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Experimental Analysis on Peak to Average Power Ratio Minimization by DFT Spread for Uplink Transmission

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ABSTRACT

With the advancement in wireless communication systems and the increase in demand for high data rates, Orthogonal Frequency Division Multiplexing (OFDM) has proved to be a key technology for the future 3G and 4G wireless communication system. OFDM offers a considerable high spectral efficiency, multipath delay tolerance, immunity to the frequency selective fading channels and power efficiency. However, one major disadvantage of OFDM system is the high PAPR (Peak to Average Power Ratio) of the transmitted signal. A number of techniques are employed to reduce PAPR ratio. In this paper, various techniques proposed for PAPR reduction techniques have been discussed along with the criteria of their selection. This paper provides an intuitive knowledge of the concept used with the comprehensive and comparative review of some PAPR reduction techniques.

Keywords: OFDM, IFFT, PAPR, PAPR reduction techniques, signal scrambling, signal distortion

1. INTRODUCTION

With the growing mobile radio communication systems, Orthogonal Frequency Division Multiplexing(OFDM) has been considered as the essence of most 4G communication systems fixed Wi-Fi system, mobile Wi-Fi system fixed WiMAX system mobile WiMAX system and Long Term Evolution (LTE system)[1]. OFDM is a Multi-carrier Modulation (MCM) scheme in which a large number of closely spaced orthogonal sub-carrier signals are used to carry data on several parallel data streams or channels. Unlike Frequency Division Multiple Access (FDMA), OFDM uses the spectrum much more efficiently by spacing the channels closer together. OFDM is a promising technology of the future communication system. Amongst all attractive advantages of OFDM, there are some disadvantages of OFDM like high PAPR (Peak to Average Power Ratio) and BER (Bit Error Rate).

The peak to average power ratio (PAPR) of a transmitted signal is one of main challenges in wideband multi-carrier systems that use orthogonal frequency division multiplexing (OFDM) or multipleinput multiple-output (MIMO) OFDM. In order to utilize the technical features of OFDM, it is necessary to analyze the characteristics of PAPR including its distribution and reduction in OFDM systems. The distribution of PAPR bears stochastic characteristics in OFDM system and can be expressed in terms of Complementary Cumulative Distribution Function (CCDF). Various approaches have been proposed to reduce PAPR which are classified into different approaches: clipping technique, coding technique, probabilistic (scrambling) technique, adaptive predistortion technique, and DFT-spreading technique. An effective PAPR reduction technique should give the best tradeoff between the capacity of PAPR reduction and transmission power, data rate loss, implementation complexity and Bit-Error-Ratio (BER) performance etc.

ECG signals are the representation of heartbeat values. To obtain a distortion less, accurate & error free signals we uptakes a filtering techniques by using several filters. Normally ECG signals used to get mixed with so many interferences. With these interferences we are analyzing with various filters along with the PSNR values. When these signals are analyzed the misleading happens, when it get mixed with background noise. The first aim is to remove the noise and go for analysis. In this project we have used many filters for noise removal & noise removed signal is given for analysis such as stress in the patient. Those signals are used for easy way of analysis. In this project we have taken a random noise in the addition of low frequency noise as HUM signal & high frequency noise. These noise are removed using S-Golay filter, Notch filter, Low Pass Butterworth filter, Smooth filter, Gaussian filter, Moving Average filter, Moving Weighted window, Median filter, FIR filter. The performance measures such as PSNR (Peak Signal to Noise Ratio) is calculated and determined.

2. DFT SPREADING

DFT SPREADING Before going into the DFT spreading technique, let us consider OFDMA[3]. Among the multiple access techniques associated with OFDM, OFDMA is one of the most useful approaches in the mobile cellular system. This is possible because in the condition of different signal to interference and noise ratios(SINRs) in different cells, users are allowed to select their own subset of subcarriers with better channel conditions, as given in Figure1,the DFT is taken as the same .

