PRECODING-BASED PAPR REDUCTION TECHNIQUE FOR UF-OFDM AND FILTERED-OFDM MODULATIONS IN 5G SYSTEMS

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ABSTRACT

In this proposed system a precoding-based PAPR reduction technique is proposed for both the UF-OFDM and the F-OFDM cases. In this system we are using the Zadoff Chu Transform for the precoding process. The input bit stream is first modulated by QAM modulation and then the precoding technique is performed. For UF-OFDM, after that the inverse discrete Fourier transform is performed on the data streams and then the filtering is applied. For the filtering operation Chebyshev filter is performed and then the data are send through the channel. And for the F-OFDM process the data are modulated and the inverse discrete Fourier transform is performed. And then the cyclic prefix is obtained and then the spectrum shaping filter is applied on the data streams. Here the considered channel is the AWGN channel. After that the reverse operations are performed. And in the performance evaluation the BER, PAPR, IAPR, Normalized (PSD) is calculated on the obtained output signal.

Keyword: OFDM, BER, AWGN, PAPR, PSD

1. INTRODUCTION

For 5G systems, mm-wave communication is envisioned to be the key component to meet the demands of high data rates, high spectral efficiency and low latency. For 5G mm-wave communication, selection of waveform is an important criterion. 4G systems employ OFDM (orthogonal frequency division multiplexing) for downlink and DFTS-OFDM (Discrete Fourier Transform spread-OFDM) for transmission in uplink. Apart from several important features such as low complex transceiver design, easy integration with MIMO, robustness to frequency selective channel, OFDM comes with the major drawbacks of high PAPR and high OOB (out-of-bound) emissions. To improve OOB emissions, several MCMs have been proposed for 5G systems such as F-OFDM and UF-OFDM. Compared to OFDM, these filtered MCMs provide

lower OOB emission, lowers power spectral density (PSD) side lobes and preserves the OFDM based transceiver design. However, these modulation schemes have high PAPR. The high PAPR results in the high design complexity of Analog to Digital (A/D) and Digital to Analog (D/A) converters and drives the operation of PA in the linear region which increases the cost and complexity of PA and reduces the efficiency RF high power amplifier (HPA). Thus, PAPR reduction techniques are conventionally used which solve the design complexity of A/D and D/A converters and increases the transmit power, improves received SNR for the same range, resulting in the increased efficiency.

2. PROPOSED METHOD

In this proposed system a precoding-based PAPR reduction technique is done by using the zadoffchu transform precoding method for both the UF-OFDM and the F-OFDM systems. The principle of this method is to transform the UF-OFDM signal to a lower order summation of single carrier signals and the F-OFDM signal to single carrier signal. The performance of the proposed PAPR reduction technique is evaluated by the simulation results obtained. The proposed simulation results which shows that the proposed system which outperforms that the existing precoding technique. The performance results which shows the better simulations.

