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MIMO-OFDM DOWNLINK WIRELESS SYSTEM WITH REDUCED PAPR

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Abstract- Orthogonal Frequency Division Multiplexing (OFDM) is a multi -carrier transmission method which is most broadly used in the field of communication. One of the main drawback of this scheme is Peak to Average Power Ratio (PAPR). There are various methods introduce for the reduction of PAPR in OFDM . However these technique have major disadvantage that they reason non -linear in-band deformation and out-of-band emission, this reduces the scheme throughput. Thus,Multi-Input and Multi output , which is the proposed technique discussed in our declaration overcome this trouble. In this method, we replace some of the broadcast data symbols by nulls, i.e. we introduce errors in the transmitted signal. At the receiver, an iterative decoder is used to correct the purveyor and channel errors. particularly, we suggest to together carry out MU precoding, OFDM cadence, and PAR lessening by solving a convex optimization trouble. We develop a matching fast iterative truncation algorithm (FITRA) and show mathematical results to show marvelous PAR-reduction competence. The appreciably summary linearity supplies ultimately permit the use of cut-rate RF components for the large-scale MU-MIMO-OFDM system.

Keywords: OFDM, PAPR, Switching and Shifting of Null Sub-Carriers

INTRODUCTION

After more than thirty years of research and growth carried out in the field of communication OFDM has been widely implemented in high speed digital communication [1]. OFDM has its major benefits of higher data rates and better presentation. The higher data rates are achieved by use of multiple carriers and presentation improved by use of guard interval which leads to removal of put in the ground Symbol intrusion (ISI) [2]. OFDM has several features which makes it more advantageous for high speed data transmission. These features include High Spectral competence, strength to Channel Fading, and protection to Impulse Interference, litheness and Easy Equalization. In spite of these benefits there are some drawback such as PAPR, Offset occurrence and Inter Carrier meddling (ICI) between sub-carriers [3]. Practical wireless channels typically exhibit frequency selective fading and a low-PAR precoding solution suitable for such channels would be desirable. rather, the explanation should be such that the complexity required in each (mobile) terminal is small (due to stringent area and authority constraints), whereas heavier allowance could be afforded at the BS. Orthogonal frequency-division multiplexing (OFDM) [8] is an efficient and well-established way of commerce with regularity selective channels. In addition to simplify the equalization at the receiver, OFDM also facilitate per-tone authority and bit allocation, development in the occurrence domain, and band influential. However, OFDM is known to suffer from a high PAR [9], which necessitate the use of linear RF mechanism (e.g., power amplifiers) to avoid out-of-band emission and signal distortions. regrettably, linear RF workings are, in general, more costly and less power efficient than their non-linear counterparts, which would sooner or later result in exorbitant costs for large-scale BS implementations having hundreds of antennas. Therefore, it is of paramount end result to reduce the PAR of OFDM-based large-scale MU-MIMO s to facilitate parallel low-cost and low-power BS implementations.

Contributions

In this paper, we increase a novel system broadcast scheme for large-scale MU-MIMO-OFDM wireless s, which only affects the indicator giving out at the BS while departure the meting out compulsory at each workstation undamaged. The key idea of the wished-for scheme is to exploit the surfeit of degrees-of-freedom (DoF) offered by equip the BS with a large number of antennas and to *jointly* perform MU precoding, OFDM modulation, and PAR reduction, referred to as PMP in the remnants of the paper. Our contributions can be summarize as follows: • We formulate PMP as a convex optimization problem, which in cooperation performs MU precoding, OFDM modulation, and PAR reduction at the BS. •

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We enlarge and examine a novel optimization algorithm, referred to as fast iterative truncation algorithm (FITRA), which is able to find the solution to PMP efficiently for the (typically large) extent arising in large-scale MU-MIMO-OFDM s. • We present numerical reproduction results to make obvious the capability of the proposed MU-MIMO-OFDM system extend scheme. Specifically, we analyze the trade-offs between PAR, error-rate performance, and out-of-band radiation, and we present a comparison with conventional preceding schemes. b. Notation lowercase bold-face writing for column vectors and upper-case bold-face letters select matrix. The M×M distinctiveness matrix is denoted by Im. The M×N all zeros matrixes by 0m×n. and Fm refers to the M×M discrete Fourier transform(DFT) matrix.

