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Analysis Of Ber Performance Of Ofdm System Using Different Modulation Methods

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Abstract: - Now a days, demand for wireless systems are reliable and have a high spectral efficiency have increased because of the rapid expand of wireless digital communications. orthogonal frequency division multiplexing (ofdm) has been recognized for its good performance to achieve high data rates. ofdm and multiple input and multiple output (mimo) are two main techniques employed in 4th generation long term evolution (lte) networks. in ofdm, multiple carriers are used and it provide higher level of spectral efficiency as compared to frequency division multiplexing (fdm). in ofdm, because of loss of orthogonality between the subcarriers there is inter carrier interference (ici) and inter symbol interference (isi) and to overcome this problem, the use of cyclic prefixing (cp) is required. this uses 20% of available and width. but we are using the proposed method the bit error rate (ber) is improved and this may lead to higher accuracy rate.

Keywords- **Ofdm, Cp, Ber, Qam, Haar, Dft**

I. INTRODUCTION

The Radio Connectivity Sector of the International Telecommunication Union has developed a group of guidelines for the fourth gen of Telcom systems (ITU-R). The data rate criterion was specified in the International Mobile Telecommunications Advanced project. International Telecommunication Union Radio communication Sector (ITU-R) specified the requirements for 4th generation of cellular systems and International Mobile Telecommunications Advanced project (IMT-Advanced) specified the requirement of data rate. Discrete Wavelet Transform is high presentation digital signal processing method for procedure in applying multicarrier modulation [2].

The multimode transmission method using WPM (wavelet packet modulation) and OFDM (orthogonal frequency division multiplexing) is possible and explained. The WPM using the discrete wavelet transform is a multiplexing transmission method in which data is assigned to wavelet sub bands having different time and frequency resolutions is also explained[3]. Favourable outcome of the OFDM has been achieved that multi-carrier modulation is a well-organized offer for wireless communications.

Wavelet based modulation is a recent type of modulation for transmission of signals which is multicarrier in nature on the channel which is wireless that uses the property of wavelet called orthogonality but other than the sine functions. In this paper brief study is given on the wavelets and the BER performance comparison between the two systems of FFT based OFDM and the DWT based OFDM the analysis done for the Haar wavelet family with the modulations of QAM and simulated in the AGWN channel based on the survey of the OFDM in communication system.

II. WAVELET TRANSFORM and HAAR TEANSFORM

A transform of this kind is the Wavelet transform. It is responsible for the representation of time and frequency. (Other transforms, such as short time Fourier transforms and Wigner distributions, can also provide this information.) It's not uncommon for a particular spectral component to be of particular interest at any given time.Knowing the time intervals at which these specific spectral components arise can be very useful in these situations. A wavelet is a mathematical function used to divide a given function or continuous-time signal into different scale components. Usually one can assign a frequency range to each scale component. Each scale component can then be studied with a resolution that matches its scale.

Wavelet transform (WT) are very powerful compared to Fourier transform (FT) because its ability to describe any type of signals both in time and frequency domain simultaneously while for FT, it describes a signal from time domain to frequency domain. The Haar transform is the simplest of the wavelet transforms. This transform crossmultiplies a function against the Haar wavelet with various shifts and stretches, like the Fourier transform cross multiplies a function against a sine wave with two phases and many stretches. The Haar functions are an orthogonal family of switched rectangular waveforms where the amplitudes can differ from one function to another

III. PROPOSED METHOD

The use of the Discrete Fourier Transform for the implementation of OFDM has been suggested in previous works. In OFDM, the wavelet transform has the power to replace the DFT. The wavelet transform is a method for analyzing signals in both the time and frequency domains at the same time. It's a multi-resolution processing technique in which the input signal is decomposed into various frequency components for scale resolution analysis. Every type of wavelet filter can be used to optimize the method to suit the needs, and wavelets can also be used to produce multi-resolution signals.

A cyclic prefix is used in conventional OFDM systems to minimize ISI and ICI, which use 20% of available bandwidth and trigger bandwidth incompatibility, but it is not used in wavelet-based orthogonal frequency division multiplexing systems. Wavelet-based OFDM is additionally versatile, and since it gives better symmetry, it decreases the requirement for cyclic prefixing, which is expected to save symmetry in DFT-based OFDM. Thus, OFDM dependent on wavelets utilizes less transfer speed than OFDM dependent on DFT.

