International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

A Review of Performance Analysis of LDPC Coded PAPR Reduction Technique in OFDM System

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Abstract - *Orthogonal Frequency Division Multiplexing (OFDM) is used for many of the latest wide bandwidth and high data rate wireless systems including Wi-Fi, cellular telecommunications and many more. An OFDM signal has a noise like amplitude variation and has a relatively high large dynamic range, or Peak-to-Average-Power Ratio (PAPR). LDPC code is better among different techniques used to reduce high PAPR. In this review paper collected data about OFDM, PAPR and LDPC (Low Density Parity Check) code.*

Key Words: **OFDM, PAPR, LDPC**

1. INTRODUCTION

Wireless communication is one of the important aspects of long distance communication. Along with the progress in technology rapid changes has been achieved in the field of wireless communication. Recent advances in wireless communication systems have increased the throughput and reliability of wireless channels. But still the bandwidth and spectral availability demands are endless. Researches in this field show that OFDM has become the modulation choice for high data-rate communication systems. But OFDM has the disadvantage of having large fluctuations in signal amplitude which has resulted in a high Peak-to-Average-Power Ratio (PAPR).

High PAPR is a major drawback of multicarrier transmission system which leads to power inefficiency in RF section of the transmitter. The PAPR of an OFDM signal can be reduced in several ways: amplitude clipping and filtering, cyclic coding, partial transmit sequence, selective mapping, and multiple signal representation techniques. Among which, coding based approaches have inherent error control capability and simplicity of implementation. But this approach has limitations like an exhaustive search to find the best codes and to store large lookup tables for encoding and decoding.

Among a variety of PAPR reduction techniques, the partial transmit sequence (PTS) scheme has attracted a lot of attention since it introduces no distortion in the transmitted signal and achieves significant PAPR reduction. However, the PTS phase factor information is required at the receiver as side information, which decreases the transmission efficiency or complicates the system design. LDPC code is a type of linear block codes. We are analyzing Low Density Parity Check (LDPC) code for PAPR reduction in OFDM systems with low searching complexity and good error correcting performance.

2. DATA COLLECTION

2.1 OFDM Signal Processing

The basic principle of OFDM is to split a high-rate data stream into a number of lower rate streams that are transmitted simultaneously over a number of sub-carriers. Because the symbol duration increases for the lower rate parallel sub-carriers, the relative amount of dispersion in time caused by multi-path delay spread is decreased. Inter symbol interference is eliminated almost completely by introducing a guard time in every OFDM symbol. In the guard time, the OFDM symbol is cyclically extended to avoid inter carrier interference.

In OFDM system design, a number of parameters are up for consideration, such as the number of sub-carriers, guard time, symbol duration, sub-carrier spacing, modulation type per sub-carrier, and the type of forward error correction coding. The choice of parameters is influenced by system requirements such as available bandwidth, required bit rate, tolerable delay spread, and Doppler values. Some requirements are conflicting. For instance, to get a good delay spread tolerance, a large number of sub-carriers with a small sub-carrier spacing is desirable, but the opposite is true for a good tolerance against Doppler spread and phase noise.

2.2 PAPR

The OFDM signal, which results from super imposition of many individual sinusoidal subcarriers, would have high amplitude, when these sinusoids are in phase at the IFFT input, and are thus added constructively to generate large amplitude corresponding to a high PAPR at the IFFT output.

The peak amplitude of OFDM signal could be N times that of a single carrier system, where N denotes the number of carriers. The mathematical representation of PAPR of an OFDM signal can be given as,

$$PAPR[x_n] = \frac{\max_{0 \le n < N} |x_n|^2}{E[|x_n|^2]}$$

Where E {. } denotes average power.

PAPR can be expressed in 'dB' as follows,

$$PAPR\ (dB) = 10 \log_{10} PAPR(x_n)$$

3. LITERATURE REVIEW

Eduardo and Leung [1] An experimental OFDM/FM system was implemented using unmodified commercial VHF FM radio equipment and a fading channel simulator. The BER and WER results obtained from the hardware measurements agreed closely with the results obtained using the numerical methods. This agreement shows that the EBC model can be used to accurately predict the performance of OFDM/FM systems. A subsequent paper will address several methods for improving the performance of OFDM/FM. These include switching diversity, forward error correction (FEC) coding and a decision feedback correction technique developed for OFDM.

Malik and Idrus [2] The optimum BER performance of OFDM signal can be improved by increasing the CR level and SNR value. The slightly drawback that exist by increasing the CR level is the minor growth in PAPR value. However, this PAPR value is greatly and significantly much lower than the not clipped OFDM signal. The OFDM signal with the reduction of PAPR value will boost up the OFDM popularity in the wireless telecommunication system network.