Outline of the Paper

The remainder of the document is organized as introduces the model and summarize important PAR-reduction concepts. The proposed system transmission scheme is detailed and the fast iterative truncation algorithm (FITRA) is developed.

PEAK TO AVERAGE POWER RATIO

PAPR Problem

One of the new problems emerging in OFDM s is the so-called Peak to Average Power Ratio (PAPR) problem. The input symbol watercourse of the IFFT should have a uniform power spectrum, but the output of the IFFT may result in a non-uniform or spiky power spectrum. Most of transmission energy would be allocated for a few instead of the majority subcarriers. This problem can be quantified as the PAPR measure. It causes many problems in the OFDM at the transmitting end.

Effect of PAPR

There are some obstacles in using OFDM in transmission in contrast to its advantages :
(i) A major obstacle is that the OFDM signal exhibits a very high Peak to Average Power Ratio (PAPR).
(ii) Therefore, RF power amplifier should be operated in a very large linear region. Otherwise, the signal peaks get into non-linear region of the power amplifier causing signal distortion. This signal deformation introduces intermediation among the subcarriers and out of band radiation. Thus, the power amplifiers should be operated with large authority back offs. On the other hand, this leads to very inefficient intensification and expensive transmitters. Thus, it is highly desirable to decrease the PAPR.
(iii) These large peaks cause saturation in power amplifiers, leading to inter modulation products among the subcarriers and disturbing out of band energy. Therefore, it is desirable to reduce the PAPR.

POPOSED TECHNIQUES

PAPR Reduction Techniques

The PAPR is painstaking as one of the major disadvantage in the multicarrier communication s. In order to reduce and eliminate these problems many different methods are future. These methods are classified into various categories. All the proposed method mainly aim at reducing the PAPR as much as possible and along with it they take care not to interrupt and perturb the other parts of the . The algorithms considered while diminution should not be intricate and easily implementable. Following are the category of PAPR reduction.

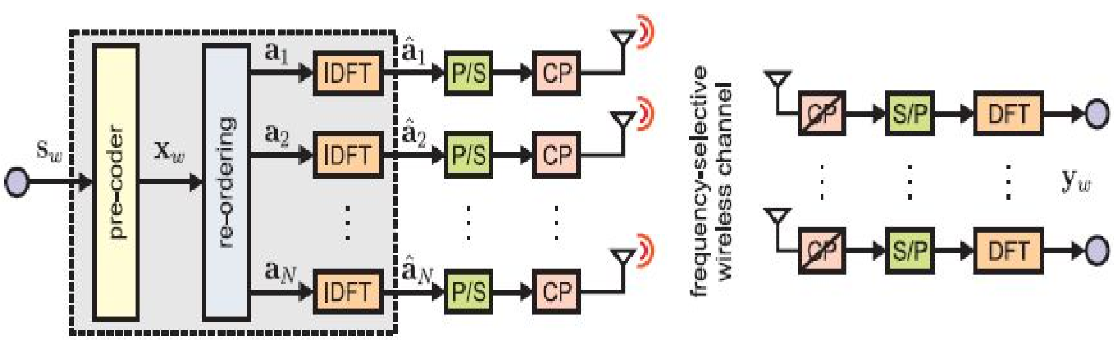

Fig 1 shows Large-scale MU-MIMO-OFDM system (left: BS with *N* transmit antennas; right: *M* independent single-antenna terminals). The proposed system transmission scheme, referred to as PMP, combines MU precoding ,OFDM modulation, and PAR reduction.

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Transparent Methods

In this category the receiver does not know about the method that the bringer has applied. The same thing takes place when it comes to the receiver. The bringer also does not necessarily know regarding the method that the receiver is using.

