Performance Evaluation of PAPR Analysis for Confined Beamforming MIMO OFDM system

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***Abstract*— HPA is usually operated at or near the saturation region. OFDM signal amplitudes is very wide with high PAPR. HPA will introduce inter-modulation between the different subcarriers and introduce additional interference into the systems due to high PAPR of OFDM signals thus increases the BER.High precision DAC supports high PAPR with a reasonable amount of quantization noise, but it might be very expensive for a given sampling rate of the system. A low-precision DAC would be cheaper, but its quantization noise will be significant.A better solution is to reduce the PAPR of the transmitted signal with some manipulations of the OFDM signal itself.**

Keywords—DAC,PAPR,OFDM & BER

I.INTRODUCTION

Multiple input Multiple output orthogonal frequency division multiplexing (MIMO OFDM) is extensively used in present and next generation broadband wireless communications, because it can provide high data rate transmission over multipath fading channels [1][2]. Among the MIMO techniques, beam forming (or preceding) has been generally adopted communication standards, e.g., LTE, Wi-MAX and Wi-Fi applications, because it can achieve full diversity, which results in a reliable transmission. It is known that OFDM systems suffer from high peak-to average power ratio (PAPR). High PAPR leads to high attempt in conniving the power amplifier (PA) in order to keep a wide linear region for preventing signal clipping, which therefore increases not only hardware complexity but also power consumption.

The PAPR issue is bad when beamforming is applied in OFDM systems, because the dynamic range of the signals increases after beamforming. Many methods have been proposed for reducing the PAPR including deliberate clipping, companding, probabilistic methods, and coding, these methods may more or less distort signals and the data rate. For example, the most straightforward PAPR reduction method is via clipping peak signals before transient them to the PA .However, clipping induces inband and out of band distortion and requires additional signal processing techniques to reconstruct the received signals. Another category of methods to reduce the PAPR is through probabilistic schemes such as partial transmit sequence (PTS selected mapping (SLM) and sign adjustment The objective of probabilistic methods is to reduce the probability that peak power exceeds a certain PAPR for matter will need to create these components. subsequently generation broadband wireless communication require- swifter data processing (low complexity), higher data rate, and stronger (robust) performance. The broadband channel is a typically non-line-of-sight channel and includes many impairments such as time-selective and frequency-selective fading. To address these challenges, one promising solution is to combine two powerful technologies, namely, multiple-input multiple-output (MIMO) antennas and orthogonal frequency division multiplexing (OFDM) modulation.

II.ANALYSIS OF PEAK TO AVERAGE POWER RATIO

MRT OFDM systems generally perform much worse than EGT OFDM systems in terms of PAPR, PAPR reduction algorithms are proposed for both MRT OFDM and EGT OFDM systems. It is worth to mention that for MRT OFDM systems, algorithm can improve both PAPR and bit error rate; for EGT OFDM, algorithm improves PAPR while it only slightly degrades bit error rate. In this paper, we analyze the PAPR performance for single user MIMO OFDM systems adopting either one of the two most commonly used beamforming schemes, i.e., maximum ratio transmission (MRT) and equal gain transmission(EGT) [MRT is the optimal beamforming scheme interms of receive SNR, but the PA design for MRT is more complicated than EGT. It has been shown that the maximum SNR loss between MRT and EGT is only 1.05 dB fading channels. Two types of average power: one is block average power and the other is long-term average power the block average power is the average power of an OFDM block at a specific transmit branch. The baseband PAPR of the beamforming OFDM system is defined as

$$\max_{0\le i\le M_{t-1}}\left\{PAPR^{(i)}\right\}=\max_{0\le i\le M_{t-1}}\left\{\max_{0<t\le T}\frac{S^{(i)}(t)^2}{\bar{P}_{av}}\right\}$$

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III MAXIMUM RATIO TRANSMISSION (MRT)

MRT is the optimal beamforming scheme in conditions of receives SNR, but the PA design for MRT is more difficult than EGT. It has been shown that the maximum SNR loss between MRT and EGT is only 1.05 dB under Rayleigh fading channels. It is importance to emphasize that, unlike Conventional PAPR reduction methods, there is no need to send side information from the transmitter to the receiver in the proposed algorithms. In addition, for MRT OFDM systems, the proposed algorithm not only can reduce the PAPR but also can improve the bit error rate performance. This satisfying result is obtained thanks to the motivation from the derived results. The proposed algorithm attempts to adjust the power at some subcarriers after beamforming as closely as possible. Since the subcarrier power is equalized in a certain level, both the PAPR and the bit error rate performance are improved simultaneously

IV EQUAL GAIN TRANSMISSION (EGT)

The proposed algorithm attempts to adjust the power at some subcarriers after beamforming as closely as possible. Since the subcarrier power is equalized in a certain level, both the PAPR and the bit error rate performance areimproved simultaneously. For EGT OFDM systems, the proposed algorithm can reduce the PAPR, while at the same time it only slightly degrades bit error rate performance. Finally, simulation results are provided to show the accuracy of the derived theoretical PAPR results and the performance improvement achieved when using the proposed PAPR mitigation algorithms.

