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Analysis of Reduction of PAPR by Linear Predictive Coding in OFDM

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ABSTRACT

The major challenge in orthogonal frequency division multiplexing (OFDM) is to reduce high peak to average power ratio (PAPR) that leads to non linear distortion for the application of high power amplifier. PAPR is defined as the ratio between the maximum instantaneous power and its average power. In this paper, we have presented new PAPR reduction technique to reduce peak to average power ratio using Linear predicting coding (LPC) in OFDM system. In this paper, proposed technique show the significant reduction in PAPR without any harmful degradation in power spectral density (PSD), computational complexity (CC) and performance error of the system. This proposed method can be applied for any number of subcarrier and independent of modulation scheme under Additive White Gaussian Noise (AWGN) channel.

Keywords-- PAPR, OFDM, LPC, AWGN, PSD, Bit error rate (BER)

I. INTRODUCTION

OFDM system is a special case of frequency division multiplexing (FDM) worked as PAPR reduction technique where all carrier signals are orthogonal. A multi-carrier modulation technique that is a fourth generation (4G) wireless communication system for seem to be OFDM systems that an attractive candidate. OFDM offers immunity to multipath delays, low symbol interference (ISI), high spectral efficiency, selective fading immunity and high energy efficiency DVB and global mobile interoperability based on microwave access Wi-MAX mobile [1]. To include techniques to cut decode and encode signals. Under the term signal randomization techniques two schemes are included where are the first is partial transmission sequence (PTS) and second is selected mapping (SLM). Although, to the some techniques for reducing the PAPR have been summarized in [2]. The PAPR has proposed a preceded SLM method with a Vander Monde Matrix (VLM) for the reduction of IEEE 802.11 standards and DVB-T system [3] effect of the wireless channel and receiving end.

In this paper is based on LPC technique to a new PAPR reduction technique to proposed system and PAPR reduction technique studied in term of CCDF, BER performances and power spectral density. The model is not shown to reduce the proposed system in PAPR reduction method without decreasing the system performances can significantly to the system. In OFDM systems and LPC technique to existing PAPR reduction technique such as selective mapping (SLM) [4,5], has performed better than the system. To the OFDM system in PAPR reduction technique method as an overview is organized follow as proposed method with concept and mathematical analysis and computational complexity of system model. Results and simulation method are discussed in concludes the systems to orthogonal frequency division multiplexing is a particular form of multi-carrier modulation scheme that divides the entire frequency selective fading channel into many narrow band orthogonal flat fading side channels. In the OFDM system is a high speed data rate to over a number of low data rate subcarriers is transmitted in parallel is not subject to ISI due to the long duration of the symbol.

A. PAPR PROBLEM IN OFDM

$$x(n) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X_{k} e^{j \frac{2\pi}{N} kn}, 0 \le n \le N-1 \qquad (1)$$

Given the large PAPR in OFDM signal may be generated Where N number of independently modulated subcarrier which can by an N number of point inverse fast Fourier transform (IFFT) in the transmitter and considering the N block symbols to the fast Fourier transform (FFT).

$XN = \{Xk, k = 0, 1, \ldots, N-1\}$, is formed of the system.

Where X_K, is the symbol carry by the K_{th}, sub-carrier model system.

$$PAPR = \left[\frac{\max |X(n)|^2}{E\{|X(n)|^2\}}\right] \qquad (2)$$

Where $E\{|X(n)|^2\}$, denotes as the expectation operation Increase in case of PAPR reduction technique system similar to the number of subcarriers.

B. LPC CODING

These systems are very compatible because the signal in PAPR reduction compounds of OFDM can shows a very high PAPR reduction technique. If using the linear prediction coding in PAPR reduction method is the matching sequence of the previous IFFT operation is applied so that the PAPR technique in OFDM signal is also reduced.

According to [5], there is a close relationship between self-correlation periodic (ACF) functions in vector X and PAPR reduction method.

Let $\rho(i)$, be the ACF of the signal X given that the

$$(i) = \sum_{k=0}^{N-1-i} X_{k+1} + iX_k \qquad (3)$$

For $i = 0,1 \ldots\ldots\ldots, N-1$

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Where $X_{k+1} + iX_k$ denoted the complex conjugate in reduction technique.
The PAPR reduction technique to the transformed signal is limited by the system.

$$PAPR \leq 1 + 2/N \times \delta \quad (4)$$

Where δ, is defined as in reduction system that is.

$$\delta = \sum_{i=1}^{N-1} |\rho(i)| \quad (5)$$

Where $|\rho(i)|$ is the absolute a periodic (ACF).
Equation (4) and equation (5), denoted as the input vector with a lower range λ, it can produce a signal with a lower PAPR reduction technique in OFDM systems [5].