Clipping

The technique with the lowest complication is the article technique. In the excerpt system, simply clip the high amplitude peaks. Some of these techniques use digital clipping, i.e. the signal is brusque at the output of the inverse discrete Fourier transform without any oversampling. This causes regrowth of the signal peaks after the subsequent interpolation. To avoid the signal re-growth some techniques clip the indicator after interpolation and subsequently use a filter to reduce the consequential out-of-band spectral leakage. In addit ion they cause peak regrowth and result in significant distortion of the wanted signal.

Tone Reservation

In the tone reservation method [5] the orthogonality between the different subcarrier is exploited to generate the peak lessening signal. In the OFDM not all subcarriers are used for data transmission. Some of them are reserved for the reduction signal. Due to the fact that all subcarrier are orthogonal the signal generate by the reserved tones does not concern the data carrying tones. In the tone reservation method both transmitter and receiver know the set of data carryin subcarriers. The creation of the reduction signal can be done in different ways with different complexities. The PAPR decrease method using tone stipulation method can be transformed into a convex optimizat ion problem. Advantages of tone stipulation include among other no side in sequence and low complexity.

Active Constellation Extension

The lively constellation addition method [5] future is an extension of the tone injection method for PAPR reduction. Here only the points at the constellation boundary have multiple representations and these points container be moved wherever. The advantage with this method is that the decision regions for the receiver are not varying, so neither receivers nor the standard have to be changed. In s that have very bulky constellation only a small part of the constellations is placed on the edges and there are fewer possibilit ies to move the points on the group limits, in these cases the reduction performance is low. As known above, the IEEE 802.11a normal [7] employs null sub-carriers at specific position. In switching algorithm two null sub-carriers are switched with two other carriers which are carrying in turn. There are many combinations possible. We have to try all combinations in order to get minimum PAPR, which is our ultimate aim. Thus to dig awake all mixture two nested 'for' loops are used. After each amalgamation the PAPR is considered and compared to the up to that time calculated PAPR value. Here the minimum PAPR value is retain (The PAPR min value is initially set to 0 db.). After all combination are pooped we are finally left with one amalgamation for a meticulous symbol which has the minimum PAPR value. This combination is later transmit. This development is carried out for rest of the symbols.

Shifting Null sub-carriers

For 16-QAM, the total number of sub-carriers is 64.
According to the IEEE 802.11a standard among the 64 subcarriers- the first 6 sub-carriers, the last 5 sub-carriers and the sub-carrier at position '33' should all be null carriers . Apart from the null sub-carriers the remaining sub-carriers contain modulate data before introducing it to inputs of IFFT. The fundamental concept of the Shifting algorithm is that the null sub-carriers are essentially shifted to the positions of data sub-carriers. Now, all the null sub-carriers from furthermore of the two sides – low frequency edge or high frequency border shouldn't be shifted since they also serve as guard band. Thus it is advisable to use only one null subcarrier from each side of low frequency and high occurrence edge. The null sub-carrier at position below should be left unaltered since it serves to avoid DC energy. According to the future Shifting method, the 6th null sub-carrier, from the low frequency edge is switched with every other data sub-carrier in positions and null sub-carrier from the high occurrence edge is switch through every other data sub-carrier in positions.

Implemented version of Shifting Null sub-carriers

According to the proposed method, the 6th null sub-carrier from the low frequency edge is switched with the 7th position which is a data subcarrier. Then from the higher frequency edge the 60th unacceptable subcarrier is switched with the 59th position data sub-carrier. IFFT operation is performed. PAPR is then calculated for this arrangement of data and null sub-carriers. This PAPR value is stored in a variable where only the minimum value is stored. This variable can be assumed as "minPAPR".

SIMULATION RESULTS

In this section, we demonstrate the efficacy of the future joint precoding, modulation, and PAR drop

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approach, and provide a comparison to conventional MU precoding schemes.