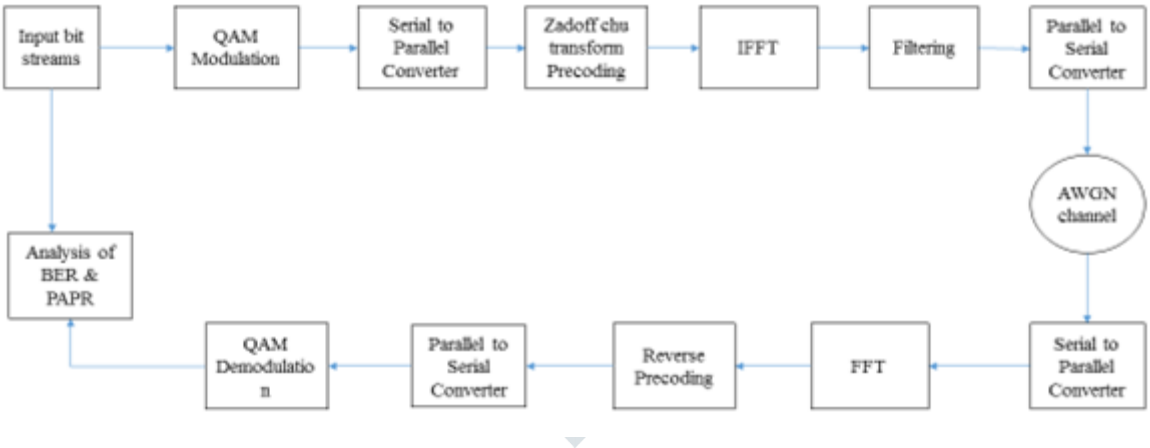

Fig.1 flow diagram of proposed method

Modules:

- OFDM Symbol Generation Model

  OFDM is a frequency-division multiplexing (FDM) scheme used as a digital multi-carrier modulation method and is essentially identical to coded OFDM (COFDM) and discrete multi-tone modulation (DMT). It is used in such diverse applications as digital television and audio broadcasting, wireless networking and broadband internet access. OFDM has also been adopted in some military communication systems.In an OFDM scheme, a large

number of orthogonal, overlapping, narrow band sub-channels or subcarriers, transmitted in parallel, divide the available transmission bandwidth. The separation of the subcarriers is theoretically minimal such that there is a very compact spectral utilization.

- Modulation and filtering Model

QAM (quadrature amplitude modulation) is a method of combining two amplitude-modulated (AM) signals into a single channel, thereby doubling the effective bandwidth. This modulation technique is a combination of both Amplitude and phase modulation techniques. One of the main aspects of the Chebyshev filter is that it has a steep roll-off. It reaches its ultimate roll-off faster than other forms of filter. Accordingly is widely used in RF applications where a steep transition between pass-band and stop-band is required to remove unwanted products such as intermodulation of harmonics. The ideal raised cosine filter frequency response consists of unity gain at low frequencies, a raised cosine function in the middle, and total attenuation at thigh frequencies.

- ZCT Precoding Model

Zadoff-Chu codes are the special case of the generalized Chip-Like polyphase sequences having optimum correlation properties. Zadoff-Chu sequences have an ideal periodic conditions. In the ZCT precoded OFDM systems, the baseband modulated data is passed through S/P converter which generates a complex vector of size. ZCT precoding is applied to this complex vector which transforms this complex vector into new vector of same length.

$$a_n = \begin{cases} e^{\frac{j2\pi r}{N}\left(\frac{k^2}{2}+qk\right)}, & \text{for } N \text{ even} \\ e^{\frac{j2\pi r}{N}\left(\frac{k(k+1)}{2}+qk\right)}, & \text{for } N \text{ odd} \end{cases}$$

- Performance Analysis Model

The peak-to-average power ratio (PAPR) is the peak amplitude squared (giving the peak power) divided by the RMS value squared (giving the average power). It is the square of the crest factor. The bit error ratio (also BER) is the number of bit errors divided by the total number of transferred bits during a studied time interval. The bit error probability is the

expectation value of the bit error ratio. After that the PAPR and IAPR performance are evaluated and also the normalized PSD is calculated.

