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Performance Improvement Of Image Data Communication Over MIMO-WLAN Using Different Wavelet Denoising Techniques

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Abstract—The image transmission over wireless communication system suffers from distortion due to the adverse effect of the channel. The Multiple-Input Multiple-Output based wireless system is a promising high data rate interface technology and wireless multipath fading channel. A method based on Space-Time Block Coding with MIMO setup for use in wireless communication channels. In the comparison is made between the diversity gain of MIMO systems in terms of BER for High QAM modulation techniques. This paper, performance of WLAN system is simulated and bit error rate (BER) performance is observed. On BER level is depend on the modulation type, then the SNR value and channel behavior. In Modulation schemes that we have used in this paper are QPSK, QAM, which further improved image denoising. The results have been shown in the paper for the simulation over various diversity.
Keywords- WLAN, MIMO, STBC, Wavelate transform, Communication channel, etc.

I. INTRODUCTION

The performance of wireless communication systems is mainly governed by the wireless channel environment system. As opposed to the typical static and predictable characteristics of a wired channel, in the wireless channel is rather dynamic and unpredictable, in making an exact analysis of the wireless communication system often difficult. In optimization of the wireless communication system has become critical to the rapid growth of mobile communication services and broadband mobile Internet access services. In fact, the understanding of wireless communication channels will lay the foundation for the development of high performance and bandwidth-efficient wireless transmission technology.

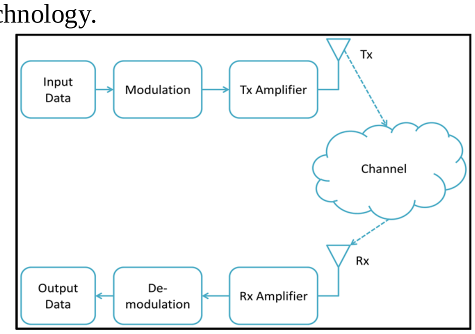

Fig. 1 Wireless communication system

In recent years, there has been a growing interest in the development of potentially mass-producible wireless systems using millimeter waves, wireless local area network systems. To develop millimeter wave wireless LAN systems, we need to know the reflection and transmission characteristics in millimeter wave bands so that we can evaluate indoor multipath propagation characteristic and the interactions of millimeter waves with various objects. In the many propagation characteristics have extensively been studied, several models have focused on specific indoor environments. Lee and Bertoni use a hybrid system ray-mode conversion model for the L-bend and T-junction, respectively, for a 900-MHz signal in a 4-m wide tunnel. The channel capacity of multiple-input multiple-output (MIMO) for a wireless communications system in a rich multipath environment is a larger than that offered by conventional scheme. Channel capacity of WLAN transmission or Multiple Input Multiple Output transmission has been discussed separately in many literatures. However, there are only a few papers dealing with the channel capacity of MIMO–WLAN transmission. In, the feasibility of dual-polarized antennas in the MIMO system has been validated for indoor scenarios. In this article addresses basic issues regarding the wireless LAN systems that operate the 60-GHz frequency band as part of the fourth-generation (4G) technology. The 60- GHz band provides 7 GHz of unlicensed spectrum with a potential to develop a wireless communication system with multi Gbps throughput. The IEEE 802.11 standard committee, one of the major organizations in the WLAN specification development, established the IEEE 802.11ad task group to develop an amendment for the 60-GHz Wireless LAN technology.

All wireless systems must be able to operate in a multipath propagation channel, where an object in the environment can cause multiple reflections to arrive at the receiver system. In general, effective antenna selection and deployment strategies are important for reducing the bit error rate in indoor wireless systems. The transmission quality is estimated with strength of power in the narrowband communication system. Besides, prior knowledge of the characteristics of the channel is necessary for understanding how the signal is affected by the environment. Therefore, many techniques of channel calculation have been developed in recent years. Especially, using ray-tracing method to obtain the impulse response is extensively applied. The different values of dielectric constant and conductivity of materials for different frequencies schemes are carefully considered in channel calculation.