Simulation Parameters

Unless explicitly stated otherwise, all simulation results are for a MU-MIMO-OFDM having $N = 100$ antenna at the BS and serving $M = 10$ single-antenna terminals. We employ OFDM with $W = 128$ tones and use a spectral map T as specified in the 40MHz-mode of IEEE 802.11n [20].10 We consider coded transmission, i.e., for each user, we independently encode 216 information bits using a convolution code (rate-1/2, generator polynomials [133*o* 171*o*], and constraint length 7), apply random interleaving (across OFDM tones), and map the coded bits to a 16-QAM constellation (using Gray labeling). To implement (PMP-L), In addition to LS and MF precoding, we also consider the performance of a baseline precoding and PAR-reduction method. To this end, we make use of LS precoding followed by truncation (clipping) of the entries of the time-domain samples $\hat{\mathbf{a}}n$, $\forall n$. We use a clipping strategy where one can state a target PAR, which is then used to compute a clipping level for which the PAR
in (4) of the resulting time-domain samples is no more than the chosen target PAR.

Performance Measures

CCDF computes the authority complementary cumulative distribution (CCDF) function from a time area signal. The CCDF curve shows the amount of time a signal spends above the average control level of the deliberate signal, or equivalently, the probability that the signal power will be above the average power level. To compare the PAR characteristics of different precoding schemes, we use the complementary cumulative distribution function (CCDF) defined as

$$\mathbf{CCPF(PAR) = P\{PAR_n > PAR\}}$$

We furthermore define the "PAR performance" as the maximum PAR level PAR$*$ that is met for 99% of all transmitted OFDM symbols, i.e., given by CCDF(PAR$*$) = 1%. The error-rate performance is measured by the average (across users) symbol-error rate (SER); a symbol is said to be in error if at least one of the information bits per received OFDM symbol is decoded in error. The "SNR operating point" corresponds to the minimum SNR required to achieve 1% SER. In order to characterize the amount of signal power that is transmitted outside the active tones.

Summary of PMP Properties

Figures 2 and 3 summarize the key characteristics of PMP and compare its PAR-reduction capabilities and error-rate performance to those of LS and MF precoding, as well as to LS precoding followed by clipping (denoted by "LS+clip" in the following). the real part of a time domain signal $\hat{\mathbf{a}}1$ for all precoding schemes (the imaginary part behaves similarly). Clearly, PMP results in time-domain signals having a significantly smaller PAR than that of LS and MF; for LS+clip the target PAR corresponds to 4 dB. The frequency-domain results. the PAR-performance characteristics for all considered precoding schemes. One can immediately see that PMP reduces the PAR by more than 11 dB compared to LS and MF precoding (at CCDF(PAR) = 1%); as probable, LS+snip achieves 4 dB PAR deterministically. In order to maintain a constant transmit power, the signals resulting from PMP require a stronger normalization (roughly 1 dB) than the signals from LS precoding; this performance causes the SNR-performance loss compared to LS The performance loss of MF and LS+clip is mainly caused by residual MUI. It is important to realize that even if LS+clip outperforms PMP in terms of the equivalence/SNR trade-off in the high-PAR regime, LS+clip results in substantial out-of-band interference; this important drawback is a result of ignore the shaping constraints (7). In meticulous, we can observe from that dipping the PAR for LS+clip quickly results in significant OBR, which renders this scheme useless in practice. By way of difference, the OBR of PMP is significantly lower and degrades gracefully when lowering the PAR. Furthermore, we see that reducing the maximum number of FITRA iterations K increases the OBR. Hence, the regularization parameter λ together with the maximum number of FITRA iterations K determine the PAR. In this communication may be used for data transmission for source to destination to reduction of peak average power ratio. In an modulation technique is modulation is a process in which the characristics of a carrier wave is varied in accordance with the instant nous principles of a message signal or modulating signal. In this proposed may be alive used for the reduction of PAPR by using multi input and multi output communication technique. In this process by using orthogonal frequency de-multiplexing technique is used for large band width communication for transmission and receiver section. In main advantage of BER rate decreases the both transmission and reception for a communication process.In filtra algoritham may be used for to reduced the bit error rate for a digital communication systems. For complementary cumulative distribution function may be used for to quantity time signal spends probability that the signal power average power height cor PAR reduction for multi input and multi output system technique for using now adays communication orthogonal FDM system. The OFDM system used for long distance communication source to distination. This substantially alleviates the linearity requirements of the radio-frequency (RF) components. Furthermore, PMP only affects the signal processing at the BS and can therefore be deployed in existing MIMO-OFDM wireless communications. Facilitates an explicit trade-off between PAR, SNR performance, and out-of-band interference for the large-scale MU-MIMO-OFDM system.