3. RESULT

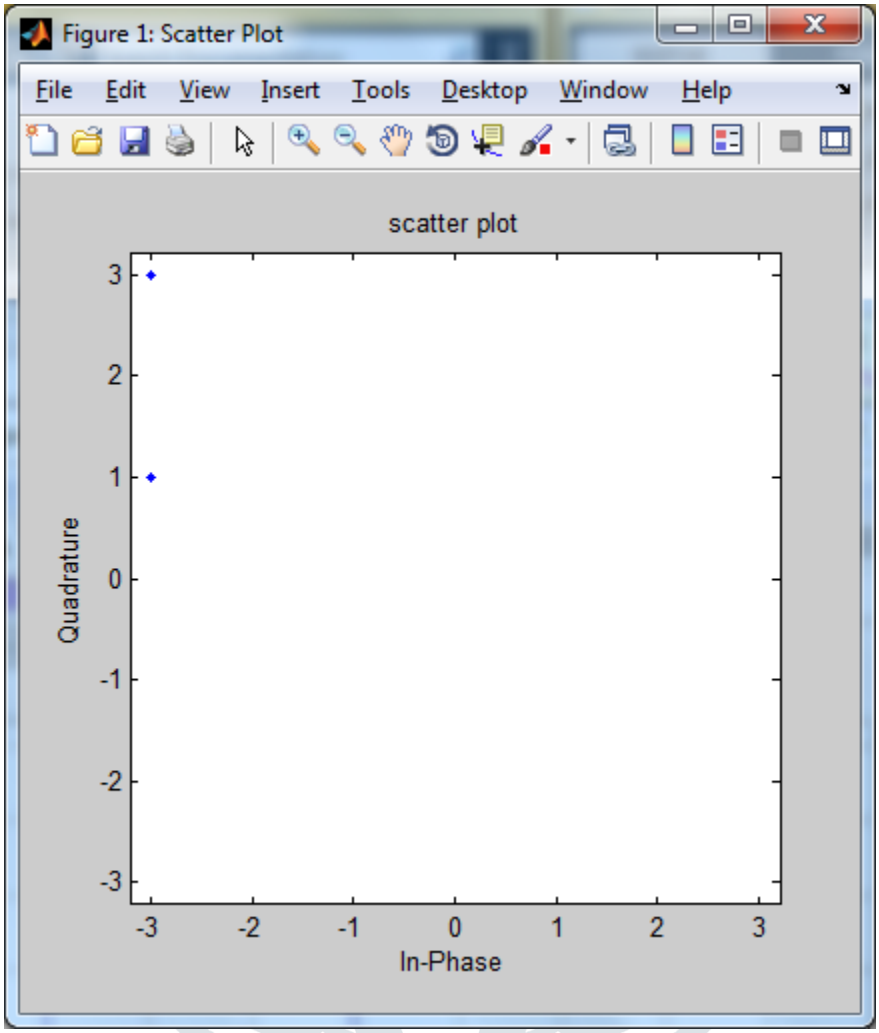

Fig.2 Scatter Plot

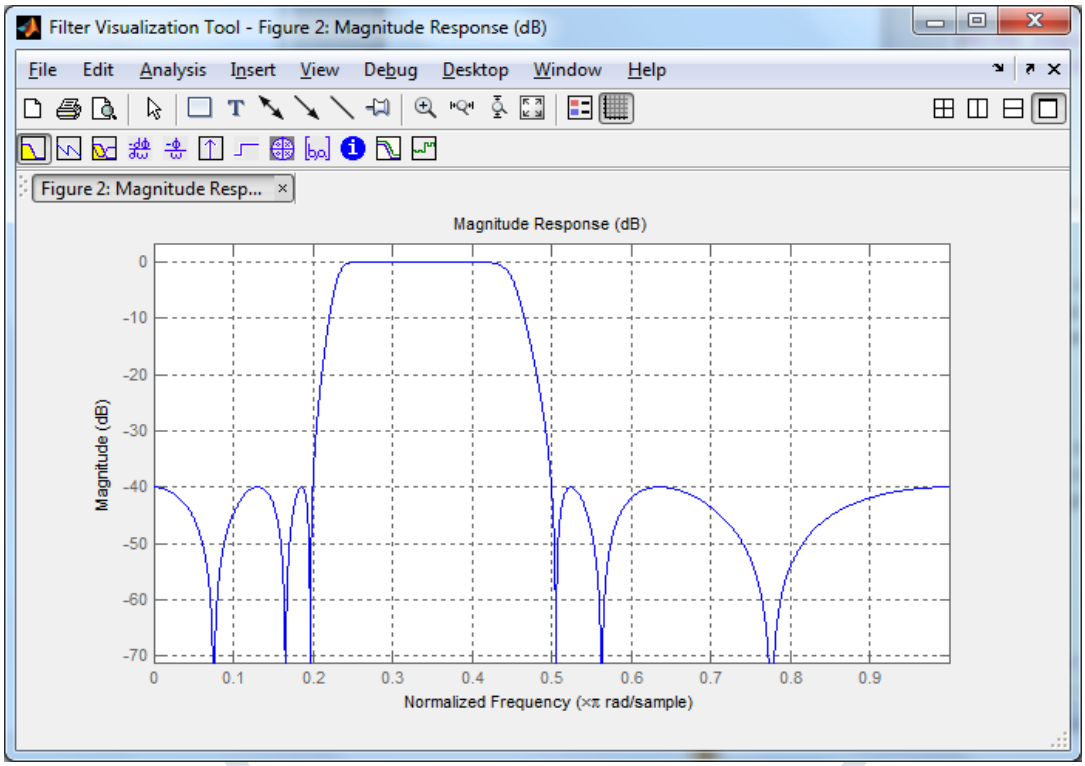

Fig.3 magnitude Response (dB)

