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Complementary Cumulative Distribution Function for PerformanceAnalysis of OFDM Signals And Implement PAPR Reduction Techniques In OFDM System usinng CCDF function on matlab

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Abstract

Peak-to-Average Power Ratio (PAPR) is an important parameter for the analysis of orthogonal frequency division multiplexing (OFDM) signals. CCDF curves are known to have great importance in the study of signal performance on the basis of power level. This paper presents the CCDF performance of the OFDM signal with different number of carriers. Simulation is used to implement the CDF equation and its accuracy is checked on the results. Theoretical results and simulation results are compared

Keywords- component; formatting; CCDF; PAPR; OFDM PTS;SLM;

I. INTRODUCTION

In this paper, we propose a simple technique for the reduction of high Peak to Average Power Ratio (PAPR), based on Clipping and Differential Scaling Selected mapping (SLM) is a promising peak-to-average power ratio (PAPR) reduction technique for orthogonal frequency division multiplexing (OFDM) system Partial transmit sequence (PTS), is one of the most attractive method to reduce the PAPR in OFDM systems. It achieves considerable PAPR reduction without Distortion

Power Complementary Cumulative Distribution Function (CCDF) curves provide critical information about the signals encountered in 3G systems. These curves also provide the peak-to-average power data needed by component designers.

This application note examines the main factors that affect power CCDF curves, and describes how CCDF curves are used to help design systems and components. When are CCDF curves used? Perhaps the most important application of power CCDF curves is to specify completely and without ambiguity the power characteristics of the signals that will be mixed, amplified, and decoded in communication systems. For example, baseband DSP signal designers can completely specify the power characteristics of signals to the RF designers by using CCDF curves. This helps avoid costly errors at system integration time. Similarly, system

Manufacturers can avoid ambiguity by completely specifying the test signal parameters to their amplifier suppliers. CCDF curves apply to many design applications. Some of these applications are:

- Visualizing the effects of modulation formats.
- Combining multiple signals via systems components (for example, amplifiers).
- Evaluating spread-spectrum systems.
- Designing and testing RF components.

II. WHAT ARE CCDF CURVES?

Figure 1A shows the power versus time plot of a 9-channel CDMA One signal. This plot represents the instantaneous envelope power defined by the equation:

Power = I2 + Q2

Where I and Q are the in-phase and quadrature components of the waveform. Unfortunately, the signal in the form shown in *Figure 1A* is difficult to quantify because of its inherent randomness and inconsistencies. In order to extract useful information from this noise-like signal, we need a statistical description of the power levels in this signal, and a CCDF curve gives just that. A CCDF curve shows how much time the signal spends at or above a given power level. The power level is expressed in dB relative to the average power. For example, each of the lines across the waveform shown in *Figure 1A* represents a specific power level above the average. The percentage of time the signal spends at or above each line defines the probability for that particular power level. A CCDF curve is a plot of relative power levels versus probability.

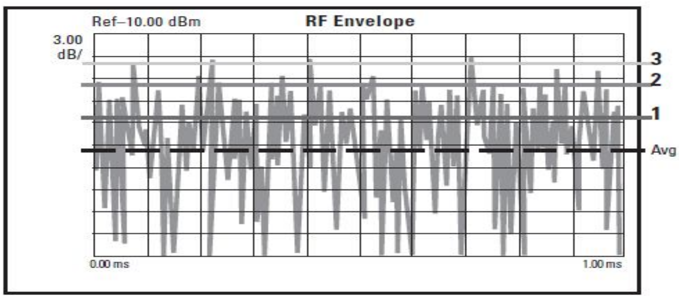

Figure 1A: construction of a CCDF curve

Figure 1B displays the CCDF curve of the same 9-channel CDMA One signal captured on the E4406A VSA. Here, the x-axis is scaled to dB above the average signal power, which means we are actually measuring the peak-to average ratios as opposed to absolute power levels. The y-axis is the percent of time the signal spends at or above the power level specified by the x-axis. For example, at t = 1% on the y-axis, the corresponding peak-to-average ratio is 7.5 dB on the x-axis. This means the signal power exceeds the average by at least 7.5 dB for 1 percent of the time. The position of the CCDF curve indicates the degree of peak-to-average deviation, with more stressful signals further to the right.

