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IMPLEMENTATION OF DIFFERENT HYBRID SLM-PTS SCHEME FOR PAPR REDUCTION IN OFDM SYSTEM

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ABSTRACT

OFDM stands for orthogonal Frequency Division Modulation. It is a wideband wireless digital communication techniqueOFDM is a digital modulation scheme which can be used for high speed video communication and audio communication without any inter symbol interference(ISI).In this work, a modified hybrid algorithm will be developed to obtain better PAPR reduction performance and reduce computational complexity compared with the conventional hybrid scheme. This algorithm will combine selected mapping (SLM) with partial transmit sequence (PTS) strategies, and further employs linear addition and exchange of various PTS sub-blocks to create more alternative OFDM signal sequences. As a result, with the same numbers of IFFT and phase rotation sequences, this algorithm has the potentials to provide better PAPR reduction performance with lower computational complexity.

Keywords: OFDM, PTS,SLM

I. INTRODUCTION

Orthogonal frequency division multiplexing (OFDM) is a multicarrier communication system. In OFDM one of the disadvantages is high peak to average power ratio (PAPR).PAPR is the ratio of maximum peak power to the average peak power. High PAPR reduces the system efficiency and increases the cost of radio frequency (RF)poweramplifier. In this scheme four proposed hybrid algorithm will be developed to obtain better PAPR reduction. Conventional hybrid (CH) scheme will be implemented by combining SLM and PTS scheme. Additional hybrid (AH) scheme will be implemented by combining modified SLM scheme with CH scheme. Switching hybrid (SH) scheme will be implemented by combining the switching technique with the CH scheme. Modified hybrid scheme will be implemented by combining AH and SH scheme.

II. SELECTED MAPPING (SLM)

In the SLM technique, the transmitter generates a set of sufficiently different candidate data blocks by multiplying the same number of different phase sequences, all representing the same information as the original data block. The one with the lowest PAPR is selected for transmission. Information about the selected phase sequence should be transmitted to the receiver as side information.

Differentially encoded modulation may be applied before the IDFT and right after generating the alternative OFDM symbols. At the receiver, differential demodulation has to be implemented right after the DFT.

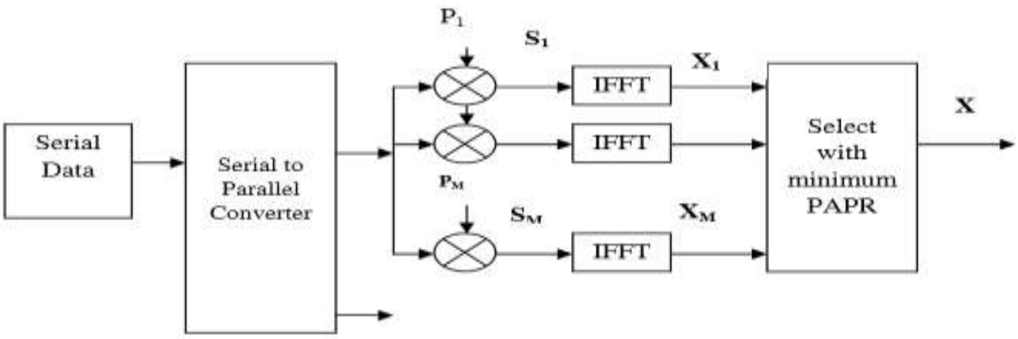

Figure 1. The Block Diagram of Selected Mapping Technique

III. PARTIAL TRANSMIT SEQUENCE (PTS)

The transmitter constructs its transmitting signal with low PAPR, by scrambling appropriate rotation factors to subcarrier sub blocks. The difference between SLM and PTS is that the SLM applies independent scrambling rotations to all subcarriers, while the PTS only applies scrambling rotations to subcarrier sub blocks.

