AN IMPROVED PCA METHOD WITH DISCRETE COSINE TRANSFORM (DCT) FOR PEAK-TO-AVERAGE POWER RATIO (PAPR) REDUCTION

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ABSTRACT

Orthogonal Frequency Division Multiplexing (OFDM) which is the recognized signal modulator parameter has been widely applied at wideband communication and Digital Signal Processing. 4G mobile communications and Wireless networks have been accounted for the nobility of OFDM. This due to some advantages of OFDM for instance, high spectral efficiency, high transmission bit rate and immunity against multipath fading which leads to the heavy application of OFDM in our appliances nowadays. However, high Peak-to-Average Power Ratio (PAPR) value is still the agenda which being looked into by a lots of researchers who are specialize in OFDM. This is because high value of PAPR restrict the achievement of signal transmission. This paper discusses the improved method of Principle Component Analysis (PCA) to bring down PAPR values of OFDM system. The proposed ideas involves Discrete Cosine Transform replaces the Fast Fourier Transform in the OFDM signal modulation technique by utilizing the modulation scheme of Quadrature Phase Shift Keying (QPSK). This proposed methods able to provide better performance in PAPR reduction. The proposed method of PCA with DCT with the 1024 numbers of subcarriers improves the greatest performance by 5.72%.

Keywords: *DCT; IDCT; OFDM; PAPR; PCA*

INTRODUCTION

Most of the wireless LAN standards like IEEE 802.11a/g and Wi-Max are utilizing OFDM to enhance the world of wireless communication in 21st century. Under the concept of innovation study, the series of mobile technology from 2G to 3G and from 3G to 4G, can be regarded as a sequence of incremental innovation, since each emerges gradually with continuous improvement from the preceding technology [1]. OFDM able to provide substantially high spectral and high power efficiency, immune to the multipath delay and frequency selective fading [2]. Furthermore, Gu et al. suggested that OFDM can occupy huge space of capacity system than conventional single carriers system [3].

METHODOLOGY

The PAPR of an OFDM system increases slightly with the number of subcarriers. The more the involvement of the subcarriers quantity, PAPR value reduction improvement will increase.

PAPR was generally expressed as the quotient of maximum power in the time domain(highest power) to the average power(mean power) of the transmission of OFDM signal. The mathematical formula is shown as:.

$$PAPR = \frac{\mathrm{P_{peak}}}{\mathrm{P_{average}}} \qquad (1)$$

where P_{peak} = Peak power of the OFDM system, $P_{average}$ = Average power of the OFDM system.
Devika Rajeswaran and Aswathy K. Nair proposed Principle Component Analysis with the combined method of Clipping and Filtering for PAPR reduction [4]. So far, there is still no research of PCA with DCT on PAPR reduction even though there are a lot of method combined with DCT such as PTS with DCT and SLM with DCT

Figure 1 shows the progress diagram of design implementation of improved PCA method with DCT.

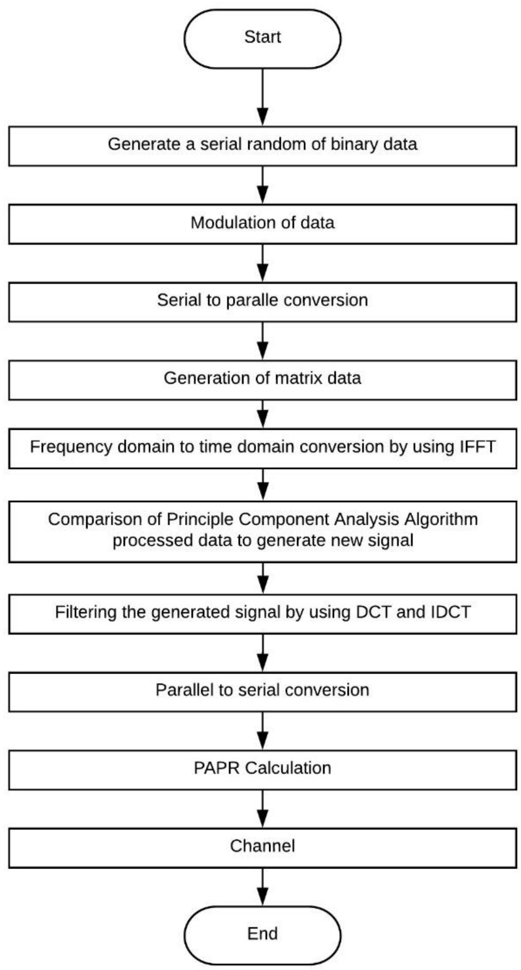

Figure 1: Progress diagram of design implementation

Figure 1 shows the block diagram of PCA DCT implementation

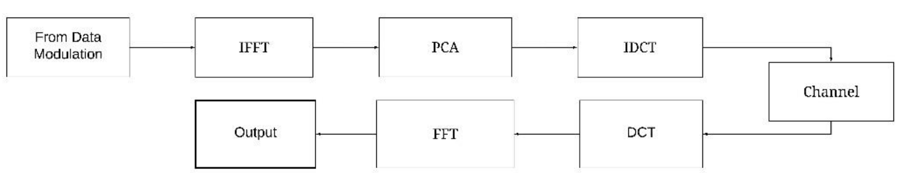

Figure 1 the block diagram of PCA DCT implementation

No.	Parameter	Value
1	Total number of subcarriers	64,512, 1024
2	Modulation Scheme	QPSK
3	Number of symbol	10000
4	Number of iteration	1000

Table 1 shows parameters for QPSK modulations for the improved PCA technique.