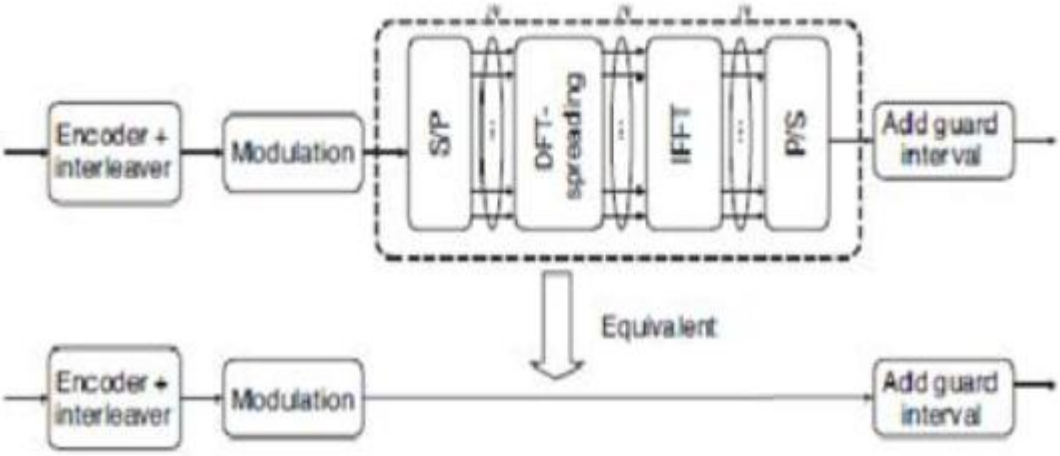

Fig. 1: Equivalence of OFDMA system with DFT-spreading code to a single carrier system

As given in Fig1, the DFT is taken as the same size as IFFT of an OFDMA system, which is used as a spreading code. Under this circumstances, OFDMA becomes equivalent to the Single Carrier FDMA[SC-FDMA] system, because the DFT and IDFT operations virtually cancel each other[4].in this case, the transmit signal will have the same PAPR as in a single-carrier system. In OFDMA systems, subcarriers are partitioned and assigned to multiple mobile terminals (users).Unlike the downlink transmission, each terminal in uplink uses a subset of subcarriers to transmit its own data. The rest of the subcarriers, not used for its own data transmission, will be filled with zeros. Here, it will be assumed that the number of subcarriers allocated to each user is M.

In the DFT-spreading technique, M-point DFT is used for spreading, and the output of DFT is assigned to the subcarriers of IFFT. The effect of PAPR reduction depends on the way of assigning the subcarriers to each terminal. As depicted in, there are two different approaches of assigning subcarriers among users: DFDMA (Distributed FDMA) and LFDMA (Localized FDMA). Here, DFDMA distributes M DFT outputs over the entire band (of total N subcarriers) with zeros filled in (N-M) unused subcarriers, whereas LFDMA allocates DFT outputs to M consecutive subcarriers in N subcarriers. When DFDMA distributes DFT outputs with equidistance N/M = S, it is referred to as IFDMA (Interleaved FDMA) where S is called the bandwidth spreading factor.

3. PROPOSED METHOD

3.1 Power line interference:

It consist of 50/60Hz pickup and harmonics, which can be modeled as sinusoids. Characteristics, which might need to be varied in a model of power line noise, of 50/60Hz component include the amplitude and frequency content of the signal. The amplitude varies up to 50 percent of peak-to-peak ECG amplitude, which is approximately equivalent to 25mv. Decomposing the power-line interfered signal into ten IMF's (Intrinsic Mode Functions), this power line information almost distributed to the 1st intrinsic mode functions. +R. Sivakumar, Tel.: 8883925991 E-mail address: hod.ece@rmkec.ac.in, tamil_ct@reddiffmail.com 141 2012 International Conference on Computer Technology and Science (ICCTS 2012)

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DOI: 10.7763/IPCSIT.2012.V47.27 where in is the set of N intrinsic mode functions. (B. Narsimha, and et al, 2011).
Figure 2: PLI eliminated signal (B. Narsimha and et al, 2011).

3.2. Base line drift with respiration:

The drift of the base line with respiration can be represented by a sinusoidal component at the frequency of respiration added to the ECG signal. The amplitude and frequency of the sinusoidal component should be variable. This baseline can be eliminated by decomposing the signal into 15 intrinsic mode functions reconstructing the signal with suppressing the final IMF is having the base line information. (B. Narsimha and et al, 2011). Figure 3:Base line wander effect correction (B. Narsimha and et al, 2011).

3.3. Electrode contact noise:

It is a transient interference caused by loss of contact between the electrode and the skin that effectively disconnects the measurement system from the subject. The loss of contact can be permanent, or can be intermittent as would be the case when a loose electrode is brought in and out of contact with the skin as a result of movements and vibration. (Md. Zia Ur Rahman and et al, 2009).

3.4. Muscle contraction:

The MA (Muscle Artifacts) originally had a sampling frequency of 360Hz. The original ECG signal with MA is given as input to the filter. Muscle contraction cause artifactual milli volt level potentials to be generated. The base line electromyogram is the microvolt range and therefore is usually insignificant. It is simulated by adding random noise to the ECG signal. The maximum noise level is formed by adding random single precision numbers of ±50% of the ECG maximum amplitude to the uncorrupted ECG. (Md. Zia Ur Rahman and et al, 2009).