Manhas and Soni [3] Different channel coding (Linear/Cyclic block code) is applied on OFDM system using AWGN channel. It has been found that both BPSK and QPSK based OFDM system with cyclic block code has least value of BER as compared to Linear block code OFDM system with other digital modulation technique. Hence the result shows that cyclic block code BPSK/QPSK based OFDM has better BER value as compared to Linear block code OFDM system. So cyclic block code method of channel encoding is preferred in OFDM system as compared to linear block code.

Dey and Islam [4] Linear block coding based PAPR reduction technique is proposed for OFDM system which distributes input data to sub-block, uses the Hamming code sequences, changes phase of the modulated output resulting in significant performance gain in terms of PAPR reduction. PAPR reduction of approximately 3 dB was achieved. Additionally, the BER improvement of the proposed method is higher than of conventional method. The analysis and numerical results show that the proposed models can provide improved performance in BER and reduce PAPR of OFDM system.

Suriyakala and Thomas [5] There are many different methods proposed for the purpose of reducing the PAPR of an OFDM signal. The methods include Clipping, Partial Transmit Sequence, Selective Mapping and Coding. Amplitude clipping will reduce PAPR to desired value but as a result of this data loss will occurs. Partial Transmit Sequence and Selective Mapping techniques are distortion less PAPR reduction methods. Main drawback of these technique are searching complexity increases exponentially with the number of sub- blocks and its need to transmit the phase factor information as side information to the receiver to extract the original signal. Channel coding in OFDM system can effectively reduce the PAPR. Ease of implementation and inherent error handling capability are the key benefits of coding based PAPR reduction.

Han and Lee [6] Studied gradient-descent search is performed to obtain the phase factors. The PAPR statistic of the proposed technique is much better than that of the iterative flipping algorithm and is very close to that of the ordinary PTS technique with significantly reduced search complexity. The proposed technique can be an alternative solution for reducing the complexity of the ordinary PTS technique with little performance degradation.

Wang and Chen [7] Compared to the existing PAPR reduction methods, the ABC-PTS algorithm can get better PAPR reduction and significantly reduce the computational complexity for larger PTS sub-blocks at the same time. Moreover, because the ABC-PTS algorithm only has three control parameters, so it is easy to be adjusted. Simulation results show that the ABC-PTS algorithm is an efficient method which can provide a better PAPR performance.

Saadi and Guessoum [8] The search complexity of optimal combination of phase weighting factors is reduced at the same time as the number of samples required for PAPR calculation. Based on simulation results, it is shown that with the proposed suboptimal strategies, one can get with DE-PTS method a PAPR reduction performance close to that of an optimal PTS but with a significantly reduced computational complexity.

Omar Daoud [9] LDPC improves the reduction ratio over the turbo encoding. In addition, the technique presented has not only shown a significant reduction in PAPR, but also, implicitly, an improvement in BER without increasing the computational complexity. The simulation results have also shown that there is a further improvement (between 4% and 30%) in the PAPR performance when the spreading rate is increased to more than two but when compared to the extra complexity and extra hardware required to increase the spreading rate, it is necessary to question whether the trade-off is justifiable. This, of course, depends on the specific application and what coding rate and modulation method is used.

4. PROPOSED WORK

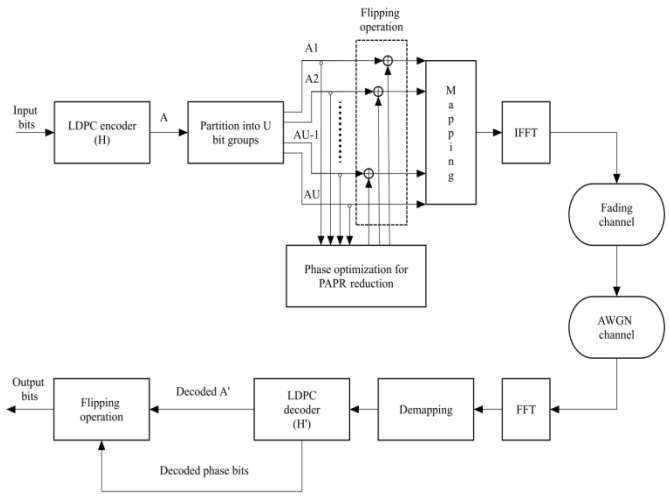

Fig -1: Block Diagram of PAPR reduction by flipping bit groups using LDPC

5. CONCLUSION

All the data regarding OFDM, PAPR, LDPC is collected. Through these reference papers it is clear that LDPC code technique is better than any other technique to reduce PAPR in OFDM.

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