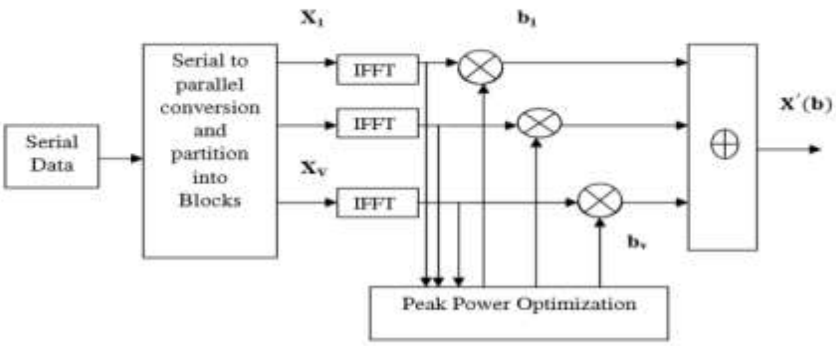

Figure 2. The Block diagram of PTS Technique

IV. PROPOSED HYBRID SCHEME

4.1Conventional Hybrid Method (CH)

The block diagram of the earlier SLM-PTS combined method (so called CH method) is shown in Fig. 3.The original OFDM symbol is multiplied with the U phase rotation sequences, and then each of the new OFDM symbols is partitioned into V pair wise disjoint sub-blocks . Those OFDM sub-block values are calculated by each optimization of PTS blocks. For simplicity and without loss of generality, V = 2 is always considered here. Each signal x(u), where u = 1, . . . , U, with the lowest PAPR is selected by each optimization block. They can be written as

$$\{\widetilde{b1}^{(u)},\widetilde{b2}^{(u)}\} = \underset{\{b1^{(u)},b2^{(u)}\}}{\operatorname{argmin}} \left\{\sum_{v=1}^{2} b_v^{(u)} X_v^{(u)}\right\} \ldots\ldots\ldots\ldots (1)$$

$$\hat{X}^{(U)} = \sum_{v=1}^{2} b_v^{(u)} X_v^{(u)} \ldots\ldots\ldots\ldots\ldots (2)$$

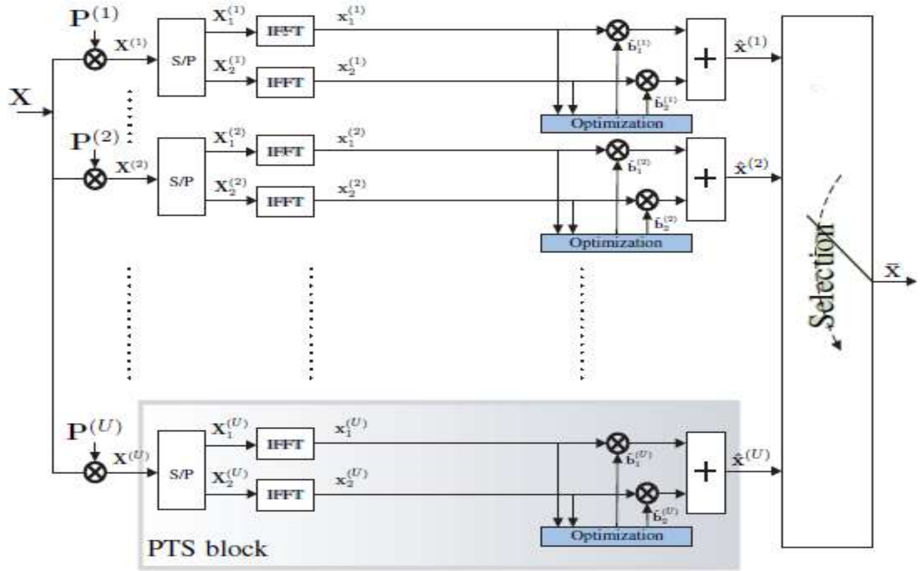

Fig3:-The Block diagram of Conventional Hybrid method

4.1.1 Simulation of CH method

In this method both SLM and PTS are used and optimised using phase sequences.