II. MULTIPLE-INPUT MULTIPLE-OUTPUT SYSTEM

OFDM is a special form of multicarrier (MC) that dates back to 1960s [3]. The concept of MC transmission was first explicitly proposed by Chang in 1966. Orthogonal Frequency Division Multiplexing (OFDM) is a multicarrier transmission technique, in which divides the bandwidth into many carriers; each one is modulated by a low rate data stream. OFDM is similar to FDMA, in that the multiple user access is achieved by subdividing the available bandwidth into multiple channels that are then allocated to users. OFDM uses the spectrum much more efficiently by spacing the channels much closer together. Pictorially it can be represented as shown in the figure1.

Multiple-Input Multiple-Output (MIMO) technology is a wireless technology that uses multiple transmitters and multiple receivers to transfer more data at the same time. The MIMO technology takes advantage of a radio-wave in the phenomenon called multipath where transmitted information bounces off walls, ceilings, and other objects, for reaching the receiving antenna multiple times via different angles and at slightly different times. MIMO technology leverages multipath behavior in using multiple, "smart" transmitters and receivers with an added "spatial" dimension to dramatically increase performance and range. The MIMO makes antennas work smarter by enabling them to combine data streams arriving from different paths and different times to effectively increase receiver signal-capturing power. They have smart antennas use spatial diversity technology, which puts surplus antennas to good use. If there are more antennas than spatial streams, and the additional antennas can add receiver diversity and increase range.

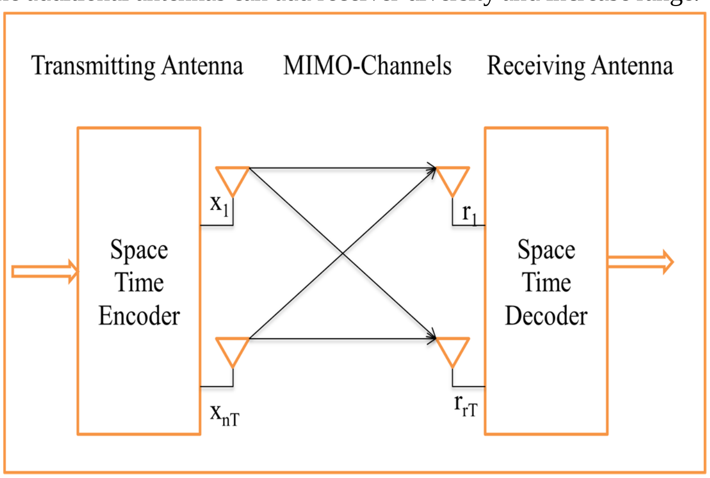

Fig. 2 MIMO system

A. Space Time Block Code

Space-time coding is a method used in multiple antenna systems to not only increase the reliability of the communication system, but also increase. Space-time Codes (STCs) have been implemented in a cellular communication as well as in wireless local area networks. The space time coding is performed in both spatial and temporal domain, for introducing redundancy between signals transmitted from the various antennas at various time periods. In the research on Space Time Code focuses on improving the STBC system performance by employing extra transmits antennas. It can achieve transmit diversity and antenna gain over spatially un-coded systems without sacrificing bandwidth. In a general, the design of STC amounts to finding transmits matrices that satisfy certain optimality criteria.

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III.WAVELET DENOISING TECHNIQUES

The Wavelet Denoising tool to remove noise from signals using wavelet transform. Compared to denoising based on Fourier Transforms, and Wavelet Denoising works better in preserving the shape of the real signal, especially for signals with abrupt changes. The computation of Wavelet Denoising is actually based on multi-level 1D discrete wavelet transform (DWT). After decomposing the input signal into many levels, this tool uses threading to change the values of the detail coefficients. Then it performs inverted wavelet transform on the approximation coefficients and the altered detail coefficients. The result is a denoised signal. The level for the wavelet decomposition, the wavelet type and the method to perform the thresholding can be customized in the dialog of this tool.