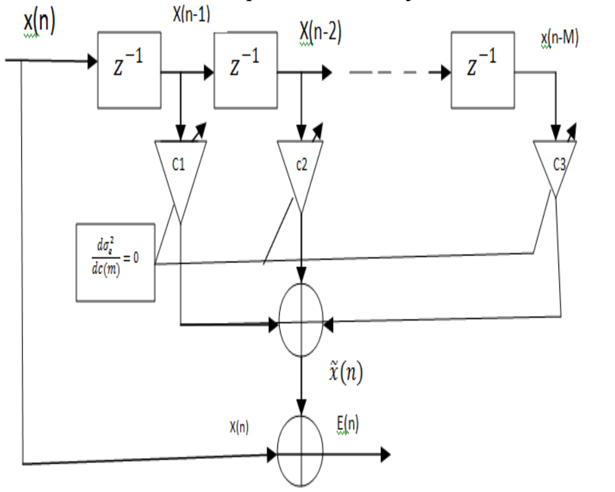

Figure 1: Block diagram of linear predictor coding in system

II. RELATED WORK

Multicast Broadcasting service support in OFDM based Wi-MAX system work has been done to proposed by T. Jiang, W. Xiang in (2008) used Methodology multicasting broadcast wireless networking [1]. This is one of the faster and easier deployment and revenue realization, lower operational costs for network maintenance. The drawback of this existing system is that a null is placed in the direction of the interferers, so the antenna gain is not maximized at the direction of the desired user. Peak-to-average power ratio reduction techniques for OFDM signals has been done to proposed by Jiang, T., & Wu, Y. in (2008) [2]. Used methodology of PAPR reduction for multiuser broadband communication system use high power amplifier (HPA), Multiuser OFDM and PAPR reduction technique .In this system one of the serious draw-back is to compose the signal can exhibit a very high peak power when the input sequences are highly correlated. To discussed some important aspects including the distribution of the PAPR reduction technique as well as provided mathematically analysis. The proposed enhanced method perform in the paper presented the reduction in PAPR at the cost of lose in data rate, transmit signal power increases BER performances degradation.

VLM preceded SLM technique for PAPR reduction in OFDM system work has been done to proposed by Md. Mahmudul Hasan in (2013) [3]. Used methodology, VLM precoding based SLM technique performances are evaluated by MATLAB simulation in term of CCDF and BER. In OFDM system the main drawback is that the composite transmit signal can exhibit a very high peak power when the input sequence are highly correlated. The proposed enhanced precoding method performs in this paper presented the better than the conventional precoding techniques without increasing the complexity of the system or degrading the BER.

Channel Estimation in OFDM Systems work has been done to proposed by Srishtansh Pathak and Himanshu Sharma in (2013) [10]. Used methodology Least Square Error (LSE), and Minimum Mean Square Error (MMSE), channel estimators. In OFDM system the main drawback is that the high peak-to-average-power ratio (PAPR), bit error rate (BER) and high sensitivity to carrier frequency offset (CFO). The proposed enhanced precoding method performs in this paper presented the better than the OFDM lies in processing frequency-selective channels as multiple flat-fading sub-channels.

III. PROPOSED WORK

A. Autocorrelation of PAPR

OFDM signal can exhibit a very high PAPR, when the input sequences are highly correlated.

Using the LPC coding technique in PAPR reduction method is to de-correlate the input sequence before IFFT operation is applied so that PAPR of OFDM signals is also reduced according to [5].

$$x(n) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X_{k} e^{j\frac{2\pi}{N}kn}, 0 \leq n \leq N-1 \quad (6)$$

The PAPR of the transformed signal is bounded by

$$PAPR \leq 1 + 2/N \times \delta \quad (7)$$

Where δ, is defined as in reduction system that is.

$$\delta = \sum_{i=1}^{N-1} |\rho(i)| \quad (8)$$

B. LPC transceiver analysis and synthesis

Linear prediction is an attempt to de-correlate the signals by subtracting the best possible linear prediction from the input signal while preserving other aspects of the signals leaving a whitened residual signal which will be shown to have a very less PAPR, the basic idea of linear prediction is to transmit the prediction error signal instead of the original signal [6,7].

$$\tilde{x}(n) \sum_{k=1}^{M} c(k)\, x(n-k) \quad (9)$$

The difference between the model system in original sequence and the expected sequences, we can define the prediction error sequence and (n) as.