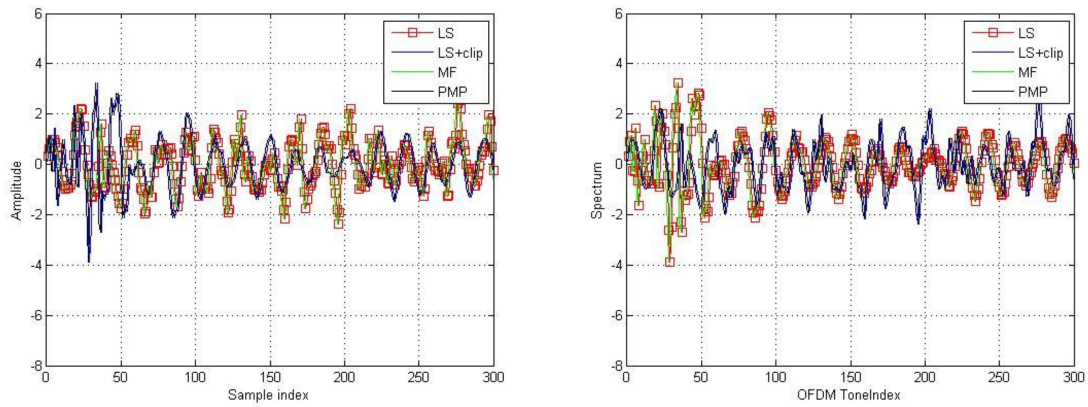

Fig 2 shows Time/frequency representation for different precoding schemes. The target PAR for LS+clip is 4 dB and $\lambda = 0.25$ for PMP relying on FITRA. (a) Time-domain signals (PAR: LS = 10.4 dB, LS+clip = 4.0 dB, MF = 10.1 dB, and PMP = 1.9 dB). Note that PMP generates a time-domain signal of substantially smaller PAR than LS and MF. (b) Frequency-domain signals (OBR: LS = $-\infty$dB, LS+clip = -11.9 dB, MF = $-\infty$dB, and PMP = -52.9 dB). Note that LS, MF, and PMP preserve the spectral properties. LS+clip suffers from substantial OBR (visible at both ends of the spectrum).