A. Biorthogonal Wavelet Transform

The biorthogonal wavelet transform is composed of the decomposition process and the reconstruction scheme with two different wavelets Ψ and $\tilde{\Psi}$. Ψ is used in the decomposition process, and $\tilde{\Psi}$ Is used in the reconstruction process. Ψ and $\tilde{\Psi}$ Are dual and orthogonal to each other, and this relationship is called biorthogonal. Meanwhile, there are two scale functions $\emptyset$ and $\tilde{\emptyset}$ In the above processes, these two scale functions are also dual and orthogonal. One is used in the decomposition process, and the other one is used in the reconstruction process. Therefore, there are four filters in biorthogonal wavelet transform. They are the decomposition, low-pass filter $\{h_n\}$, the decomposition high-pass filter $\{g_n\}$, the reconstruction low-pass filter $\{\tilde{h}N\}$ and the reconstruction, high-pass filter $\{\tilde{g}n\}$. Unlike the orthogonal wavelet transform, the reconstruction filters and the decomposition filters are different.

With filter coefficients $\{h_n\}$, $\{g_n\}$, $\{\tilde{h}n\}$, and $\{\tilde{g}n\}$, fast wavelet transform—Mallat algorithm [6] can be performed. The decomposition and reconstruction processes in $\{C_{N,k}\}$ using the Mallat algorithm are shown in Figure 1. What we can conclude from shown in Figure 3, the essence of Mallat algorithm is filtering the $\{C_{N,k}\}$ signal by decomposition filters $\{h_n\}$ and $\{g_n\}$. Then the results are sub-sampled by factor 2. The results of decomposition have two parts. One part is the signal $\{C_{N-1,k}\}$ generated by the low - pass filter $\{h_n\}$, which can be seen as the approximation of the original signal. And the other part is the signal generated by high-pass filter, which can be seen as the detail of the original signal. The reconstruction process takes the reverse process to reconstruct the original signal by reconstruction filters $\{\tilde{h}n\}$, and $\{\tilde{g}n\}$.

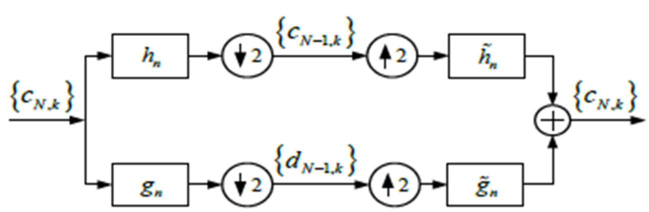
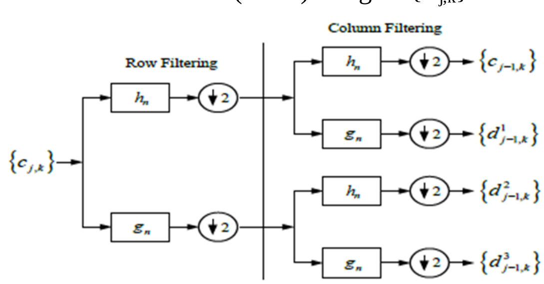


Fig. 3 Decomposition and Reconstruction Processes of 1-D Mallat Algorithm

Similar to the case of 1-D, and multi-resolution analysis of 2-D signals can be described as follows. Denote $\{C_{j,k}\}$ and $\{d^i_{j,k}(i=1,2,3)\}$ as the approximation and detail of 2-D signal f(x,y) at scale j respectively. If the original data can be considered as a 2-D discrete signal after the sampling scheme, the 2-D discrete wavelet transform (WDT) to signal $\{C_{j,k}\}$ can be indicated by Figure 2.