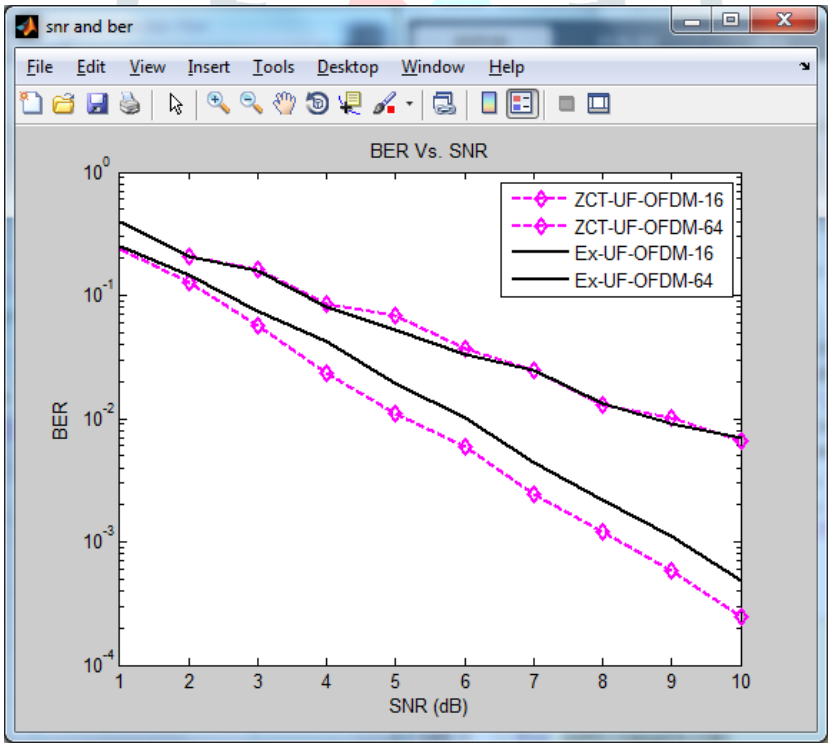

Fig.4 BER vs. SNR

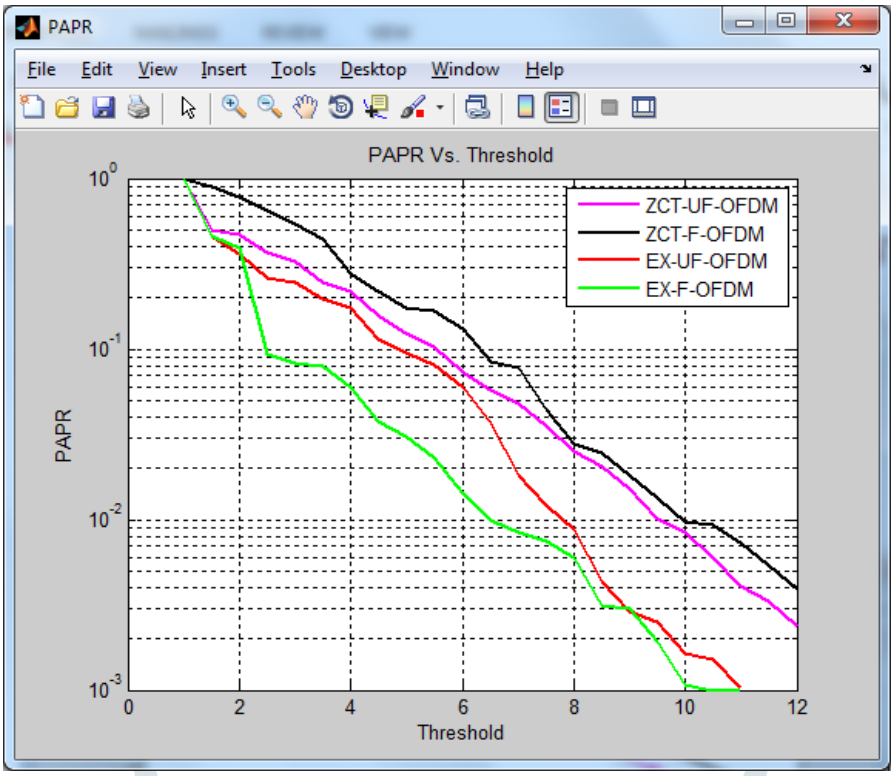

Fig.5 PAPR vs. Threshold

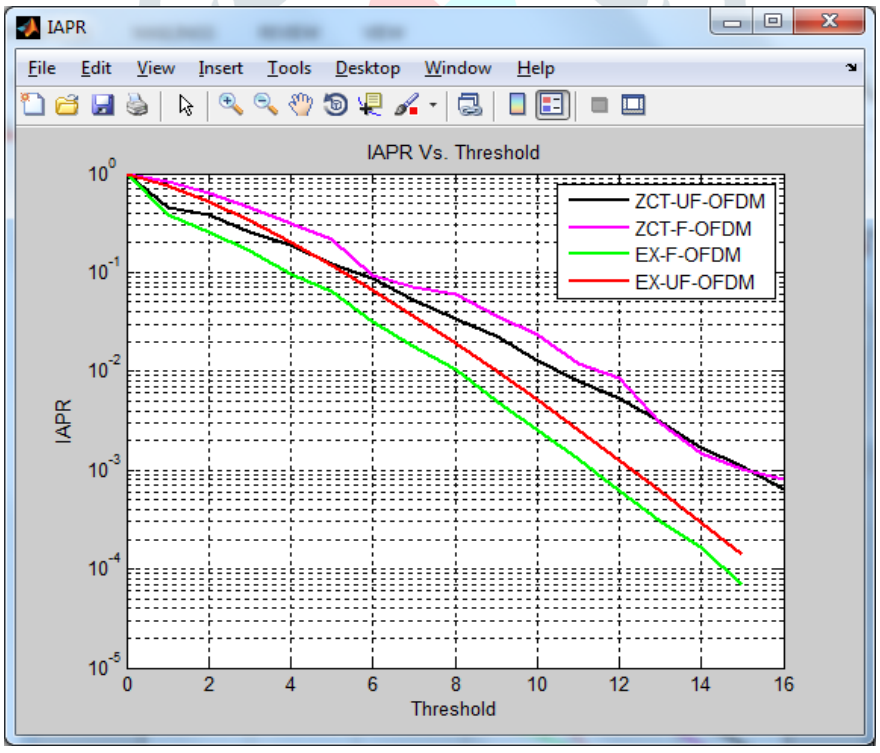

Fig.6 IAPR vs. Threshold

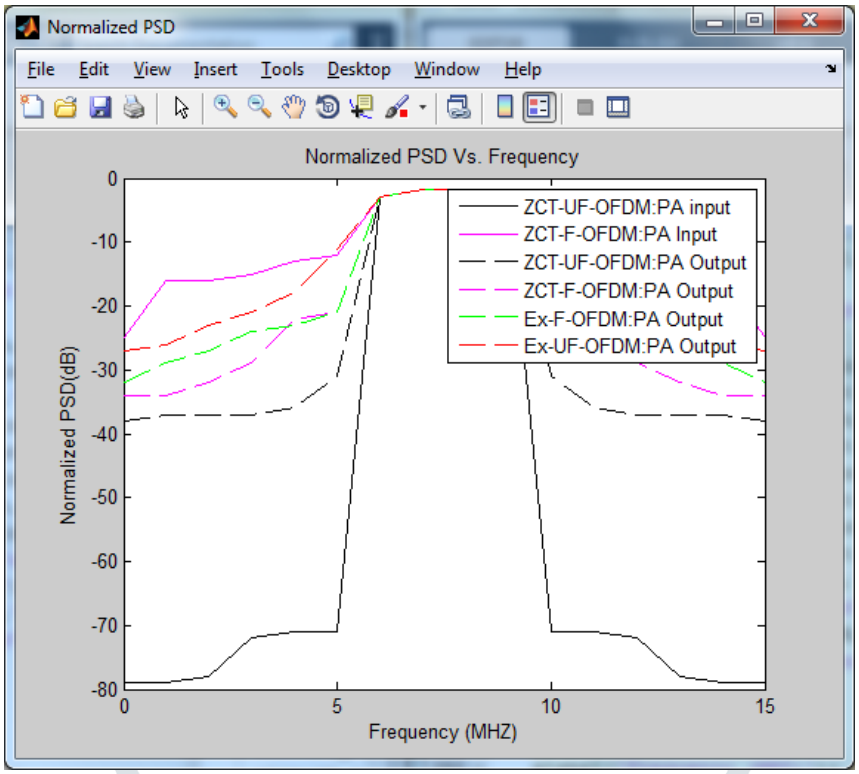

Fig.7 Normalized PSD vs. Frequency

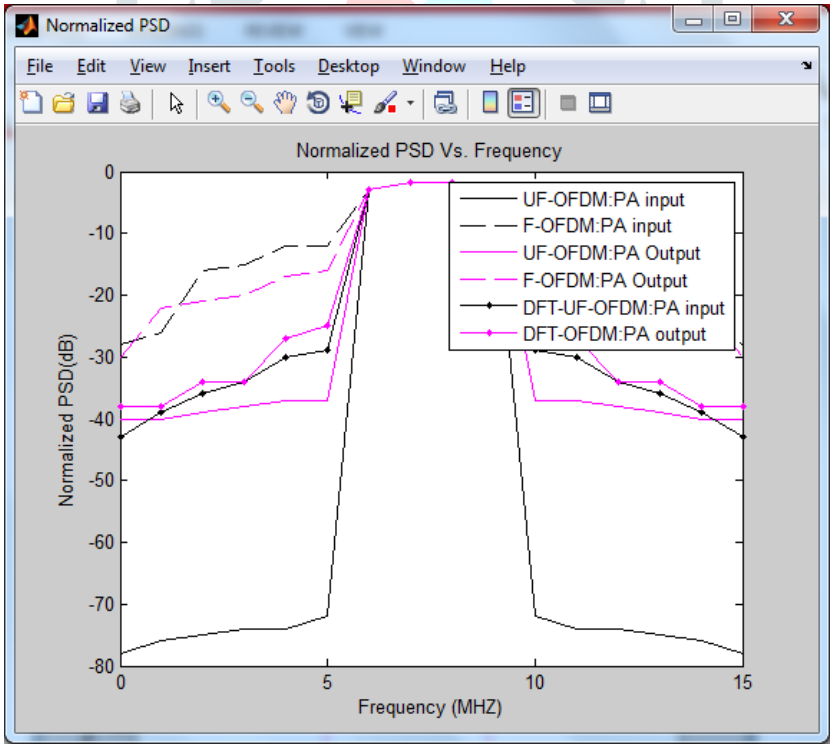

Fig.8 Normalized PSD vs. Frequency

4. CONCLUSION

Thus in the proposed PAPR reduction technique using the Zadoff Chu transforms for the UF-OFDM and the F-OFDM modulation schemes were proposed. In this proposed system at first the input signal data is generated randomly and then the generated data symbols are tends to the modulation process. For that in our proposed system we use the QAM modulation. After that modulation filtering is performed. After filtering the data the signal is precoded