

Performance Evaluation Of PAPR Reduction In OFDM System Using Non Linear Companding Transform

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ABSTRACT-Orthogonal Frequency Division Multiplexing is considered as an advanced communication model which has wide range of applications such as 3G, 4G, and Wi-Fi etc. Though OFDM has lots of advantages over conventional communication models such as FDMA, CDMA still it has some disadvantages in that the major drawback is Peak to Average Power Ratio. In literature several theories are proposed to resolve this issue but none of the algorithm is designed to meet the practical approach. In our work a novel approach is present to resolve the Peak to Average Ratio by introducing the variable slopes parameters K_1 , K_2 and inflexion points A ($A > 0$) and CA ($0 < C < 1$) in the probability density function in the Non Linear Companding Transform Technique then based on the inflexion point and variables parameter analysis, The performances of two incompatible features PAPR and Bit Error rate can be achieved. Selection of Non Linear Companding transform parameters plays an essential role as overall performance, robustness depends on it. The proposed theoretical work results can be view through MATLAB simulation.

KEY WORDS: High power amplifier (HPA), non linear Companding transform (NCT), Orthogonal Frequency Division Multiplexing (OFDM)

I. OVERVIEW

Orthogonal frequency division multiplexing is considered as highly successful communication model compares to conventional communication models because of low sensitivity to multipath propagation and eminent spectral efficiency. Orthogonal frequency division multiplexing too suffers from some drawbacks, high peak to average power ratio is main drawback which occurs due to the insufficiency power distribution by high power amplifier which results in in-band and out-band distortion. Digital communication are comprised of two communication representations pass band representation and base band representation, pass band represents continuous mode of communication while base band represents digital mode of communication. In our proposed work we present the base band representation of

orthogonal frequency division multiplexing signal with N sub carriers as follows

$$x(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X_k e^{j2\pi \frac{k}{Nt_s} t}, \quad 0 \leq t \leq Nt_s \quad (1)$$

N represents number of sub carriers

t_s =Sampling time

X represents the frequency domain of orthogonal frequency division multiplexing symbols such as $X=[X_1, X_2, \dots, X_{N-1}]^T$

$T=Nt_s$ =symbol duration.

When the number of sub carriers is large then it can be treated as complex Gaussian process by the central limit theorem, this complex Gaussian process technically called as Peak to average power ratio. In order to resolve this issue several theories are proposed in the literature. One of such theory proposed in the literature is μ -law Companding; it

reduces the Peak to average power ratio impact on orthogonal frequency division multiplexing in small amount. To overcome the drawback of μ -law Companding in our proposed work we present the Non linearCompanding transform technique for efficient results

II. PROPOSED WORK

In our work a novel approach is present to solve the Peak to Average Ratio(x_n)by introducing the variable slopes parameters K_1 , K_2 and inflexion point A ($A>0$) and cut-off point $CA(0<C<1)(y_n)$ in the probability density function in the Non Linear Companding Transform Technique then based on the inflexion point and variables parameter. The probability density function express as follows

$$f_{|x_n|}(x) = \begin{cases} K_1x, & 0 \leq x \leq CA \\ K_2x + (K_1 - K_2)CA, & CA < x \leq B \end{cases} \quad (2)$$

By using the above equation, analysis of accurate Peak to average power ratio is done by using the variable parameters K_1 and K_2 in .the proposed work Non linearcompandingtransform. Generally Peak to average power ratio erupts in the orthogonal frequency division multiplexing while controlling the power generated by high power amplifier in the Non linearcompandingtransform. Based on the

Probability density function definition $\int_{-\infty}^{+\infty} f_{|Y_n|}(x)dx = 1$ we have

$$K_1 = \frac{2-A^2K_2(c-1)^2}{A^2c(2-c)} \quad (3)$$

After analysis of accurate Peak to average power ratio, from the above equation cumulative distribution function (CDF) is represents as follows

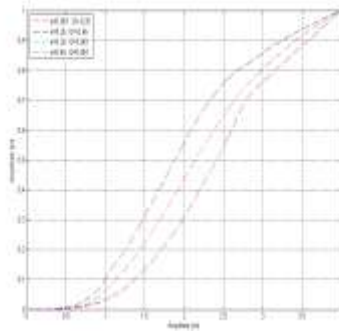
$$F_{|y_n|}(x) \begin{cases} \frac{K_1}{2}x^2, & 0 \leq x \leq CA \\ \frac{K_2}{2}x^2 + (K_1 - K_2)CAx - \frac{k_1-k_2}{2}(CA)^2, & CA < x \leq B \\ 1, & x > A \end{cases} \quad (4)$$