(a)

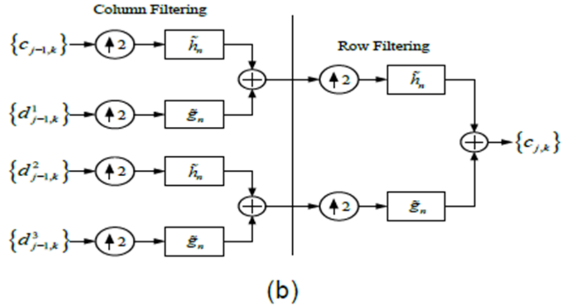


Fig. 4 Separable Filter Banks: (a) Decomposition, (b) Reconstruction

After the horizontal and vertical filtering processes, four different frequency bands $\{C_{j-1,k}\}$, $\{d^1_{j-1,k}\}$, $\{d^2_{j-1,k}\}$, and $\{d^3_{j-1,k}\}$ are obtained respectively. Continue to process with the method discussed above, we can get a pyramidal decomposition. On the contrary, each reconstruction scheme is the reverse process of the decomposition process.

IV. HAAR WAVELET TRANSFORM

There are two types of wavelet transforms the continuous wavelet transform and the discrete wavelet transform (DWT). The wavelet transform can be used to create smaller and accurate images, in which results a Multi-resolution Analysis. The discrete wavelet transform is an implementation of the wavelet transform. It uses a discrete set of the wavelet scales. In other words, in this transform decomposes the signal into a mutually orthogonal set of wavelets, which is the main difference from the continuous wavelet transforming (CWT) system, or its implementation for the discrete time series sometimes called discrete-time continuous wavelet transform (DT-CWT) system. Alfred Haar is a Hungarian mathematician invented the first DWT. The input in Haar wavelet is represented by a list of 2^n numbers. The Haar Wavelet transform firstly input is paired up, the difference is stored and passing the sum. Then the pairing of sum is done to provide the next scale finally resulting in 2^n-1 differences and one final sum.

The Haar wavelet uses both low pass filter and high pass filters. They have used filters for image decomposition first in image columns and then in image rows independently. Four sub-bands produce the output of the first level Haar wavelet. The four sub-band named as LL1,HL1,LH1and HH1.The low frequency sub-band LL1 Can be further decomposed into four sub-bands LL2,HL2,LH2 and HH2.The other three sub-bands are the high frequency parts in the vertical, horizontal and diagonal directions.

The Haar wavelet transform has a number of advantages:

It is a conceptually simple.

It is memory efficient, since it can be calculated in place without a temporary array.

It is exactly reversible without the edge effects that are a problem with other wavelet transforms.

V. RESULTS AND DISCUSSION

The performance of image transmission over MIMO-WLAN using wavelet denoising systems are implemented using MATLAB and graphical results are found showing the bit error rate probabilities of the systems, the parameters which are used to simulate these both proposed systems are shown in table 1