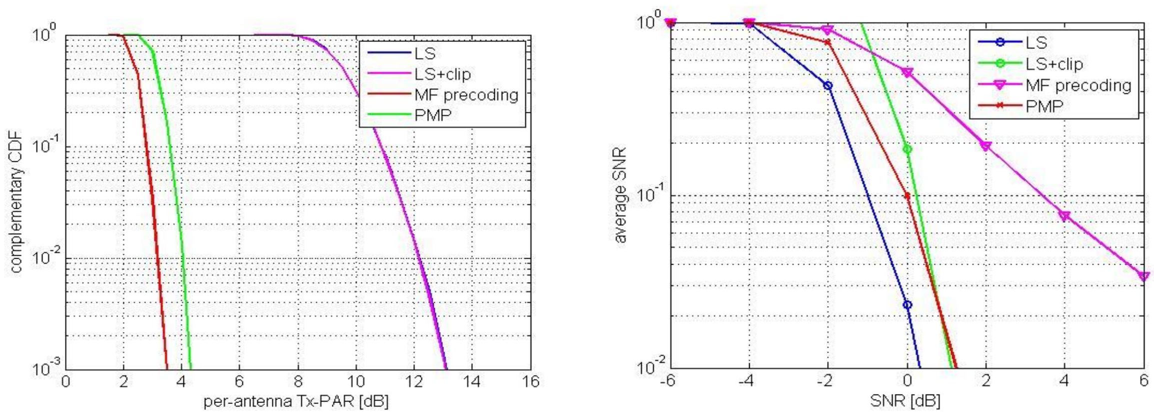

Fig 3 shows PAR and SER performance for various precoding schemes. The target PAR for LS+clip is 4 dB and $\lambda = 0.25$ for PMP relying on FITRA. (a) PAR performance (the curves of LS and MF overlap). Note that PMP effectively reduces the PAR compared to LS and MF precoding. (b) Symbol error-rate (SER) performance. Note that the signal normalization causes 1 dB SNR-performance loss for PMP compared to LS precoding. The loss of MF is caused by residual MUI; the loss of LS+clip is caused by normalization and residual MUI.

CONCLUSIONS AND OUTLOOK

The proposed joint precoding, modulation, and PAR reduction framework, referred to as PMP, facilitates an explicit trade-off between PAR, SNR performance, and out-of-band interference for the large-scale MU-MIMO-OFDM system. As for the constant-envelope precoder in [7], the fundamental motivation of PMP is the large number of DoF offered by s where the number of BS antennas is much larger than the number of terminals (users). Essentially, the system channel matrix has a high-dimensional null-space, which enables us to design transmit signals with "hardware-friendly" properties, such as low PAR. In particular, PMP yields perantenna constant-envelope OFDM signals in the large-antenna limit, i.e., for $N \rightarrow \infty$. PMP is formulated as a convex optimization problem for which a novel efficient numerical technique, called the fast iterative truncation algorithm (FITRA), was devised. Numerical experiments showed that PMP is able to reduce the PAR by more than 11 dB compared to conventional precoding methods, without creating significant out-of-band interference;

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this substantially alleviates the linearity requirements of the radio-frequency (RF) components. Furthermore, PMP only affects the signal processing at the BS and can therefore be deployed in existing MIMO-OFDM wireless communication s, such as IEEE 802.11n [20]. In addition to the extensions outlined in Section III-D, there are many possibilities for future work. Analytical PAR performance guarantees of PMP are missing; the development of such results is challenging and part of ongoing work [33]. over, a detailed analysis of the impact of imperfect channel state information on the performance of PMP is left for future work. Finally, further reducing the computational complexity of FITRA, e.g., using continuation strategies [32], is vital for a practical realization of PMP in hardware.

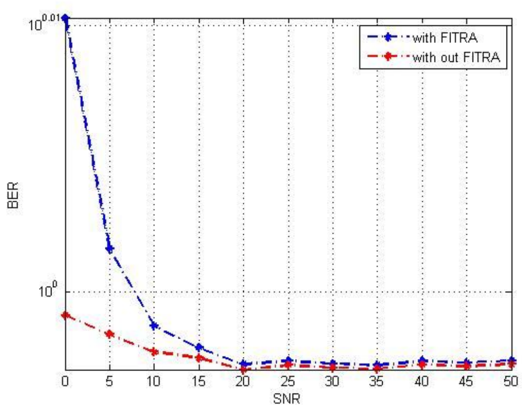

Fig 4 shows PAR performance of PMP and LS precoding depending on the number of transmit antennas *N* and the number of non-zero channel taps *T*; the number of users M = 10 is held constant and λ = 0.25 for PMP relying on FITRA. (The curves for LS precoding overlap.).

CONCLUSION

To reduce the PAPR of multi-carrier transmission, this wished-for scheme reorders the null-subcarriers and data subcarriers. This new method shifts the "innermost" null sub - carriers among different data-subcarriers to minimize the PAPR. The proposed method is deformation less, does not affect the constellation at the data-subcarriers, maintains better PAPR reduction and BER reduction performance while keeping low computational complexity, needs less CSI, can collaborate with most other PAPR-reduction methods, and can be compatible with existing standards. The Shifting/Switching method can also be fond of with other PAPR reduction techniques since the conventional methods do not alter the null sub-carriers which are used in the shifting process.

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