The following inverse function shows that cumulative distribution function is a increasing monotonic function is shows as follows

$$F^{-1}_{|y_n|}(x) = \begin{cases} \sqrt{\frac{2x}{K_1}} & x \leq \frac{1}{2} (CA)^2 \\ \frac{1}{K_2}((K_2 - K_2)CA + \sqrt{K_1 - K_2}\sqrt{(K_1 - K_2)K_1c^2A^2 + 2K_2x}) & x > \frac{1}{2} (CA)^2 \end{cases} \quad (5)$$

We can obtain the following relationship as $h(x)$ is a monotonic function

$$F_{|x_n|}(x) = \text{prob}\{|x_n| \leq x\} = \text{prob}\{h(|x_n|) \leq h(x)\} = F_{|y_n|}(h(x))$$



Figur 1 Transfer curves of the proposed work Non linearcompanding transform

After successfully attaining the transfer curves, now the Non linearcompanding transform algorithm recovers the transform companding function at the receiver section by performing the de companding operation.

$h(y)$

$$\text{sgn}(y) \cdot f^{-1}_{|y_n|}(F^{-1}_{|x_n|}(x)) \begin{cases} \text{sgn}(x) \sqrt{\frac{2}{K_1}(1 - \dots)} \\ \text{sgn}(y) \frac{1}{K_2}((k_2 - k_1)AC + \sqrt{(K_2 - K_1) \dots}) \end{cases} \quad (6)$$

III. REDUCTION OF PAPR

The accuratePeak to average power ratio of the Non linearcompanding transform is given as

$$PAPR_y = \frac{\max_{n \in \{0, \dots, N-1\}} \{|y_n|^2\}}{E\{|y_n|^2\}} = \frac{B^2}{\beta^2} = \frac{(\xi_1^2 - 4\xi_2\xi_0)^{\frac{1}{2}} - \xi_1}{2\xi_2\beta^2} \quad (7)$$

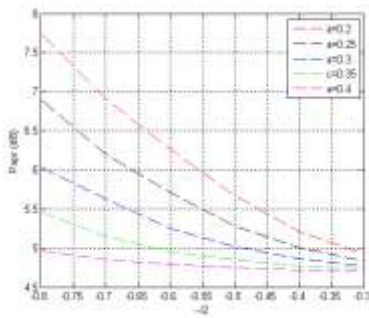
Then after attaining the accurate peak to average power ratio , the input signal is compared to thenon linearcompanding transform signal by gain G as follows

$$G(\text{dB}) = 10\log_{10} \frac{PAPR_x}{PAPR_y} = 10\log_{10} \frac{2\xi_2 B_i \max^2}{(\xi_1^2 - 4\xi_2\xi_0)^{\frac{1}{2}} - \xi_1} \quad (8)$$

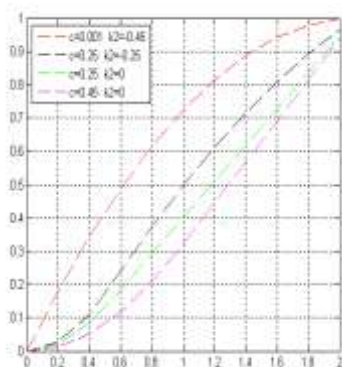
$$\text{Where } B_{i \max} = \max_{0 \leq n \leq N-1} \{|y_n|\}$$

By changing the values of K2 and c according to the analysis, peak to average power ratio is reduced at high level. This reduction is done in the interval [4.6 db, 5.8db].CCDF of proposed work are as follows by substituting REDUCTION OF PAPR equations

$$CCDF_y(\gamma_0) = \text{prob}\{PAPR_y > \gamma_0\} = CCDF_x \left(\frac{2\xi_2 B_i^2 \max}{(\xi_1^2 - 4\xi_2\xi_0)^{\frac{1}{2}} - \xi_1} \gamma_0 \right) \quad (9)$$

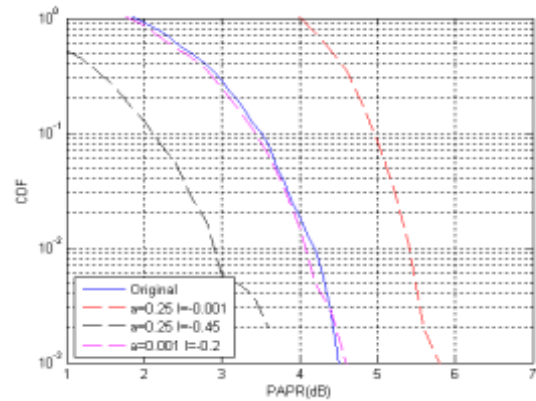


Figur 2 The accurate peak to average power ratio of Non linearcompanding transform signals.