Table 1. Parameters of MIMO-WLAN

S. No.	Parameter	Value
1	IFFT	64
2	Modulation technique	QAM-8
3	No. of Bit	52
3	No. of Symbol	100
4	Carrier Rate	½

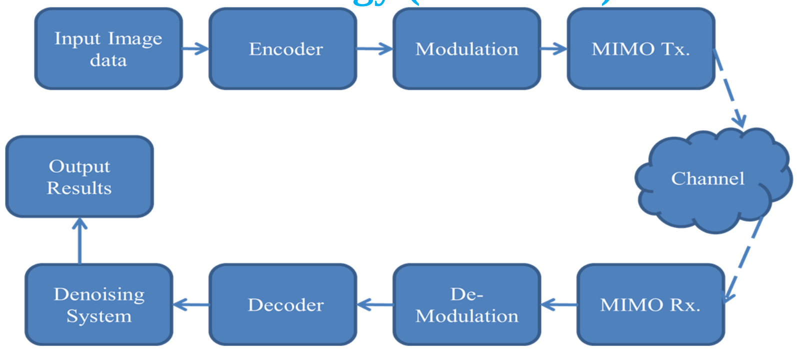


Fig. 5 System block Diagram

Fig. 6 Original Image

Fig. 7 Denioising Image

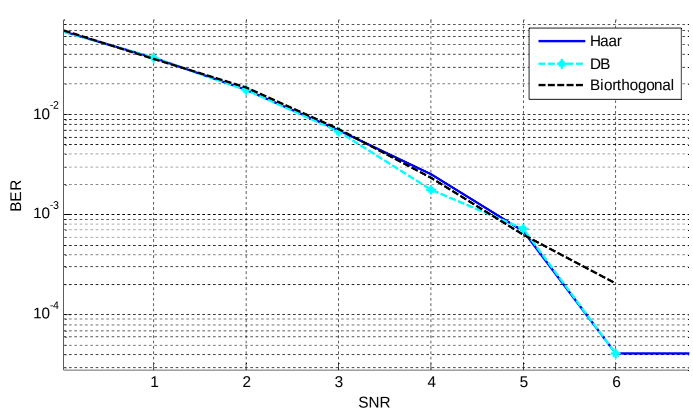


Fig. 5 Comparison for SNR and BER for Different Wavelet

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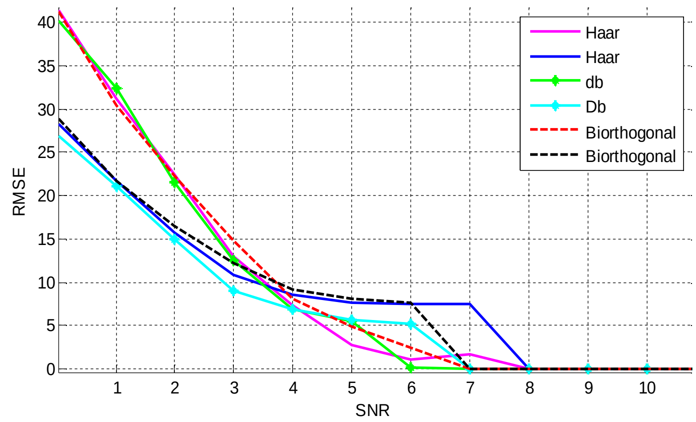

Fig. 6 Comparison for SNR and RMSE for Different Wavelet

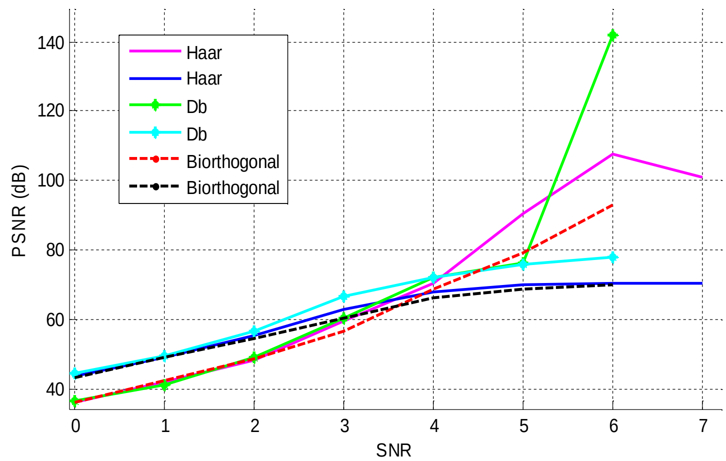

Fig. 7 Comparison for SNR and PSNR for Different Wavelet

VI. CONCLUSION

In this paper, performance enhancement of image data communication over MIMO-WLAN using different wavelet denoising techniques. The image transmission over wireless communication system suffers from distortion due to the adverse effect of the channel. The Multiple-Input Multiple-Output based wireless system using different wavelet transform, in the better results show in simple haar wavelet transform. In future we can use the same threshold function for images as well as texture images to get denoising image with improved performance parameter.