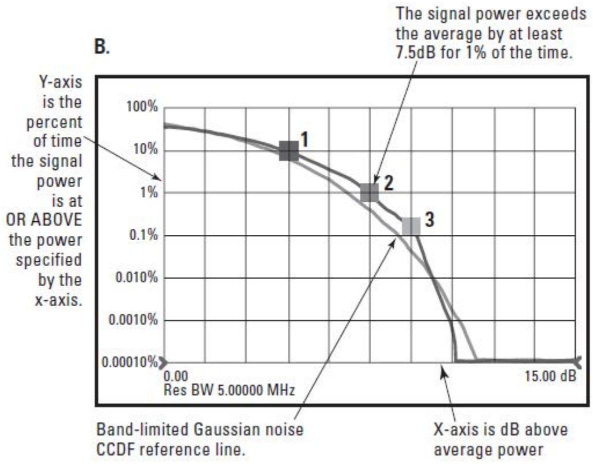

Figure 1B: CCDF curve of a typical OFDM siganal

III. STATISTICAL ORIGIN OF CCDF CURVES

```
function [] = ccdf_log_plot(x)
Th = 20*log10([0.1:0.1:10]);
kk = 1;
th_current = Th(1);
rms = sqrt(mean((x.^2)));
w = 20*log10(x/rms);
z = sort(w);
L = -inf*ones(1, length(Th));
for ii = 1:(length(z)-1)
    if (z(ii) > th_current)
        L(kk) = ii - 1;
        kk = kk + 1;
        th_current = Th(kk);
    end
end
CCDF = (length(z) - L)/length(z);
semilogy(Th, CCDF);
grid on;
```

IV. SIMULATION STUDIES

Simulation results for OFDM with 16-QAM:

1) No. of bits transmitted = 960000
2) No. of Carriers: 64
3) coding used: Convolutional coding
4) Single frame size: 96 bits
5) Total no. of Frames: 10000
6) Modulation: 16-QAM
7) No. of Pilots: 4
8) Cyclic Extension: 25%(16)

In this part we explore Mat lab simulation results of discussed methods in the previous chapters, here most results represented as CCDF of PAPR which studied in We consider 1024 OFDM with 84 0useful data subcarriers and 16 QAM modulations which is oversampled by 4 times. Pilot subcarriers are set as known value 1 in the whole simulations. The performance of the proposed modified PAPR Reduction techniques is evaluated by Complementary Cumulative Distribution Function (CCDF) of PAPR with respect to threshold PAPR0. The CCDF or Pr[PAPR > PAPR0] denotes the probability of the signals having a PAPR greater than threshold PAPR0. The CCDF of PAPR performance of the proposed technique is investigated by 16 subcarriers OFDM- system as shown in Figure.

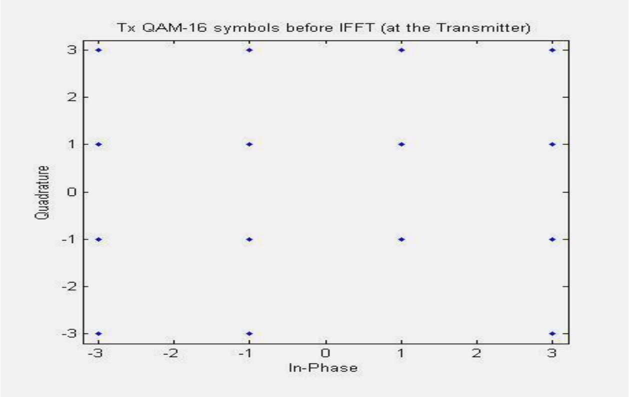

Figure 5. Successive Results pertain to transmit symbols before IFFT using symbol rate sampling.