$e(n) = x(n) - \tilde{x}(n)$, Put the value $X(n)$, in terms of M coefficients.

LPC-OFDM transmitter and receiver It is possible to solve the matrix for M coefficient c(k) to operate the system required for the arbitrary matrix [8]. It consists only of zeros in the Z-plane, with poles at Infinity Also the resulting filter is minimum phase. That is, all of its zeros are inside the unit circle, which ensures

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that the inverse filter is also stable [6,9].

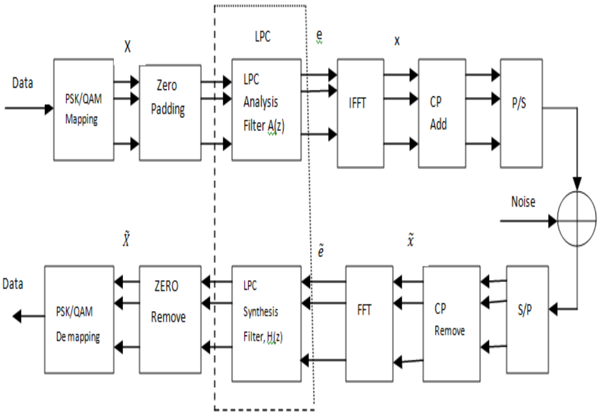

Figure 2: LPC transceiver analysis and synthesi

$$r(m) = \lim_{N\to\infty} \sum_{n=-N/2}^{N/2} x(n)x(n-m) \qquad (10)$$

Yule-Walker equations generated in this system to the case of an all zero input signals [7]. Noted the length of the Land exceed the order M to allow to assume the sequence up-to the m Log equal M system.

Flow diagram

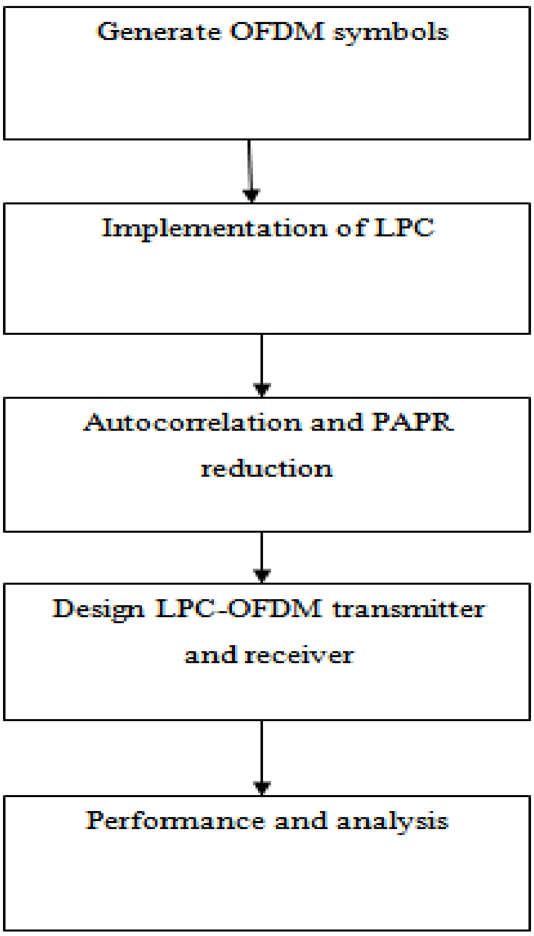

Figure 5. Flow chart

Figure 3: Flow chart

C. MODULES

1. Symbol Generation for OFDM
2. Implementation of Linear Predictive Coding
3. Reduction of PAPR
4. Performance Analysis

D. Performance Analysis:

The ratio of peak-to-average power (PAPR) is defined as the peak amplitude squared that gives us the peak power, that is divided by the RMS value squared, giving the average power [3] It's the square of the crest factor.