Number of subcarriers	PCA	PCA-DCT	Improvement(PCA with PCA-DCT)
64	9.79	9.27	0.52(5.31%)
512	10.94	10.36	0.58(5.60%)
1024	11.37	10.70	0.67(5.72%)

Table 1 Parameter for QPSK modulations

RESULTS AND DISCUSSION

Performances of OFDM system are mostly referred to complementary cumulative distribution function (Kaur & Singh, 2012) of the PAPR value. In this paper, number of subcarriers is being compared

Table 2 shows PAPR value of Original, PCA and Improved technique with DCT for N = 64, N=512 and 1024

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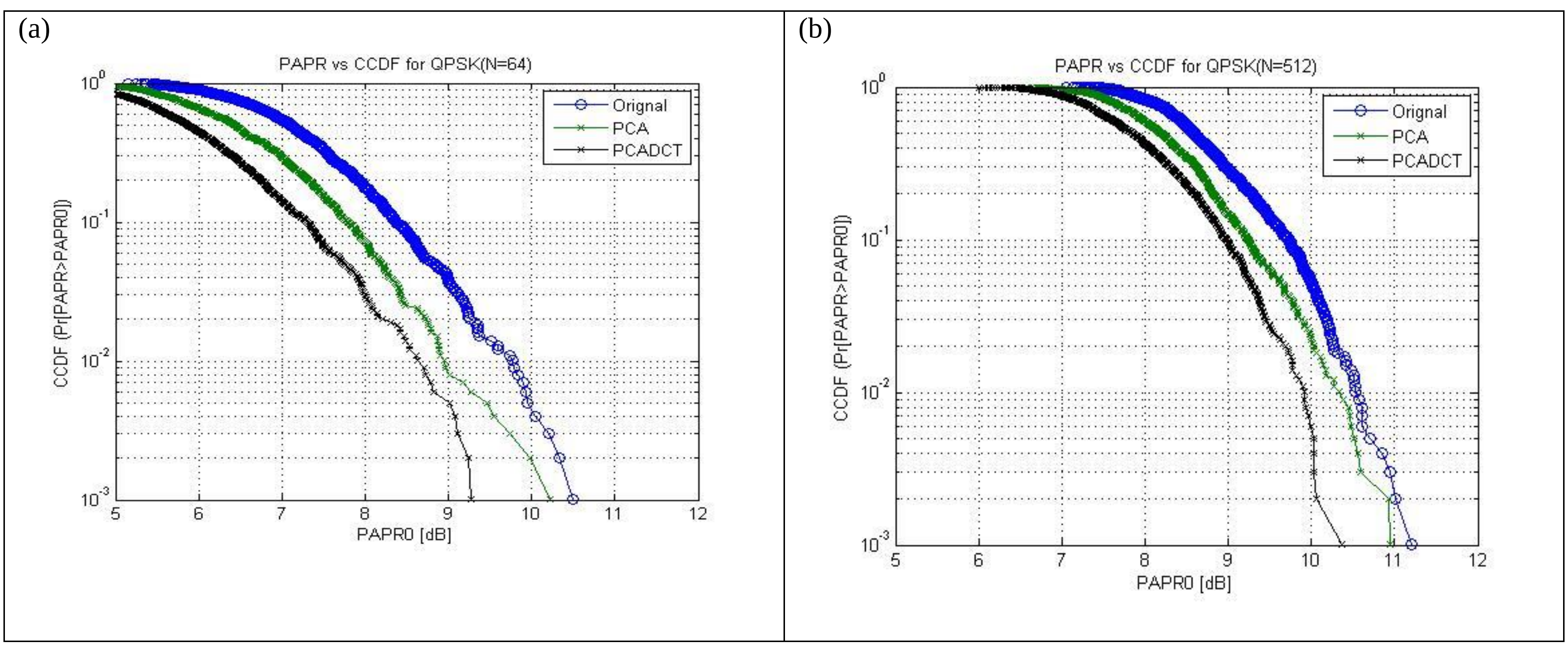

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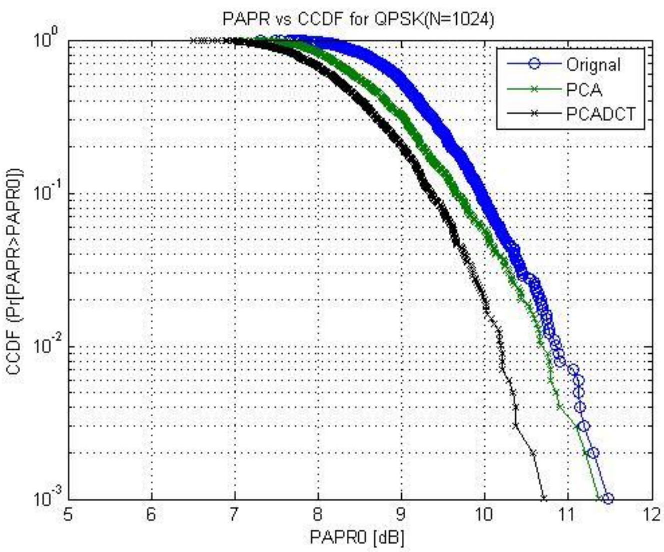

Figure 3: (a) Graph of CCDF with QPSK N=64; (b) Graph of CCDF with QPSK N=512; (c) Graph of CCDF with QPSK N=1024

From Table 2, the huge PAPR reduction improvement by 5.72% is achieved by number of subcarriers with N= 1024 compared to N= 64 which gives 5.31% improvement and N= 512 which gives 5.60% improvement. This is due to the larger the number of subcarriers, the larger the data transmitted simultaneously , the lower the probability of the distorted signal produced, the lower the amplitude of the signal, the better the improvement of PAPR reduction.

CONCLUSION

The Number of subcarriers of 1024 shows the greatest reduction of PAPR in 5.72%. From the results, the proposed improved PCA technique can reduce PAPR with significant value compared to original technique.

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