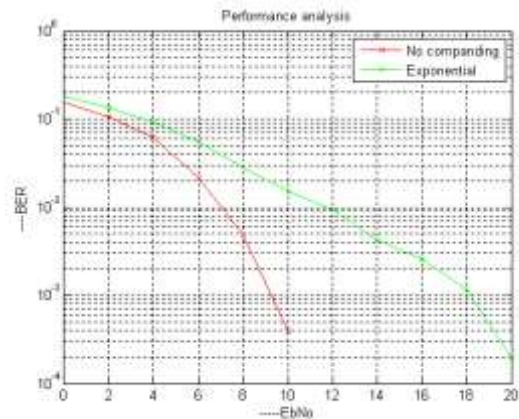


Figur3 Results of Peak to average power ratio and gain

IV. SIMULATION RESULTS

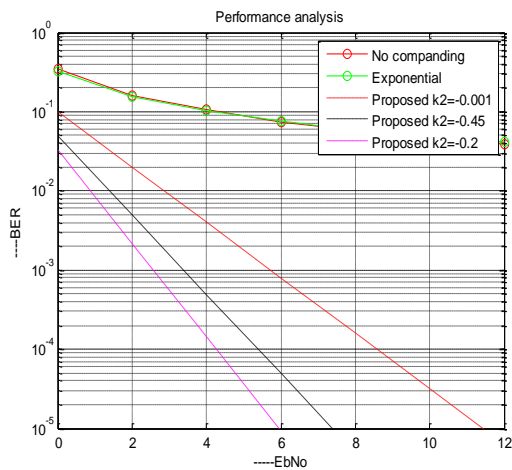


Figur 4 Reduction of peak to average ratio of different transform with 1024 sub carriers, QPSK modulation and J=4 oversampling ratio.



Figur 5 Bit error rate with 16 QAM modulation with several companding transforms under Additive white gaussian noise with 1024 sub carriers

Extended Typical Urban (ETU) is the advanced communication channel model which is being used in the valley regions where the normal conditions does not exist so the channel should be changed so the extended SUI channel model can be replaced by the ETU channel which has different type characteristics suitable to the valley regions. The offers the propagation of the signal in adverse condition, time delay of the propagation and doppler frequency has been included in this channel.



Figur 6ETU extension graph

CONCLUSION

Our proposed method yields records high performance over conventional approaches in reducing the PAPR in OFDM system. In conventional theories are proposed to resolve this issue but none of the algorithm is designed to meet the practical approach. In our work a novel approach is present to resolve the Peak to Average Ratio by introducing the variable slopes parameters K_1 , K_2 and inflexion points A ($A > 0$) and CA ($0 < C < 1$) in the probability density function in the Non Linear Companding Transform Technique.

REFERENCES

- [1] J.E. Costa, M. Midro, and S. Pupolin, "system performance," IEEE Commun. Lett., vol. 3, pp. 37–39, Feb. 1999
- [2] J. Tellado and J. M. Cioffi, "PAR reduction in multicarrier transmission systems," ANSI Document, T1E1.4 1. 2, no. 2, pp. 284–293, Mar. Technical Subcommittee, no. 97–367, pp. 1–14, Dec. 8, 1997.
- [3] J. Tellado, "Multicarrier transmission with low PAR," Ph.D. dissertation, Stanford Univ., Stanford, CA, 1998.
- [4] S. H. Müller, R. W. Bauml, R. F. H. Fischer, and J. B. Huber, "OFDM with reduced peak to average power ratio by multiple signal representation," Ann. Telecommun., vol. 52, no. 1–2, pp. 58–67, Feb. 1997.
- [5] W. Y. Zou and Y. Wu, "COFDM: An overview," IEEE Trans. Broadcast., vol. 41, no. 1, pp. 1–8, Mar. 1995.