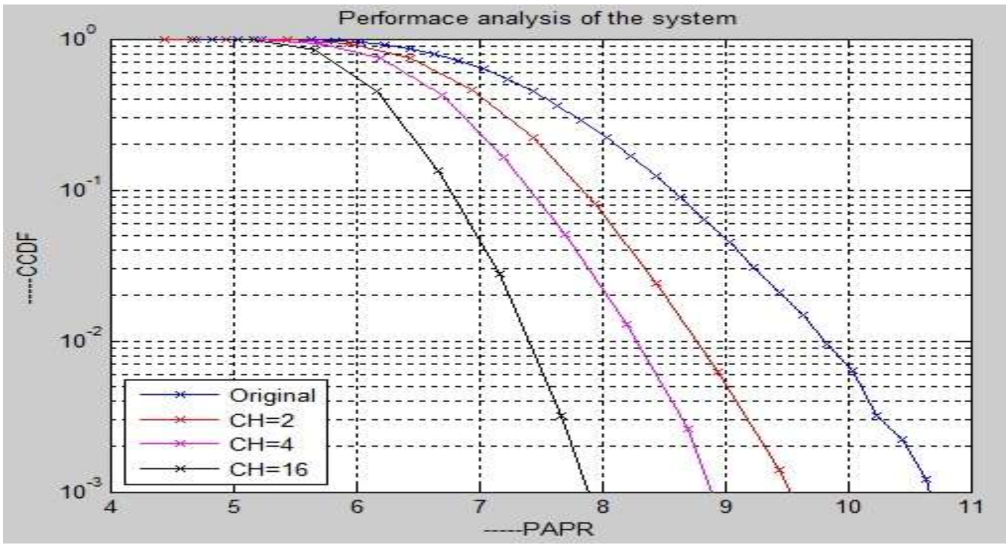

Fig.4:-The PAPR reduction performance of conventional hybrid scheme forOFDM systems.

The PAPR reduction performance with the CH scheme for various values of *U* is shown in Fig. 4.It shows that the PAPR reduction performance becomes better as the number of *U* increases.But the CH scheme has high computational complexity because of the increase of the number of IFFT.

4.2 Additional hybrid scheme (AH)

PAPR reduction is improved in CH scheme; we have generated a large number of alternative OFDM signal sequences without increasing the number of IFFT to avoid high computational complexity. Here a new additional hybrid (AH) scheme by combining the modified SLM scheme with CH scheme. The system performance is not compromised. The block diagram ofAH scheme is given in Figure 5

In this method the first U signal$\hat{X}^{(u)}$, where $u = 1, \ldots, U,$ are the same as the signal in the CH scheme. Furthermore, the alternative OFDM signal sequence are generated by the linear combination of the sub-block signal from different PTS blocks after IFFT operation. Using the linear property of Fourier transform, the linear combination of these sequences can be obtained by

$$X_v^{(u)} = c^{(i)} X_v^{(i)} + c^{(k)} X_v^{(k)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where$U + 1 \leq u \leq U^2, 1 \leq i, k \leq U, 1 \leq v \leq 2$, and $c^{(i)}$ and $c^{(k)}$are some coefficient to be chosen later. That is to say, if we have OFDM signal sequence $X_v^{(i)}$and $X_v^{(k)}$, alternative OFDM signal sequence is obtained without performing IFFT operation. Now, we would investigate how to make each element of $X_v^{(i)}$ and $X_v^{(k)}$ to have Unit magnitude under the condition that each element of the phase sequence $P^{(i)}$ and $P^{(k)}$ has unit magnitude. Basically the element of the sequence $X_v^{(i)}$ and $X_v^{(k)}$have unit magnitude if the following conditions are satisfied:

$c^{(i)} = \pm(1/\sqrt{2})andc^{(k)} = \pm(1/\sqrt{2})j$ and

Each element of $P^{(i)}$ and $P^{(k)}$ takes the value in ± 1.

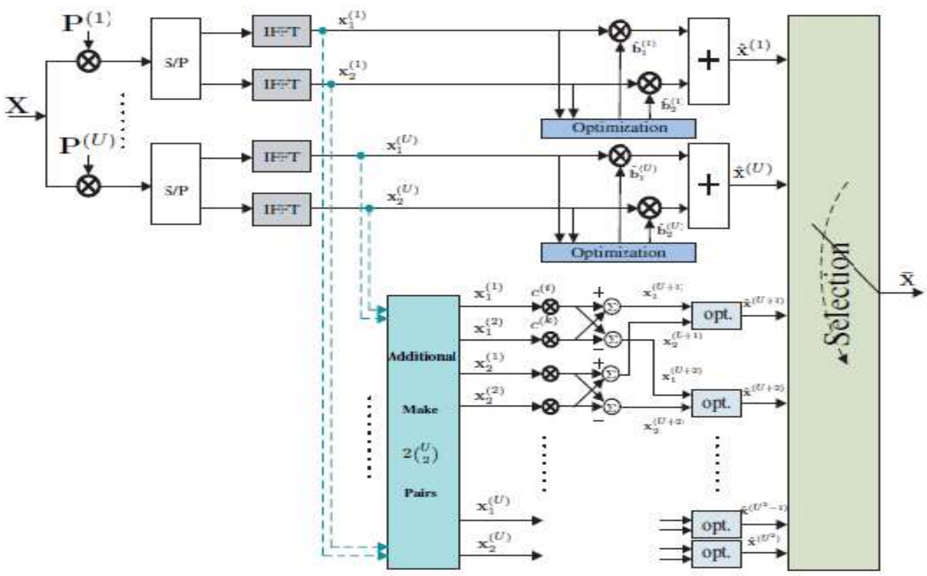

Fig 5:- The Block diagram of Additional Hybrid method

Since$|c^{(i)}| = |c^{(k)}|^2 = 1/2$), the average power of $X_v^{(u)}$ is equal to one half of the sum of average power of $X_v^{(i)}$ and $X_v^{(k)}$.From U binary phase rotation sequences, we can obtain $2\binom{U}{2}$ excessive pair sub-block sequences thus, there are total U^2excessive pair sub-blocks sequence for AH schemes. Then the alternative OFDM signal of lowest PAPR in AH scheme can be written as

$$\{b_1^{(u)}, b_2^{(u)}\} = \underset{\{b_1^{(u)}, b_2^{(u)}\}}{argmin} \{b_1^{(u)} X_1^{(u)} + b_1^{(u)} X_2^{(u)}\} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$\hat{X}^{(u)} = \hat{b}_1^{(u)} X_1^{(u)} + \hat{b}_1^{(u)} X_2^{(u)} \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where$U + 1 \le u \le U^2$.

We have to select and transmit the resulting OFDM signal sequence$\hat{X}$, which has the minimun PAPR among the whole OFDM signal sequence of overall lowest PAPR $\hat{x}^{(u)}$ sequences, which are composed by $\{X_1^{(u)}, \ldots, X_v^{(u)}\}$ after each optimization operation. The number of required side information bits for transmitter can be written as

$$N_{AH} = \log_2 u^2 + (V-1)\log_2 w \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

4.2.2 Simulation of AH method

In this method additional OFDM sequences are produced by linear combination of the existing sequences.

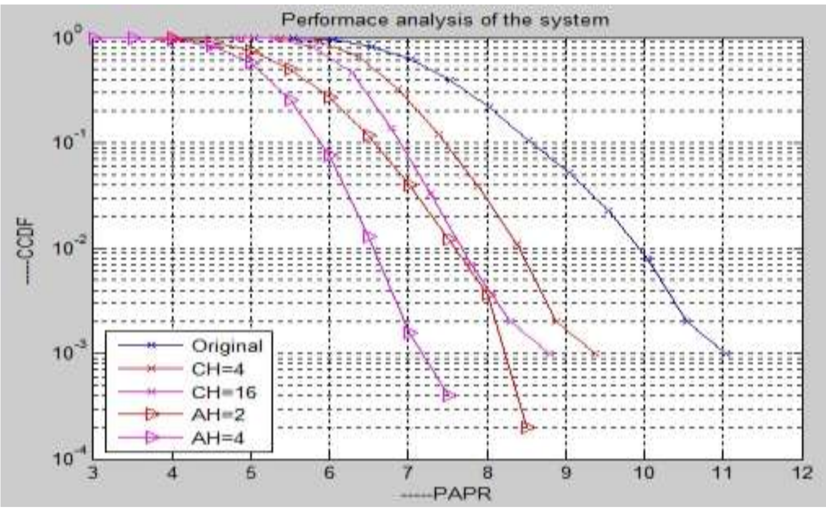

Fig. 6:-The PAPR reduction performance of additional hybrid scheme forOFDM systems.

The PAPR reduction performance with the AH scheme for various values of *U* is shown in Fig.6.From graph it is clear that, the AH scheme possesses the better PAPR reduction performance with minor increase ofcomputational complexity due to linear combination.

4.3Switching hybrid scheme

Instead of generating alternative OFDM sequence with linear combination, a new switching hybrid (SH) scheme by combining the switching technique with the CH scheme. The system performance is desirable that the number of IFFT is reduced but the PAPR reduction performance is not compromised. The block diagram of SH scheme is shown in figure 7

By the switching block, we can use original *U* pairs{x1(*u*), x2(*u*)} to generate excessive $2\frac{U}{2}$pairs of OFDM sequences without increasing the number of IFFT units. Thus, there are total U2 pairs {x(u) 1 , x(u) 2 , . . . , x(u2) 1 , x(u2) 2 } are operated by each optimization unit. Obviously, the first U signals$\hat{X}(u)$, where $u = 1 \dots\dots\dots .. U$the same as the signals in the CH scheme are. After the optimization blocks, the other alternative OFDM sequences with lowest PAPR $\hat{X}(u)$ can be written as

$$\left\{\hat{b}_1^{(u)}, \hat{b}_2^{(u)} = \underset{\left\{b_1^{(u)}, b_2^{(u)}\right\}}{argmin} \left\{b_1^{(u)} x_1^{(u)} + b_2^{(u)} x_2^{(k)}\right\} \dots\dots\dots\dots\dots\dots\dots (7)\right.$$

$$\hat{X}^{(u)} = \hat{b}_1^{(u)} X_1^{(i)} + \hat{b}_2^{(u)} X_2^{(k)} \dots\dots\dots\dots\dots (8)$$

WhereU+ 1 ≤ u ≤ U2, 1 ≤ i, k ≤ U and i _= k. In (14), x(i) v and x(k) v , i _= k come from different PTS blocks, which are generated by different phase rotation sequences, so that P(i) and P(k), where $1 \leq i,k \leq U, i \_= k$, can obtain differently alternative OFDM sequences with the minimum PAPR. Noteworthy, the number of required side information bits can be written as

$$N_{SH} = \log_2 U^2 + (V-1)\log_2 W \dots\dots\dots\dots\dots\dots\dots\dots (9)$$

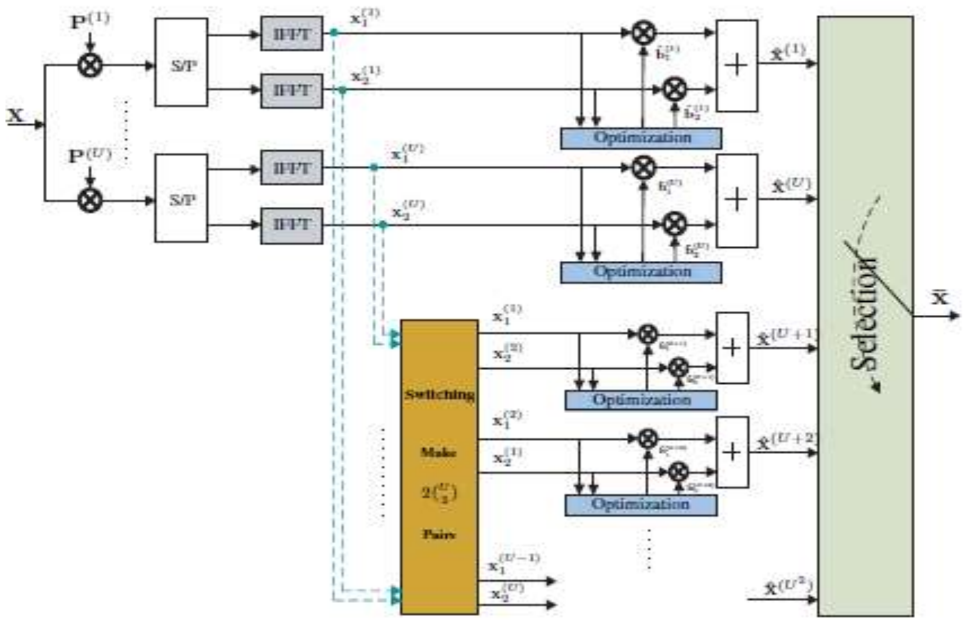

Fig 7:- The Block diagram of switching hybrid scheme

4.3.3 Simulation of SH method

Instead of generating alternative OFDM sequence with linear combination, a new switching hybrid (SH) scheme by combining the switching technique with the CH scheme is developed. The system performance is desirable that the number of IFFT is reduced means computational complexity is reduced.

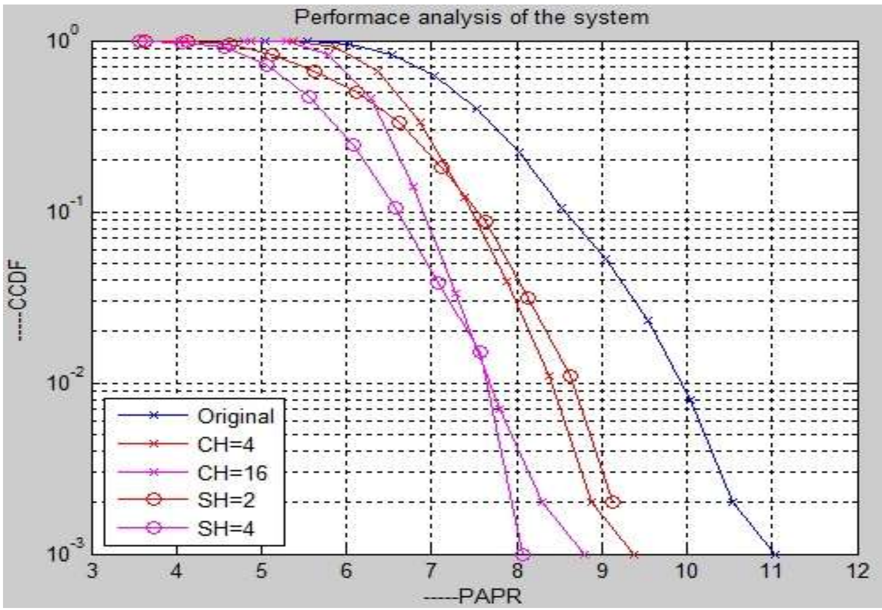

Fig. 8:- The PAPR reduction performance of switching hybrid scheme forOFDM systems.

4.4Modified hybrid scheme

In order to further improve the PAPR reduction performance without increasing the number of IFFT, the new hybrid algorithm is proposed by combining AH and SH schemes to generate more and more alternative OFDM sequences. Those $\{X_1^{(u)}, X_2^{(u)}\}$pairs, where$1 \le u \le U$, are the signal inputs of the additional block and switching block respectively and simultaneously. The block diagram of new hybrid scheme is shown in Figure 9.

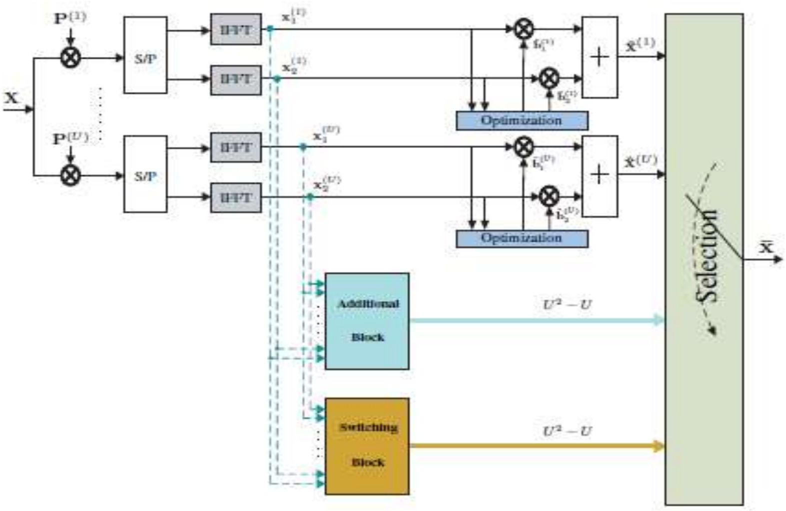

Figure:9:- The block diagram of modified modified hybrid scheme

Using the linear property of Fourier transform, the linear combination of U phase rotation sequences can obtain excessive $2\binom{U}{2}$alternative OFDM sequences. After optimization blocks, those overall lowest PAPR $\hat{X}(U)$ can be written as the same as. Using the switching technique among PTS blocks, the signals of U phase rotation sequences can obtain excessive $2\binom{U}{2}$alternative OFDM sequences. In the MH scheme, if V = 2 and U phase rotation sequences are considered, the original signals $X_v^{(u)}$can generate excessive $2\binom{U}{2}$pairs of sequences respectively and simultaneously by either additional block or switching block. Therefore, there are total $2U^2 - U$OFDM sequences with the lowest PAPR in the MH scheme. In order to recover the transmitted data information, the number of required side information bits can be obtained by

$$N_{MH} = \log_2(2U^2 - U) + (V-1)\log_2 W \quad (10)$$

4.4.4 Simulationof Modified hybrid scheme

In this method both additional hybrid and conventional hybrid methods are used to generate more number of alternative OFDM sequences. So, without increasing the number of IFFT blocks, new set of values is produced to reduce computational complexity.The new hybrid scheme can obtain the best PAPR reduction performance by combining the AH with SH schemes. After a number of comparative simulations, thenewhybridscheme has shown that the excellent PAPR reduction performance can be achieved without increasing the number of IFFT.

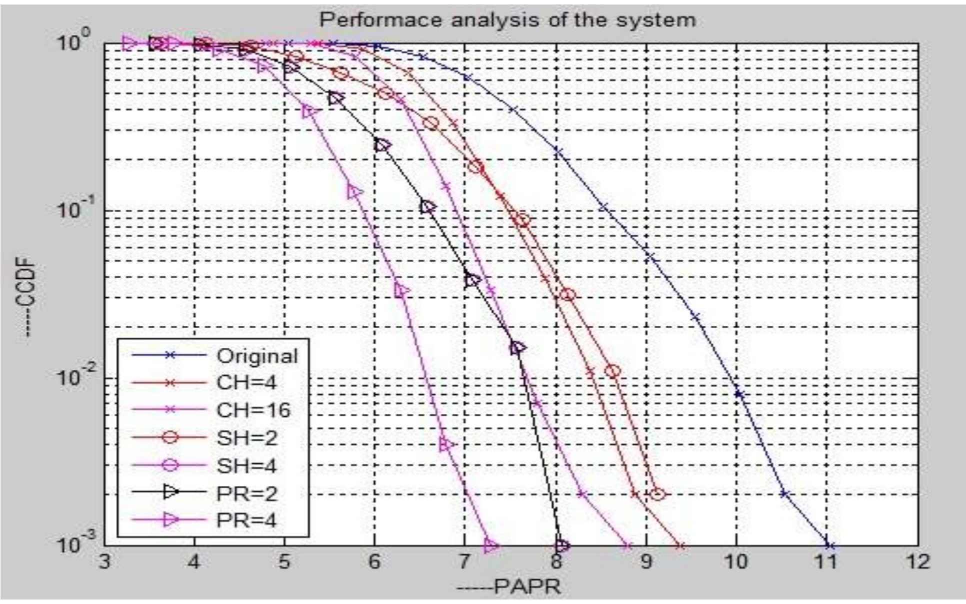

Fig. 10:- The PAPR reduction performance of hybrid scheme for OFDM systems.

V. CONCLUSION

In this paper, a modified hybrid algorithm is proposed, which obtains a better PAPR reduction performance and reduces computational complexity compared to the conventional hybrid scheme. In general, the PAPR reduction performance becomes better as the number *U* increases in CH scheme, but the CH scheme has high computational complexity because of the increase of the number of IFFT blocks.The AH scheme offers a better performance; but as compared to SH, it has more computational complexity.

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BIOGRAPHICES

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