V MIMO-OFDM SYSTEM

The combination of MIMO and OFDM has the potential of meeting this stringent requirement since MIMO can boost the capacity and the diversity and OFDM can mitigate the detrimental effects due to multipath fading. Block diagram of MIMO-OFDM system

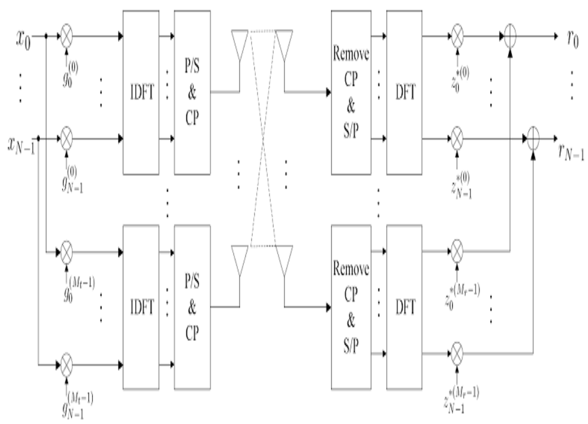

Fig 1 MIMO-OFDM system

$$a + b = \gamma \qquad (1)$$

VI BEAM FORMING

Beam forming techniques are used to create a certain required antenna directive pattern to give the required performance under the given conditions. Smart antennas are normally used - these are antennas that can be controlled automatically according the required performance and the prevailing conditions. Beamforming (or precoding) techniques have been widely adopted in modern MIMO OFDM systems. Using beamforming can significantly improve the receive SNR of OFDM systems

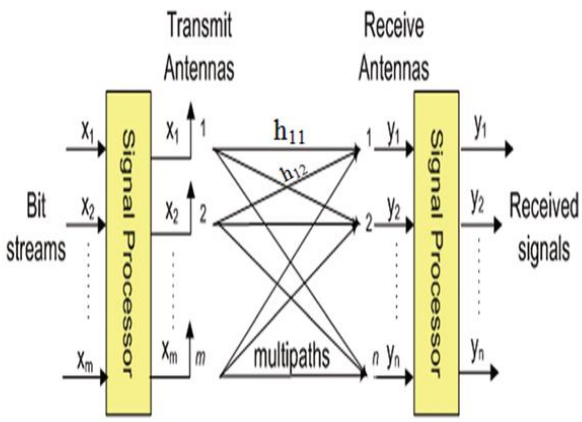

Fig 2 BEAM FORMING

VI SIMULATING 2X1 MRT AND EGT SYSTEM

- Step 1: produce random binary sequence of +1′s and -1′s.
- Step 2: Multiply the symbols with the beam steering matrices – corresponding to the phase of the channel.
- Step 3: Perform equalization at the receiver.
- Step 4: Perform hard decision decoding and count the bit errors.
- Step 5: Repeat for multiple values of Eb/No and plot the simulation result for BER v/s SNR.
- For MRC
- Step 1: Generate random binary sequence of +1′s and -1′s.
- Step 2: Multiply the symbols with the channel and then add white Gaussian noise.
- Step 3: Chose that receive path, equalize the received symbols per maximal ratio combining.
- Step 4: Perform hard decision decoding and count the bit errors
- For EGC
- Step 5: Generate random binary sequence of +1′s and -1′s.
- Step 6: Multiply the symbols with the channel and then add white Gaussian noise.

- Step 7: At the receiver, for each receive path, equalize by compensating with the known channel phase
- For EGC
- Step 8: Accumulate the equalized symbols from all the receive paths.
- Step 9: Perform hard decision decoding and count the bit errors.

