A Study on PAPR Reduction in OFDM Wireless Systems

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Orthogonal Frequency Division Multiplexing (OFDM) has well known advantages such as robustness against frequency selective fading and narrowband interference, high efficiency on bandwidth, and efficient implementation. Recently, OFDM has been widely used in digital audio broadcasting (DAB), digital video broadcasting-terrestrial (DVB-T), mobile multimedia access communication (MMAC), IEEE802.11a/g/n, IEEE802.16 and IEEE 802.20.

A major drawback of OFDM is a large peak to average power ratio (PAPR) which causes a nonlinear distortion. Owing to a large PAPR, the bit error rate (BER) performance of an OFDM system becomes degraded. Several techniques to reduce PAPR have been proposed. These techniques are known as amplitude clipping and filtering, peak cancellation, coding, interleaving, selective mapping (SLM), tone reservation (TR) and tone injection (TI), active constellation extension (ACE), partial transmit sequence (PTS) approach and cascade adaptive peak power reduction (CAPPR) approach. Among these conventional methods, PTS and CAPPR have been considered as high efficient PAPR reduction methods. However, it is difficult to get large PAPR reduction only by using PTS. On the other hand, CAPPR cannot suppress out-of-band radiation where PTS realizes lower out-of-band radiation than CAPPR.

This thesis proposes a new PAPR reduction technique. This technique employs the hybrid of PTS and CAPPR methods with coded side information (SI) technique. A
proposed reduction method realizes both the advantages of PTS and CAPPR at the same time. In order to obtain the optimum condition on PTS for PAPR reduction, a quite large calculation cost is demanded and thus it is impossible to obtain the optimum PTS in a short time. In the proposed method, by using the pseudo-optimum condition based on a genetic algorithm (GA) coded SI technique, the total calculation cost becomes drastically reduced. In simulation results, the proposed method shows the improvement on PAPR and also reveals the high performance on bit error rate (BER) of an OFDM system.

Thesis Overview:

In chapter 1, the author describes the summary and thesis overview.

In chapter 2, the author describes the overview of OFDM systems, i.e., conventional OFDM, communication channel, the IEEE 802.11 and HIPERLAN/2, PAPR of an OFDM signal and high power amplifier.

In chapter 3, the author describes some of PAPR reduction techniques for OFDM system including major advantages and drawbacks of the existing methods. These techniques have been known as amplitude clipping and filtering, peak cancellation, coding, interleaving, selected mapping, tone reservation, tone injection, active constellation extension, adaptive peak power reduction, partial transmit sequence and cascade adaptive peak power reduction.

In chapter 4, the author proposes a new PAPR reduction technique. This technique is based on a hybrid algorithm of the PTS and APPR methods. In the proposed method, for the first PAPR reduction, an input data block is partitioned into disjoint sub-blocks. The sub-carriers in each sub-block are weighted by phase rotations. The modified input data are then fed to APPR process. It reduces modulation signals over a predefined range. In simulation results, shown the PAPR and BER performance of the original signal, conventional method and the proposes method.

In chapter 5, the author proposes a new PAPR reduction technique. This technique employs the hybrid of PTS and APPR methods with coded SI technique. In the proposed method, an input data block is partitioned into the disjoint sub-blocks of PTS. Additionally, a codeword which constructs the vector set of phase rotations is prepared. It is called a coded SI table. The sub-carriers in each sub-block are weighted by the phase rotations selected from a coded SI table. The modified input data are then fed to APPR process. The hybrid of PTS-APPR method needs the side information for recovering original data blocks at the receiver side. This chapter proposes a technique for sending data together with SI which is a codeword from a transmitter to a receiver. In simulation results, shown the PAPR and BER performance of the original signal, conventional method and the proposes method.

In Chapter 6, the author proposes a new PAPR reduction technique. This technique employs the hybrid of PTS and CAPPR methods with GA coded SI
technique. In the proposed method, an input data block is partitioned into the disjoint sub-blocks. Additionally, a codeword which constructs the vector set of phase rotations is prepared by using GA. It is called a coded SI table. The sub-carriers in each sub-block are weighted by phase rotations after the phase rotations are properly selected from a coded SI table. The modified input data are then fed to CAPPR process. In simulation results, shown the PAPR, BER and power spectrum density (PSD) performance of the original signal, conventional method and the proposes method.

In Chapter 7, the author presents the conclusion of the thesis.