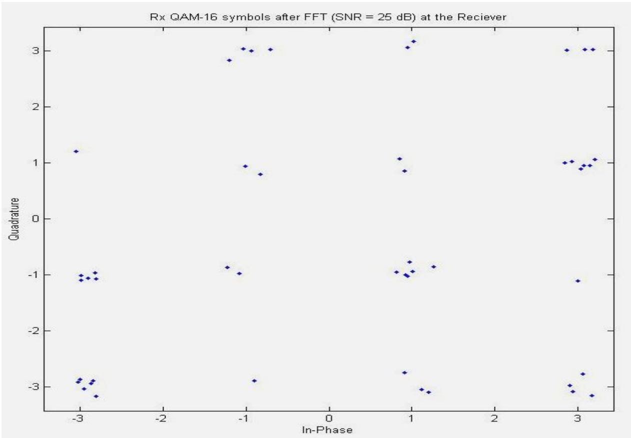

Figure 6. Successive Results pertain to receiver symbols after FFT using symbol rate sampling.

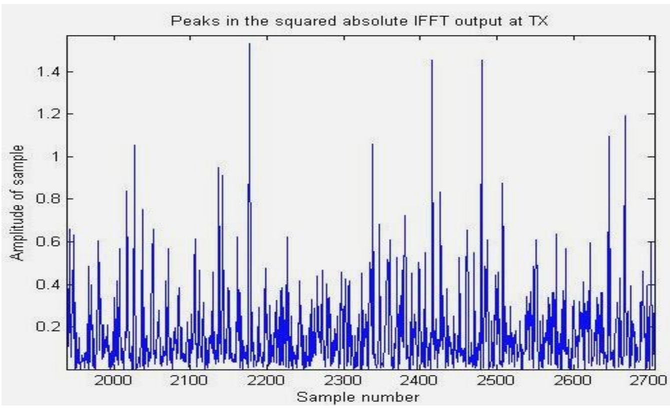

Figure 7. Successive peak Results pertain to Squared Absolute transmit symbols after IFFT showing peaks without PAPR suppression

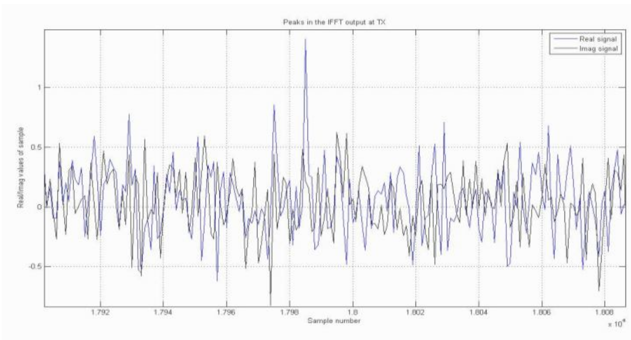

Figure 8. Successive peak Results pertain to transmit symbols after IFFT showing peaks without PAPR suppression

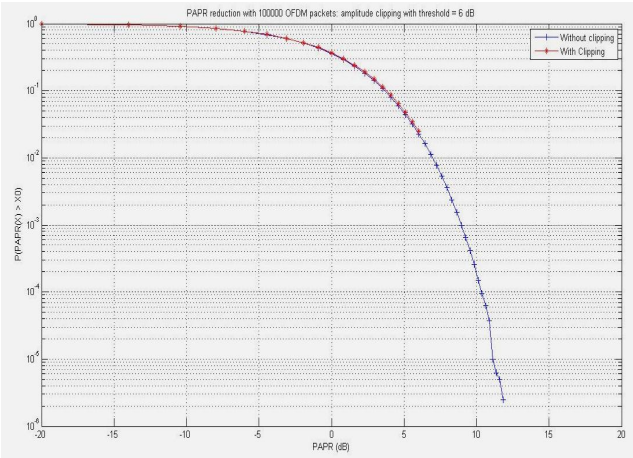

Figure 9. The performance of OFDM PAPR with Without Reduction Amplitude Clipping.

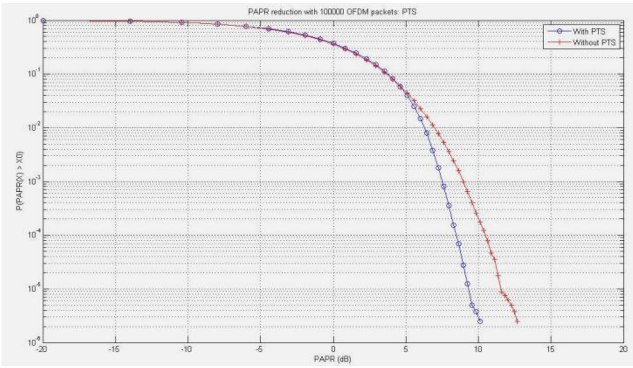

Figure 10. OFDM PAPR With Without Reduction Partial transmit sequence (PTS) combined