Step 10: Repeat for multiple values of Eb/No ranging from 0 to 25, for different values of number of receive antenna and plot the simulation result BER v/s SNR

VII RESULTS

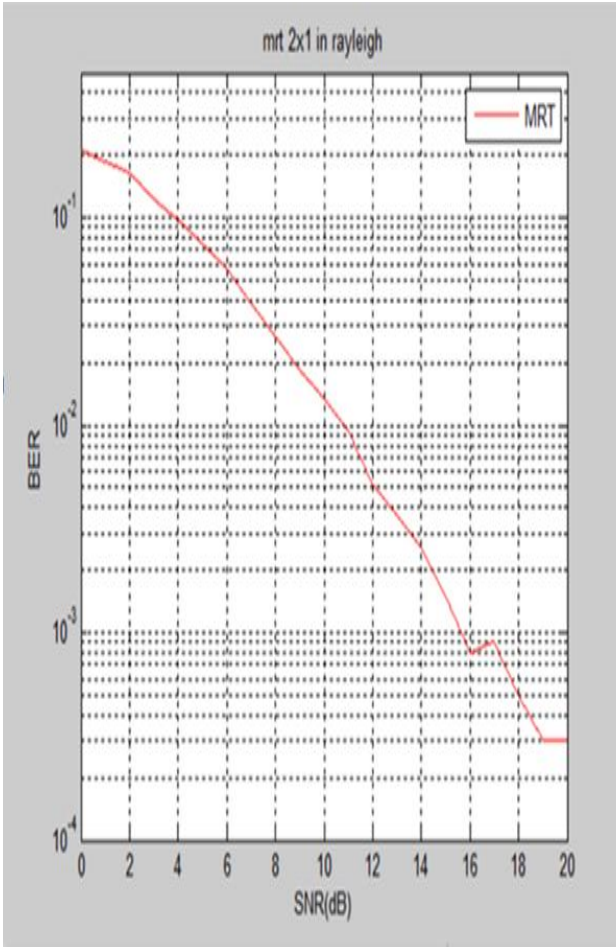

Fig 3 MRT

A MIMO 2x1 system is implemented with MRT and EGT Beamforming techniques

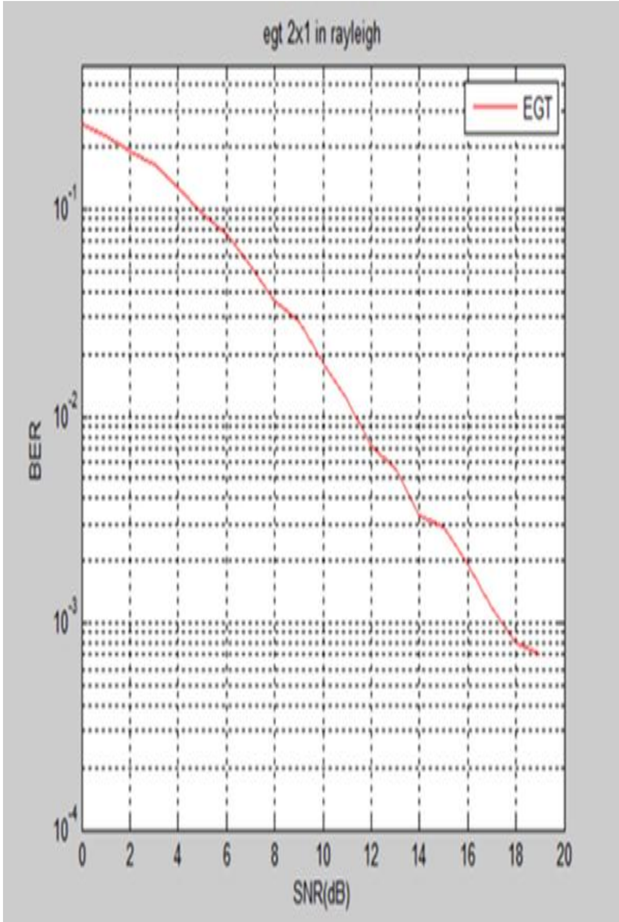

Fig 4 EGT

VII CONCLUSION

The system performance depends highly on signal-to-interference-plus noise ratios (SINR) at the receiver. It is found that using beamforming in MIMO systems significantly increases the receive SNR. between the two popular optimal beamforming techniques, Maximum ratio transmission (MRT) and Equal gain transmission (EGT), performance of MRT is optimal compared to EGT in terms of SNR. For a value of BER 10^{-3} the enhancement in SNR is around 3dB. It is also establish that for the two combining techniques, Maximum ratio combining (MRC) and Equal gain combining (EGC), the performance of the former is better than the latter in terms of BER. Also with an increase in the number of receive antenna the mandatory signal to noise ratio of the system decreases.

VIII FUTURE SCOPE

To conclude this thesis, following are some points that may lead to some better and interesting results. The study can be extended in the future in following possible directions:

The work can be further extended for different types of Beam forming techniques.

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