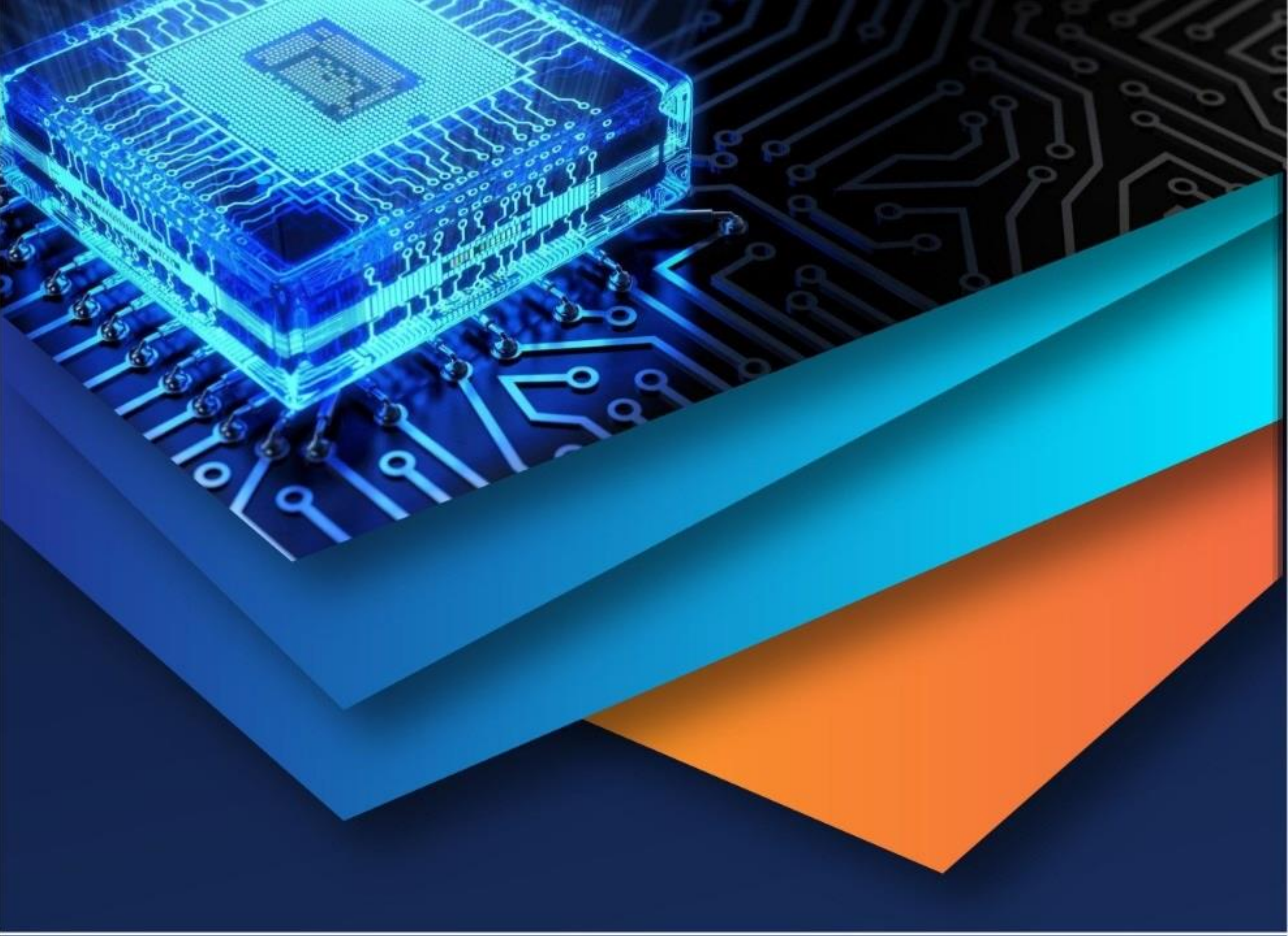


Fig 6: Comparision of PAPR reduction Original ,purposed and piecewise transform methods

Multicarrier transmission such as OFDM is one of the most attractive techniques for both wired and wireless applications due to its high data rates, robustness to multipath fading and spectral efficiency. However, it has a major drawback of generating high peakto-average ratio. The CSS scheme is the very popular and promising PAPR reduction scheme, which is evolved from the PTS scheme. In this letter, the criteria to select good SV sets are proposed, which can guarantee the optimal PAPR reduction performance of the CSS scheme. The criterion are proposed by considering the ACF of the OFDM signal subsequence for three different partition cases, random, interleaved, and adjacent partition cases. In the simulation results, the CSS scheme using the SV sets satisfying the proposed criteria shows better PAPR reduction performance than the case when the SV sets are not carefully designed. In the extension work, piecewise linear companding technique is used to reduce PAPR when compared to proposed method, It achieves high data rate and robustness compared to proposed method.

REFERENCES

[1] B. S. Krongold and D. L. Jones, “PAR reduction in OFDM via active constellation extension,” IEEE Trans. Broadcast., vol. 49, no. 3, pp. 258–268, Sep. 2003.
[2] S. H. Müller, R. W. Bäuml, R. F. H. Fischer, and J. B. Huber, “OFDM with reduced peak-to-average power ratio by multiple signal representation,” Ann. Telecommun., vol. 52, nos. 1–2, pp. 58–67, Feb. 1997.
[3] J.-Y. Woo, H. S. Joo, K.-H. Kim, J.-S. No, and D.-J. Shin, “PAPR analysis of class-III SLM scheme based on variance of correlation of alternative OFDM signal sequences,” IEEE Commun. Lett., vol. 19, no. 6, pp. 989–992, Jun. 2015.
[4] Z. Latinovic and Y. Bar-Ness, “SFBC MIMO-OFDM peak-to-average power ratio reduction by polyphase interleaving and inversion,” IEEE Commun. Lett., vol. 10, no. 4, pp. 266–268, Apr. 2006.
[5] G. R. Hill, M. Faulkner, and J. Singh, “Reducing the peak-to-average power ratio in OFDM by cyclically shifting partial transmit sequences,” Electron. Lett., vol. 36, no. 6, pp. 560–561, Mar. 2000.
[6] G. R. Hill, M. Faulkner, and J. Singh “Cyclic shifting and time inversion of partial transmit sequences to reduce the peak-to-average power ratio in OFDM,” in Proc. IEEE PIMRC, London, U.K., Sep. 2000, pp. 1256–1259.
[7] L. Yang, K. K. Soo, S. Q. Li, and Y. M. Siu, “PAPR reduction using low complexity PTS to construct of OFDM signals without side information,” IEEE Trans. Broadcast., vol. 57, no. 2, pp. 284–290, Jun. 2011.
[8] A.V Oppenheim, R.W.schafer, and J.R. Buck, Discrete-Time Signal Processing. Upper Saddle River, NJ, USA: Prentice-Hall, 1999.
[9] K.Long, Y. Fu, and Y. Wang, “The contradiction between channel estimation and PAPR performance in cyclic shifts PTS,” in Proc. IEEE BMEI,Chongqing, China, Oct. 2012, pp.1525-1528.
[10] Y.Zhou and T.Jiang, ”A novel multi-points square mapping combined with PTS to reduce PAPR of OFDM signals without side information,”IEEE Trans. Broadcast.,vol. 55, no. 4, pp. 831-835, 2009.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY