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Peak to Average Power Ratio Reduction Techniques

Mohan Reddy[1], Dinesh Reddy[2], Sai Krishna Modugula[3], [4]Dr SPV Subba Rao
[1,2,3] *B. Tech, IV year,* [4]*Professor and Head of ECE Department,*
Department of Electronics and Communication Engineering,
Sreenidhi Institute of Science and Technology, Hyderabad, Telangana, India.

Abstract: ***Multiple-input to multiple-output (MIMO) andorthogonal frequency division multiplexing (OFDM) are the utmost widely used wireless communication system because of its largebenefits and advantageous. Though MIMOOFDM systems have high advantages there is a major drawback that makes the system noisy and the inefficient use of bandwidth. This drawback mainly occurred due to the spikes in the transmitting signal. These spikes make the value of peak to average power ratio of the signal high and results indistortion and noise in the signal. To avoidthese spikes there are number of techniques introduced. We will discuss about the three methods namely partial transmit sequence, clipping and filtering method, Selective Mapping technique. All these methods are used to decrease the high peak to the average ratio by removing the spikes in thesignal. And we will see the outputs obtainedby using MATLAB software. Clipping andfiltering technique would be the simplest technique to lower the peak to average power ratio while partial transmit techniqueis the most efficient method to diminish thepeak to the average power ratio.***

KeyWords- MIMO, OFDM, Selective Mapping, Partial Transmit technique,Clipping and filtering, MATLAB.

I. INTRODUCTION

The increase in the development of new technologies resulted in increase of the demand for the higher quality in providing services for wireless communication. This technologies like 4g and 5g are providing the greater quality of services by lessening the time delay of communications meeting the requirements of the users. The MIMO OFDM systems makes the above requirements possible. A variety of different methods are used to Make radiocommunications very strong, even if there are different channels which include time variations (different times and channel encoding methods), and frequency variations. Many antenna systems are commonly called Multiple Input, Multiple Output systems (MIMO). Many antenna technologies might help to increase the data rate through spatial transmission instead of taming durability. In practice, these two methods are used distinctly or in combination, based on the channel standings. MIMO technology attracts multipath performance using multiple transmitters, and receivers without the usage of extra bandwidth than single input to single output systems to maximize performance and scope. MIMOallows multiple horns to send and receive multiple local streams at the same time. MIMOmakes the antennas work smarter by enabling themto integrate the streaming of data from differentchannels and at different times to effectively increase signal capture capabilities. The smart antennas use a variety of spatial technology, which sets out the optimal use of antennas. If there are more antennas than local streams, additional antennas can upsurge the diversity of the receiving system and increase the width. The major drawback with the MIMO and OFDM systems is that the spikes that are making the peak to the average power ratio high. So as to reduce those spikes we have several reduction techniques and methods. Thispaper will discuss how MATLAB software is used to lessening the PAPR in the MIMO OFDM systems. PAPR can be a reason for transmitter's power amplifier to operate inside the non-linear range active region, that causes substantial signal interference when power is released by amplifier. But, the higher value of PAPR can create digital filters in analog converter, which leads to theaid of a power amplifier. PAPR also introduces intermodulation disruption between sub-carriers and interferes with transmission signal and its constellation. Consequently, the power amplifier shouldwork with a huge reverse power, almost thatof PAPR leading to inadequate performance.So, it is needed to avoid the high PAPR while signal transfer to MIMO-OFDM systems.

II. LITERATURE SURVEY

Zeynab Mohammadi in 2015 outlinedmany new programs, there the bank filter andthe different methods of OFDM name are integrated together, called the UW-OFDM banking system. Mark Beko in 2014 reported a modest and moderate decrease in strength orthogonal multiplexing division systems. This is a problem, it is known beinga hard NP, is exposed to be affected by a complex order 2 systems using a convex consecutive contextual state, which makes it more peaceful to manage.M. Hasan suggested that OFDM as a vital identificationprogram for communication systems werealso accepted at most wireless stages. The

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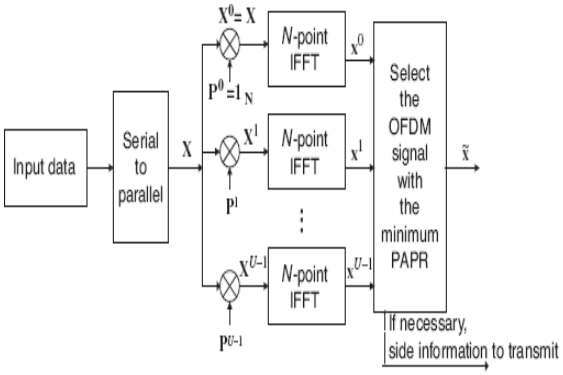
bigproblem OFDM was its Peak to the average Power Ratio (PAPR) limited applications in communication systems. X. Zhong suggested that "using the click-and-filter algorithm reduces PAPR of BER system and performance improved. That cut was analyzed again the filtering method was more efficient than direct cutting because cutting and filtering the algorithm reduces PAPR more than the direct-click algorithm. Clicks and filters method-use filter to remove belt distortion and reduce high regeneration"[4].

Z. Ibraheem suggested that OFDM as the most capable strategy for transmitting the high-resolution information. The worst thingin OFDM systems is P.A.P.R. The partial transfer sequence technique was an effectiveway to reduce PAPR Including the division of data into packets of unconnected blocks. It is noted that as the dimensions of the components enlarged, performance also getting enlightened. S. Bhavi suggested that OFDM was a multi-vehicle system. OFDM has used the orthogonal subcarrier that also exploits the efficient utility of the bandwidth. To attain the OFDM speed transfer is widely used. As the no of the sub- carrier in OFDM rises the Peak to a higher energy level. To reduce the consequence of PAPR no auspicious methods have been introduced. The screening and cleaning process provides an enhancement in decreasing the value of PAPR with a small growth in BER. D. Narendra suggested that the OFDM high data usage was widely used. OFDM provided optimal bandwidth performance because of thereason that the carrier signals were orthogonal to one other and many carriers would be sharingthe existing data. The main and basic setback of the OFDM was the high-to-high-level signal-to-transmit power output. In an attempt to minimize the complication and achieve optimum PAPR value reduction through the PTS system is proposed. It makes the rate loss of data to least while keeping its performance high. UMM Kamruzzaman in 2011 shows that the Turbo wireless link with the OFDM code is being tested in the event that Rayleigh disappears via single transmitter and single receiver system. The encodes structured data isdivided into OFDM-generated streams and simultaneous transmission using antennas. N. Sumita Shankar Manure 2011 The Orthogonal Frequency Division Multiplexing software model has been developed and validated for its wireless messaging applications. BER and the performance of the OFDM high-level model analyzes the Wierlet-based Fourier-based OFDM WGN channel programs and the results are consistent.

III. PAPR REDUCTION TECHNIQUES

A. Selective Mapping

The technique selective mapping is the utmost optimum way of diminishing the value of PAPR while the distortions occurring during the reduction process are very low. In this process the same information carrying input signal gets split into multiple blocks. A signal that consisting a smallor small PAPR value is selected among the portioned sequences that contains the similar information on the transmitter side. The signal we choose will be named as separate information index. The transmitter will use thisinformation to enable the recipient to use the provided information in predicting the signal to be chosen for transmission.



Selective mapping block diagram

In selective mapping method, the input signaldata is converted to parallel form of data afterpassing along the block named serial to parallel. Each parallel data is applied with N-point IFFT after changing the phase of the signal of each parallel data by adding different phases to calculate the peak to the average power ratio value of each data and the signal which is having the least peak to the average power ratio is selected to get theefficient output. The selective mappingtechnique reduces the PAPR efficientlywithout the occurrence of data loss and with low power requirements.

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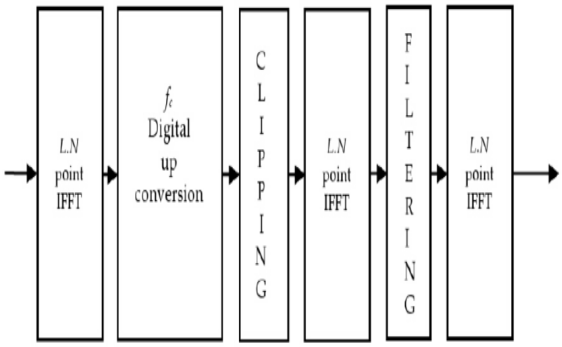
B. Clipping and Filtering

This is a distortion-based technique for the reduction of PAPR value.For this, we use a clipper that limits the signal to a set level called the interval level. The threshold limit is obtained by calculating the square root of average power multiplied to the clipping ratio. we cannot remove the distortion of the band through thefilter when it is outside the band. Such distortions can be removed by filtering and improving BER performance.

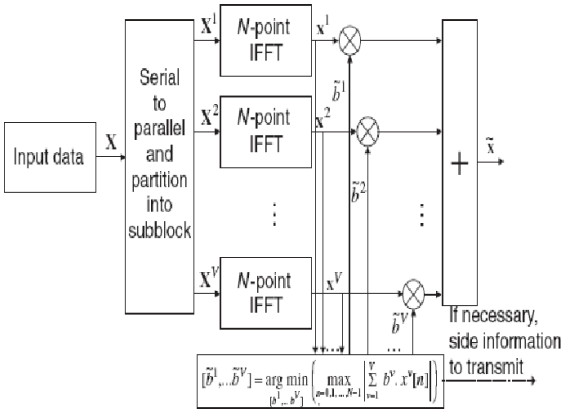


Clipping and filtering

In Clipping and filtering technique, the input signal is converted to N-point IFFT and then signal is passed through the digital up conversion block and the threshold levelof amplitude is set in the clipping block toreduce the spikes in the signal there by reducingthe peak to the average power ratio. Thenfurther filtering block is required to remove thedistortion and after removing the spikes and distortion the signal is again passed through N-point IFFT block to get the signal to its original form. The amplitude clipping method to diminish the peak to the average power ratioof the OFDM signal is one of the simplest methods to implement.

C. Partial Transmit Sequence

It is a best and effective way to minimize PAPR value. This is a distortion-less way of decreasing the PAPR value. This is a modified process for selectivemapping technique. The entire data is split in to sub code blocks where the each block consist of part of information leaving the rest part initialing with zeros. All the blocks are shared equal amount of data and the data is not repeated in those sub-blocks. The data sharing is done such a way that when adding all the data codes will result in the reconstruction of original signal.



Partial transmit sequence block diagram

This technique is highly complex to implement but gives good resultsafter reducing the peak to average powerratio. In this method, the entire code is fragmented into sub-blocks and each sub- block code is rotated with variety of rotationfactors and all these modified sub block codes are combined to generate the different signals called partial transmit signals. When combining these signals, there will be various signals with different PAPR values are generated. Out ofthe variety of signals re-generated, the one that has the minimum peak - average power ratio gets selected for further transmission. The side band

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interference information is to be send along with the transmission signal to the receiver to make it easy for retrieving the signal.

IV. SIMULATION RESULTS

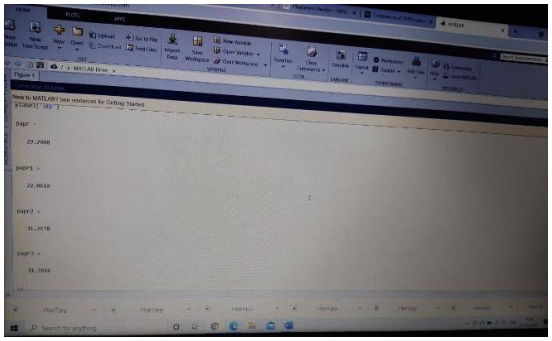

Fig.iv.1

Fig.iv.1 showing the PAPR values of the selective mapping technique, the four different PAPR values of the phase rotated signals of the original signal can be seen and the least value of it is selected.

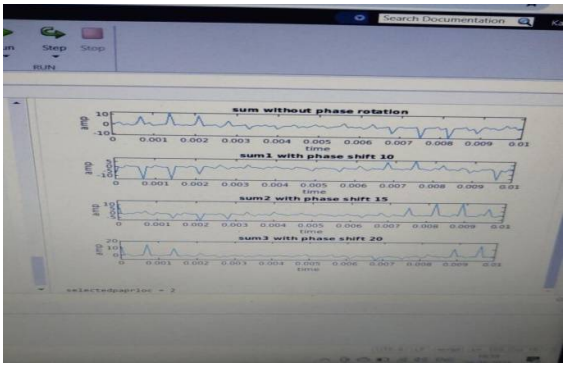

Fig.iv.2

Fig.iv.2 showing the signals with different phase shifts that are carrying the same information, it is seen that the location 2 is the signal that consisting the least PAPR, so it is the signal that is selected for transmission.

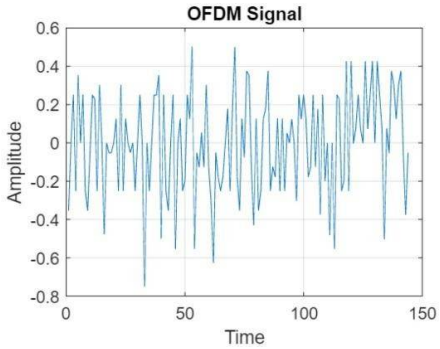

Fig.iv.3

Fig.iv.3 showing the OFDM signal in clipping and filtering technique which was obtained by transforming the randomly generated signal to time domain. This signal has the PAPR value of 0.5 without the clipping operation.

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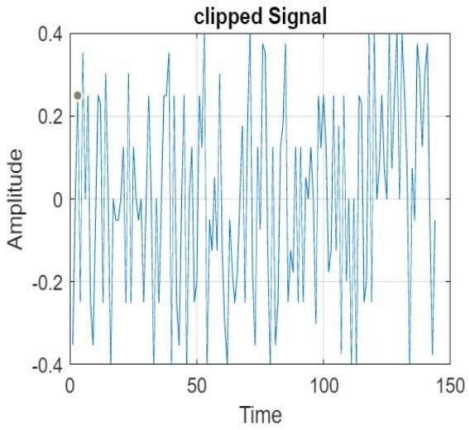

Fig.iv.4

The fig.iv.4 showing the clipped signal of the OFDM signal and the value of PAPR after clipping is found to be 0.4. the value is reduced by 0.1 compared to original signal.

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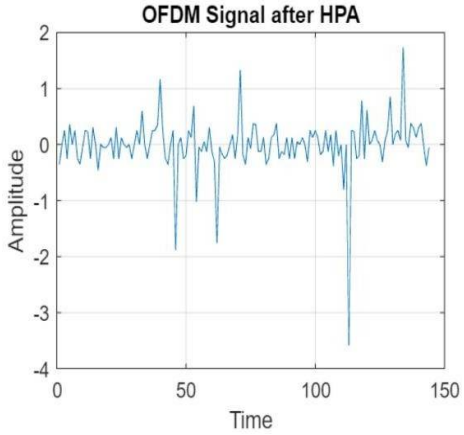

Fig.iv.5

The fig.iv.5 showing the signal after passing through the high-power amplifier before the clipping operation and the PAPR value of this signal is found to be 1.4.

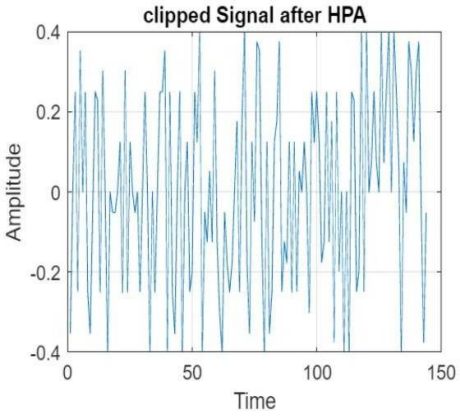

Fig.iv.6

The fig.iv.6 showing the signal when passed through the high-power amplifier after the clipping operation. The value of PAPR is found to be 0.4 where it is reduced by 1 compared to the original signal. So, the performance of the clipping filtering technique is better after passing on HPA.

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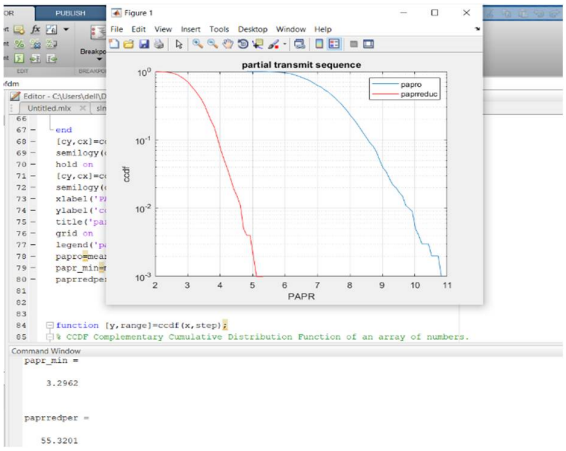

Fig.iv.7

The fig.iv.7 showing the plot of ccdf vs snr of the partial-transmit-technique. It is seen that the original signal having high PAPR value and after reducing using PTS the PAPR value is decreased. The percentage reduction in PAPR value is 55.32 percent.

V. FUTURESCOPE

In this paper, many challenges with the OFDM systems were investigated and acceptable solutions for PAPR reduction were offered. It is a well-known fact that the research is a never-ending process as the fresh beginnings occurs. As a result the channel estimation requires a lot of focus in establishing a good system performance. The PAPR reductions techniques provided in this paper can be used in conjunction with a MIMO-OFDM systems. These techniques can be useful in implementation of 5g technologies.

VI. CONCLUSION

The MIMO concept with the technique of OFDM is the most needed and evolved technology in the present lifestyle of wireless communications. We have come across the major drawback in the MIMO-OFDM systems which is high PAPR value. We have seen how the discussed reduction techniques are helpful in reducing the high value of PAPR. The selective mapping technique and partial transmit technique are distortion-less techniques but have complexity greater than that of clipping and filtering technique, while clipping and filtering technique has some distortions but has lower complexity.

VII. ACKNOWLWDGEMENT

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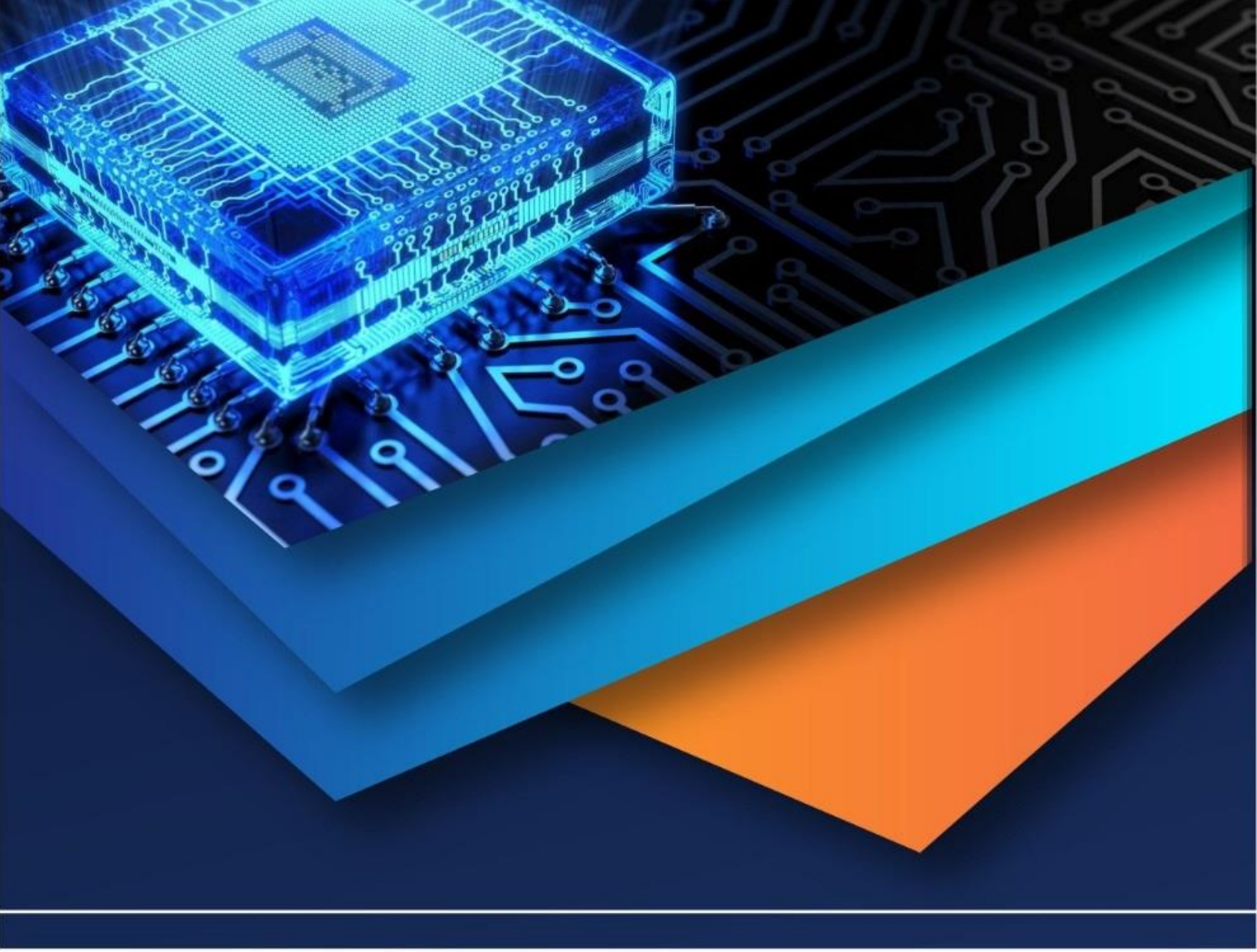

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