$$\mathrm{PAPR} = \frac{|x|peak^{2}}{x_{rms}^{\ 2}} = C^2 \qquad (11)$$

$$\mathrm{PAPR_{db}} = 10\log_{10}\frac{|x|peak^{2}}{x_{rms}^{\ 2}} = C_{db}^2 \qquad (12)$$

The bit error rate (BER) is defined as the number of bit errors divided by the total number of bits transferred during a time interval studied. BER is a measuring of a performance of unit less system, often expressed as a percentage. The bit error's probability is the expected value of the bit error rate. The bit error rate can be considered as a rough estimation of the bit error probability. This estimation is accurate for a long time interval and a large number of bit errors. In the case of QPSK and AWGN, the BER based on Eb / N0, is given by

$$\mathrm{BER} = \mathrm{erfc}\left(\sqrt{Eb/N_0}\right) \qquad (13)$$

IV. SIMULATED RESULT

V.

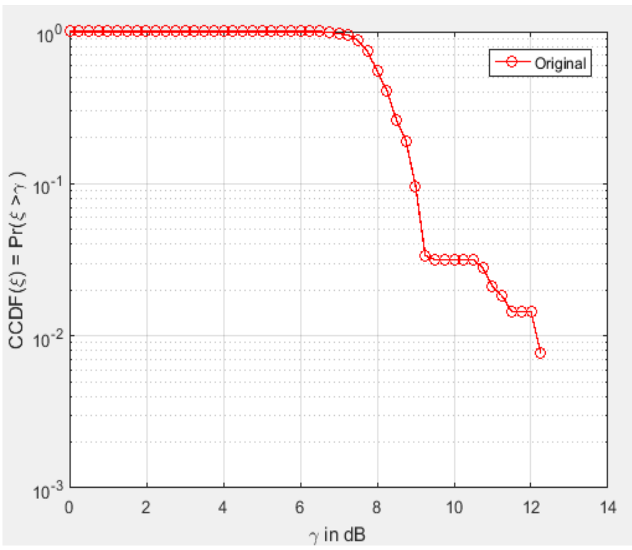

Figure 4: Base signal for OFDM using LPC system between the CCDF and γ indB

To enhanced the references circuit using LPC coding technique to better performances to reduce the PAPR reduction effect of base signal whitening by the use of LPC coding technique is shown in Figure4, It is clear from the spectral that although of an OFDM signal having varying energy at every shown frequencies such

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as the λ of an exponential distribution or Poisson distribution and complementary cumulative distribution function (CCDF).

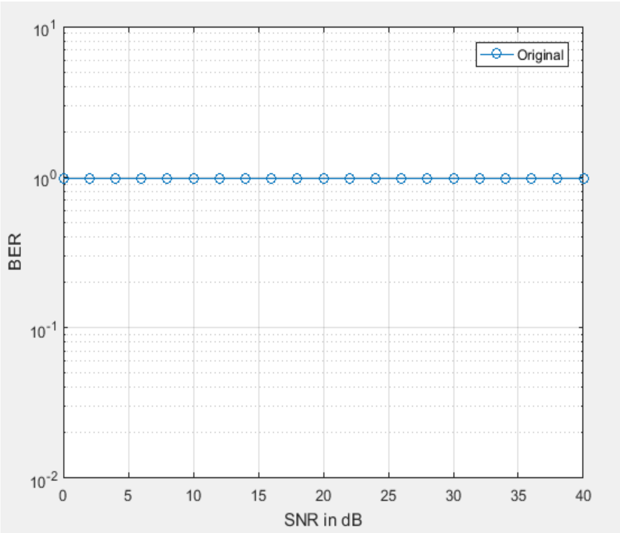

Figure 5: To BER performances for general OFDM system and LPC coding technique in OFDM system for M = 4 → 32, using LPC coding technique.

Represents this figure 5, shown in the simulation of 64-QAM LPC coding technique in OFDM systems make stability of bit error rate performances for high level modulation technique to the enhanced system reduction technique. It is shown that SNR is improved, error will less compare to the reference model by 5–3dB for value of M from 4 to 32 bit. To get the optimum order of the error filter to optimum trade off must be considered between PAPR reduction technique and BER performances.