by the ZCT precoding method and then it is passed through the AWGN channel and the reversal operations are performed. Finally the performance of the proposed system is evaluated and compared with the existing system and it shows the better results.

5. REFERENCE

[1] M. Ben Mabrouk, M. Chafii, Y. Louët and F. Bader, "Low-PAPR condition for 5G-candidate waveforms," 2017 XXXIInd General Assembly and Scientific Symposium of the International Union of Radio Science (URSI GASS), Montreal, QC, 2017, pp. 1-4.

[2] M. Ben Mabrouk, M. Chafii, Y. Louet and F. Bader, "A Precoding-based PAPR Reduction Technique for UFOFDM and Filtered-OFDM Modulations in 5G Systems," European Wireless 2017; 23th European Wireless Conference, Dresden, Germany, 2017, pp. 1-6.

[3] J. Mountassir, A. Isar and T. Mountassir, "Precoding techniques in OFDM systems for PAPRreduction," 2012 16th IEEE Mediterranean Electrotechnical Conference, Yasmine Hammamet, 2012, pp.728-731.

[4] Albdran, Saleh. “Clipping and Filtering Technique for Reducing PAPR in OFDM.” IOSR Journal of Engineering, vol. 02, no. 09, 2012, pp. 91–97

[5] H. Wang, A. A. Zaidi, X. Chen, J. Luo and M. Dieudonne, "Evaluation of 5G Waveform Candidates Considering Hardware Impairments and above 6 GHz Operation," 2017 IEEE 85th Vehicular Technology Conference (VTC Spring), Sydney, NSW, 2017, pp. 1-5.

[6] D. Zhang, M. Matthé, L. L. Mendes and G. Fettweis, "A Study on the Link Level Performance of Advanced Multicarrier Waveforms Under MIMO Wireless Communication Channels," in IEEE Transactions on Wireless Communications, vol. 16, no. 4, pp. 2350-2365, April 2017.

[7] J. Abdoli, M. Jia and J. Ma, "Filtered OFDM: A new waveform for future wireless systems," 2015 IEEE 16th International Workshop on Signal Processing Advances in Wireless Communications (SPAWC), Stockholm, 2015, pp. 66-70.

[8] I. Baig and V. Jeoti, "PAPR Reduction in OFDM Systems: Zadoff-Chu Matrix Transform Based Pre/Post-Coding Techniques," 2010 2nd International Conference on Computational Intelligence, Communication Systems and Networks, Liverpool, 2010, pp. 373-377.

[9] I. Baig and V. Jeoti, "A new ZCT precoded OFDM system with pulse shaping: PAPR analysis," 2010 IEEE Asia Pacific Conference on Circuits and Systems, Kuala Lumpur, 2010, pp. 1131-1134.

[10] Mathew, T. and A. Lakshmanasamy Mudaliar. “Alamouti STBC MIMO OFDM System using ZCT Precoded Based SLM Technique for PAPR Reduction.” (2014).