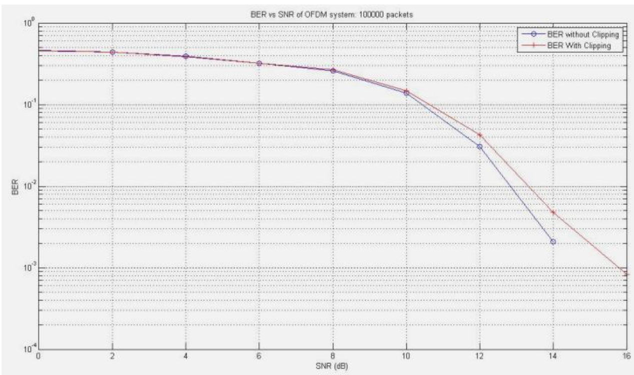

Figure 11. BER performance with clipping Simulations support the use of the variance of the posterior red colour as an indicator of when the OFDM system in With Clipping BER vs SNR. It is here compared with the actual error in the simulations blue colour .OFDM Without Clipping BER vs SNR

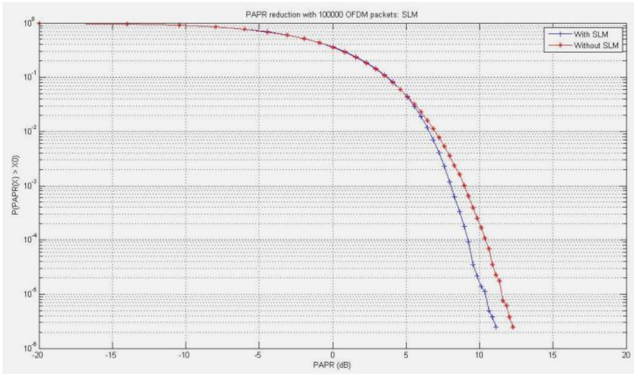

Figure 12. OFDM PAPR With Without Reduction Partial Transmit Sequence (SLM)

V. COMPARISON BETWEEN THREE PAPR REDUCTION TECHNIQUES:

To make a fair comparison between the three PAPR reduction techniques PAPR at CCDF of 10-3 and 10-5 is listed in

Table 1: Comparison between the three PAPR reduction techniques PAPR at CCDF of 10^{-3} and 10^{-5}

Reduction Techniques	PAPR at CCDF of	Conventional PAPR(dB)	Proposed PAPR (dB)	Difference of PAPR Reduction (dB)
Clipping Technique	10^{-3}	8.94	6	2.94
	10^{-5}	11.1	6	5.1
Selected Mapping	10^{-3}	9	8.1	0.9
	10^{-5}	11.1	10.4	0.7
Partial Transmit Sequence	10^{-3}	8.93	7.5	1.43
	10^{-5}	12.6	10	2.6

Table 2: gives the comparison on Performance measure of PAPR Reduction Technique.

Name of schemes	**Name of parameters**				
	Distortion Less	**Power Increase**	**Data rate Loss**	**Computational Complexity**	**Distortion Less**
Amplitude clipping	No	No	No	Amplitude Clipping	none
Partial Transmit Sequence (PTS)	Yes	No	Yes	M IFFTs ,WM-1complex vector sums	Side information extraction, inverse PTS
(SLM)	Yes	No	Yes	U IFFTs	Side information extraction, inverse SLM

VII. CONCLUSION

The high throughput OFDM signal high PAPR problems are solved by the proposed methods of Modified Interleaving technique, Modified Selected Mapping technique, Modified Partial Transmit Sequences technique and Modified Tone Reservation technique. The analysis based on varying the number of subcarriers, transmit antennas and users indicated that the proposed technique has the high PAPR reduction capability compared with the conventional techniques. This grade is achieved at the cost of slight decrease in the data rate and a negligible degradation in the bit error performance of the system. With the help of proposed Modified Interleaving, Selected Mapping, Partial Transmit Sequences techniques BER degradations performance is improved. Based on PAPR reduction performance comparison, Modified Tone Reservation provides the best result.

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