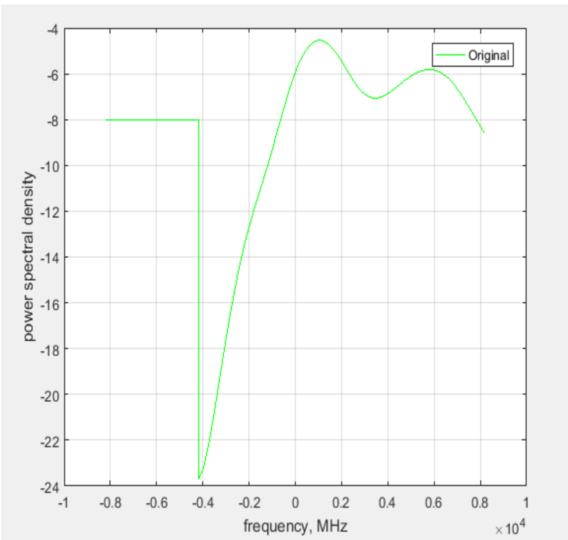

Figure 6: Improved PSD of general OFDM systems and LPC coding technique of OFDM system with the power of equalization for M = 4 to 16, by use of LPC coding technique.

Figure 6 gives view of equalized power conditions where in band spectra is demodulated system and another value of M, can have valuable PAPR minimum with diminishing error performance to using LPC coding technique. Due to the presence of out of band spectra power, it will leads to ISI if not addressed properly to make shift of the system to reference paper. If we choose smaller values of M, it will assist in reduction of interference and reduction also.

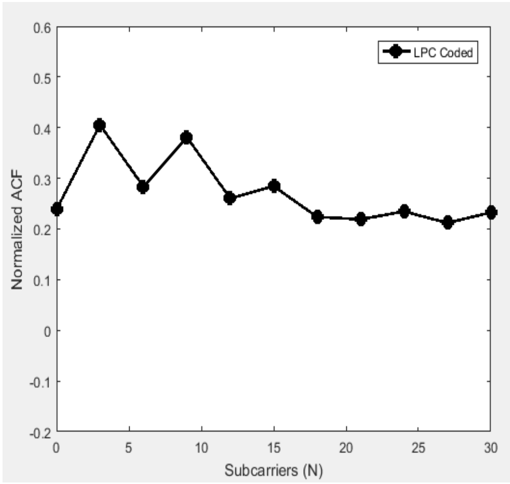

Figure 7: Normalized autocorrelation of OFDM system and LPC coding technique in OFDM signals the PAPR reduction performance was evaluated using LPC coding in PAPR reduction technique

In OFDM system probability in case PAPR reduction technique of an OFDM system sequences of may be the cross that the threshold voltage level, PAPR0 and PAPR reduction become minimum. Genuinely, if side lobes of autocorrelation will give higher values then in that case input sequence is highly correlated and PAPR reduction technique too.

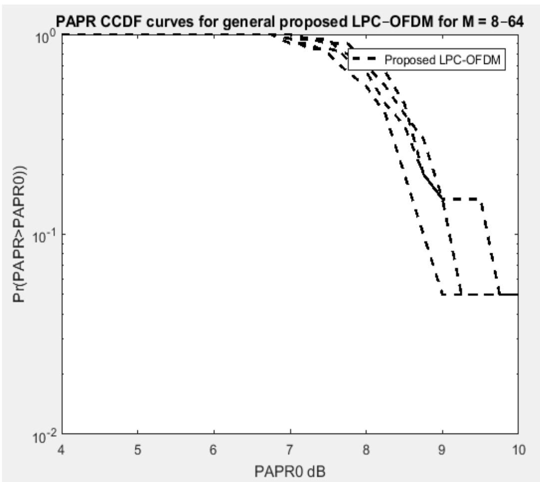

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Figure 8 .PAPR CCDF test and curves for general proposed LPC coding technique in OFDM system for M=8 to 64,

In Figure 8, PAPR reduction technique CCDF test of OFDM system having no PAPR reduction method indicate as a general OFDM system conventionally selective mapping and the proposed method or enhanced the system denoted as LPC–OFDM.