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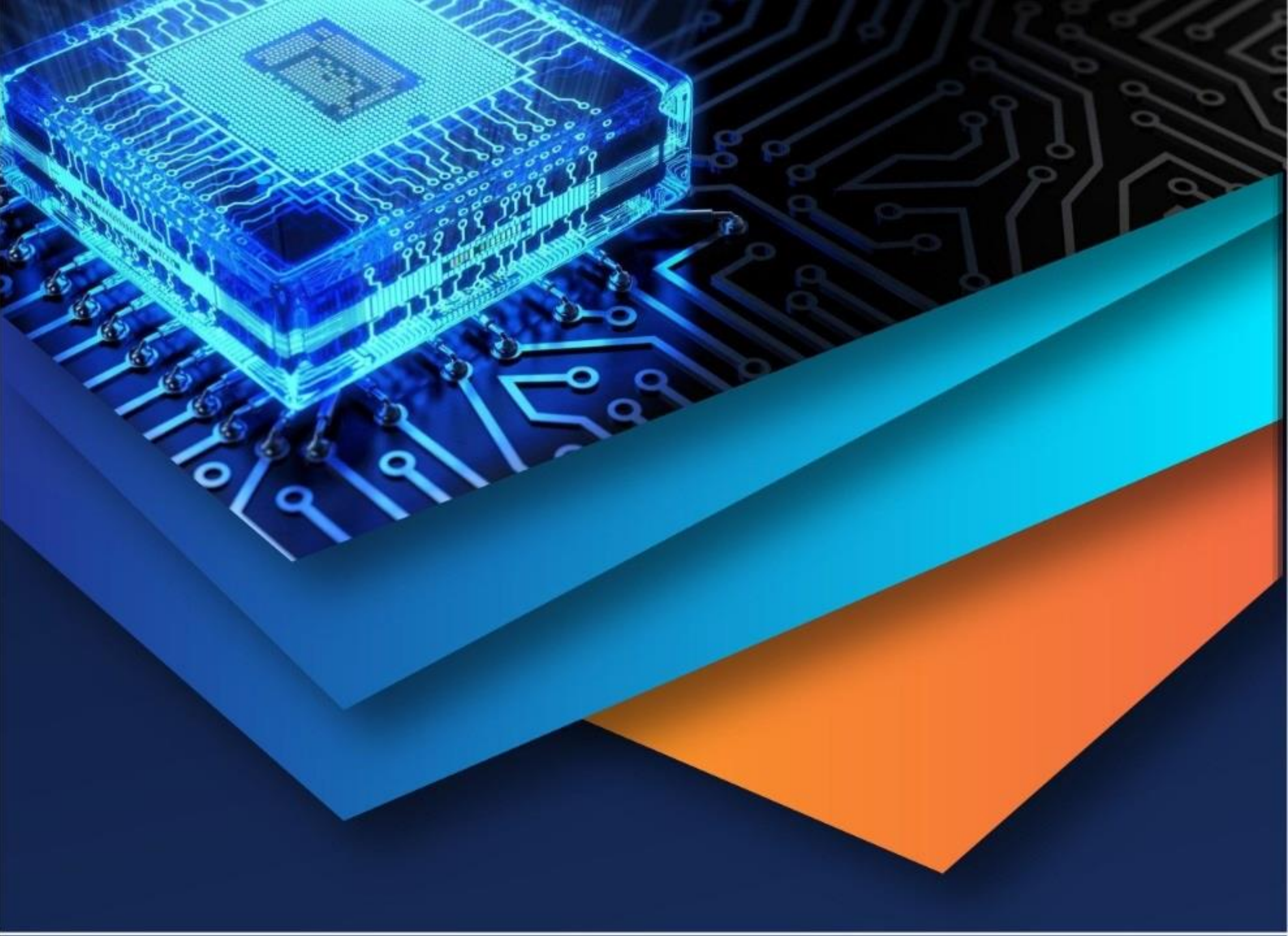

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