3.5. Motion artifacts:

Motion artifacts are transient base line changes caused by changes in the electrode-skin impedance with electrode motion. As this impedance changes, the ECG amplifier sees a different source impedance which forms a voltage divider with the amplifier input impedance therefore the amplifier input voltage depends upon the source impedance which changes as the electrode position changes. (Md. Zia Ur Rahman and et al, 2009).

4. EMPIRICAL MODE DECOMPOSITION

A new non-linear technique, called Empirical Mode Decomposition method, has recently been developed by N. E. Huang et al for adaptively representing non-stationary signals as sums of zero mean AMFM components. EMD is an adaptive, high efficient decomposition with which any complicated signal can be decomposed into a finite number of Intrinsic Mode functions (IMFs). The IMFs represent the oscillatory modes embedded in the signal, hence the name Intrinsic Mode Function. The starting point of EMD is to consider oscillations in signals at a very local level. It is applicable to non-linear and non-stationary signal such as ECG signal. (Huang and et al, 1998)

An Intrinsic Mode function is a function that satisfies two conditions:

i. The number of extrema and the number of zero crossings must differ by at most 1.
ii. At any point the mean value of the envelope defined by maxima and the envelope defined by minima must be zero.

4.1. H. R- Peak Detection

Since the R wave is the sharpest component in the ECG signal, it is captured by the lower order IMFs which also contain high frequency noise. Past analysis using the EMD of clean and noisy ECG indicates that the QRS complex is associated with oscillatory patterns typically presented in the first three IMFs.

5. RESULTS NOTCH FILTER

Orthogonal Frequency Division Multiplexing is a multicarrier modulation technique with many advantages such as high spectral efficiency, robustness to channel fading, immunity to impulse interference and less non-linear distortion. Despite of all the advantages, one of the serious drawbacks of OFDM is that it exhibits high PAPR. High PAPR leads to saturation in high power amplifiers and thus degrading the performance of the system. Thus, it is essential to reduce the PAPR. In this paper, we described different techniques proposed to reduce PAPR. With the reduction in PAPR, these techniques also affect other aspects of the system such as BER performance, data rate, computational complexity, etc. hence, the appropriate PAPR reduction should be chosen according to the requirements of the system.

In this section, we discussed on the result obtained with the experimental work done. In the proposed denoising algorithm, the five set of ECG records of MIT/BIH database were used and sampling frequency is set to 720Hz and added with 50 Hz Power line Interference noise with different input SNR values. The effectiveness of proposed algorithm was determined by the MSE and output SN Ro values. The notch filter, Haar wavelet transform and EMD were used in proposed algorithm to obtain quality de-noised ECG signal for diagnosis and analysis. The obtained results were discussed in below sub-section. Original ECG signal Noisy ECG signal Denoised ECG signal using Haar wavelet transform R-Peak waveform of Haar wavelet Denoised ECG signal using EMD R-Peak waveform of EMD

CONCLUSION

The proposed work illustrates the effect of the wavelet thresholding on the quality reconstruction of ECG signal. The notch filter applied directly to the non-stationary signal like ECG has shown more ringing effect. Haar wavelet transform is the best method to de-noise the noisy ECG signals. For 5dB input noise value, Haar wavelet transform shows the output SN Ro value 95.50% with respect to other wavelet transform which is very good for de-noising signal. Finally Haar wavelet transform is compared with EMD in which we conclude that our work shows Haar wavelet transform performs better than other methods. In this thesis a method for PAPR reduction in LTE system has been introduced, which is based on the DFT spread method. DFT spread method is further classified into two methods known as LFDMA (localized FDMA) and IFDMA (interleaved FDMA). It was shown that a interleaved FDMA and localized FDMA performs better than orthogonal FDMA in the uplink transmission where transmitter power efficiency is of great importance in the uplink

FUTURE WORK

The above discussion gives a view of advantages and disadvantages of different sub-carrier schemes. If we adopt Localized subcarrier mapping then we are losing frequency diversity, and if we adopt Distributed mapping then we are losing multi-user diversity. Also since LTE is using adaptive modulation it have CSI (channel state information), but these mapping schemes are not using CSI efficiently. To overcome this difficulty we can adopt different subcarrier mapping scheme that is optimal in the sense that it maximizes the advantages of both schemes and minimizes the disadvantages of these scheme. One way to overcome this difficulty is to use an adaptive subcarrier scheme. We can use the CSI and depending upon certain performance criteria we can adopt different subcarrier mapping schemes.

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