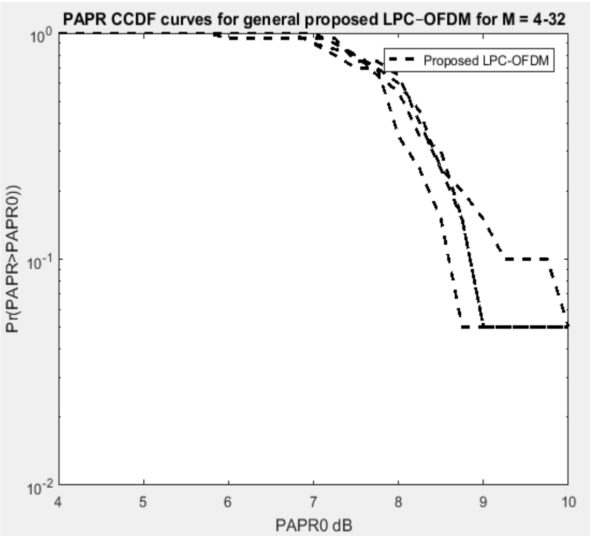

Figure 9: PAPR reduction technique CCDF curves for general proposed LPC OFDM for M=4 to 32

Figure 9, Is the extension of simulation for using 64-QAM mapping where proposed method shown that the like-wise performances. Hence it is clear that the proposed method does not depend on modulation schemes and applicable to high order modulation technique and low reduction better performances.

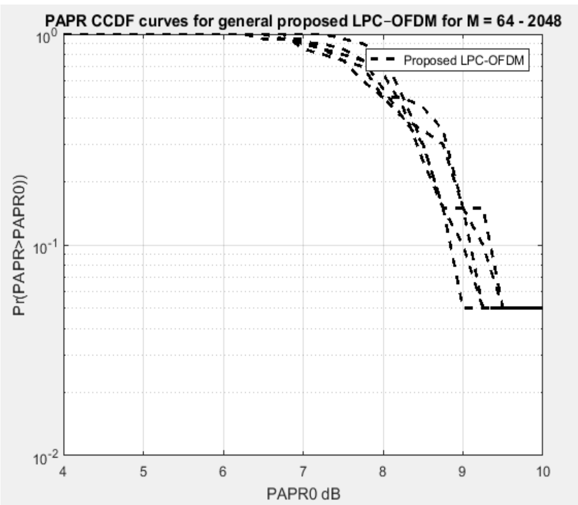

Figure 10: The PAPR reduction technique method in CCDF test curves, for general proposed LPC coding technique in OFDM system for M=64-2048

In Figure 10, PAPR CCDF of DVB to FDM systems to enhanced technique used LPC coding with linear prediction is shown. According to the DVB-T standards given N=2048, NV = 1706, BPSK for pilot symbols 16-QAM for data symbols in error is very low or minimum and symbol length 224µs are used.

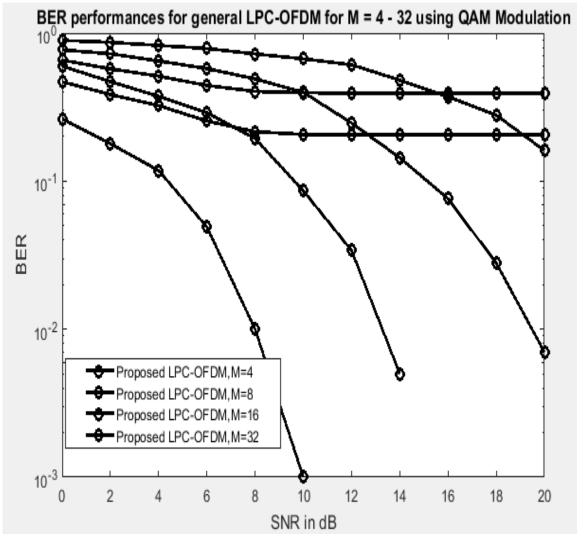

Figure 11: BER performances for General LPC OFDM for M=4 to 32 using QAM Modulation.

In Figure 11 BER performances for normal OFDM and linearly predicted filter OFDM is shown, on the basis of IEEE 802.11a standards; 8 QAM mapping, N=64 and NV = 52 are used. As a result shown that the error filtering there may not be a huge improvement but a light improvement can be seen.

VI. CONCLUSION

In this paper, various methods proposed based on linear predictive coding by using then we have reduced PAPR obtained good BER performances. It is also shown that, proposed method is applicable for any modulation scheme and the work for any number of subcarriers. To the critical concept mathematical analysis system models and simulation results are given to support the statement.

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