The discrete wavelet change (DWT) input sign will go through an assortment of channels, which will decay the sign into low pass and high pass groups. The BER is calculated by averaging through all symbols for a given value of SNR, and the same operation is repeated for all SNR values, yielding the final BERs. First, for different modulation techniques, the utility of DFT-based OFDM and wavelet-based OFDM is calculated. In wavelet-based OFDM for QPSK, 16-QAM, and 64-QAM, different wavelet type's daubechies2 and haar are used. MATLAB software is used to implement this work. MATLAB software is user friendly and very popular among researcher because of its advantages and easy handling.

IV. CODES FOR THE ABOVE OUTPUTS

Code for Performance of OFDM using FFT for different channel:

```
 % Implementation convential-OFDMA system
 clc; clearall; closeall;
 % nsym=1024;% no of symbols
% size of fft M=2;
nsub=16;% no of users
rx=randint(nsym,nsub,[0,M-1]);
rxmod=pskmod(rx,M)';% Modulate IQ
xt=ifft(rxmod);% apply iffteqn(1)
  Eb_N0=[0:3:30];
  for ii=1:length(Eb_N0) y3=awgn(xt,Eb_N0(ii)-db(std2(xt)));
%
  y3f=fft(y3);
  %
  y3m=pskdemod(y3f,M)';
  % [nnnnbr3(ii)]=biterr(rx,y3m);
end
  semilogy(Eb_N0,br3,'rx-'); hold off; gridon;
legend('AWGN channel fft based OFDM');
title('Performance of OFDM using FFT for different Channels') xlabel('---Eb/N0');
ylabel('---BER');
```

Code for BER analysis using QPSK modulation:

```
 clcclearall closeall
 st1 = 27221; st2 = 4831; % States for random number generator n = 7; k = 4; % Parameters for Hamming code
 EE=[0:6];
type={'haar','db2'};
cl={'-r','-ob'};
 msg = randi([0 1],1024*16,1); % Data to encode
 code = encode(msg,n,k,'hamming/binary'); % Encoded data
  % With Interleaving
%
inter = randintrlv(code,st2); % Interleave.
  dataMod=pskmod(inter,4); % modulation dataMod=[dataMod;dataMod(1:10)];
for j=1:length(type) %for loop wn=type{j}; %tyep of wavelet fori=1:length(EE)
a=dataMod(1:end/2);% a1(approxmition)
b=dataMod(end/2+1:end); %d1(detaiel)
 x=idwt(a,b,wn); %idwt
15
 chx=awgn(x,EE(i)-db(std(x))); % indoor channel [a1,b1]=dwt(chx,wn); % rx dwt
rMod=zeros(size(dataMod));
 rMod(1:end/2)=a1; %cobin a1 with rmod rMod(end/2+1:end)=b1; % combain b1 with rmod rMod=rMod(1:end-10);
inter_err1=pskdemod(rMod,4); % demodulation deinter = randdeintrlv(inter_err1,st2); % Deinterleave.
deinter(deinter>0)=1;
decoded = decode(deinter,n,k,'hamming/binary'); % Decode.
  %disp('Number of errors and error rate, withinterleaving:'); [nb(i),br(i)] = biterr(msg,decoded); % Errorstatistics
end semilogy(EE,smooth(br),cl{j});hold on end
 fori=1:length(EE) dmod=pskmod(code,4); % modulation dft dataif=ifft(dmod); % ifft
cho=awgn(dataif,EE(i)-db(std(dataif))); %indoor chanel dataf=fft(cho); %rxfft
daDmod=pskdemod(dataf,4);% demodulation
  daDmod(daDmod>0)=1;
decoded = decode(daDmod,n,k,'hamming/binary'); % Decode.
15
  %disp('Number of errors and error rate, withinterleaving:'); [nb(i),br(i)] = biterr(msg,decoded); % Errorstatistics
end
semilogy(EE,smooth(br),'-xm');hold off;gridon
legend('Haar','db2','FFT'),title('BER analysis using QPSK modulation')
```

Code for BER vs SNR using 16-QAM :

```
clcclearall closeall
```

```
 M=16;
rand('state',0)
data=randi([0 M-1],1,20000); N=numel(data);
modd=qammod(data,M);
 ac=modd(1:N/2); dc=modd(N/2+1:N); wt={'haar','db2'};
cl={'-r','-b','-k'}; E=[0:12];
 for j=1:length(wt) iddata=idwt(ac,dc,wt{j});

fori=1:length(E)
ch=awgn(iddata,E(i)-db(std(iddata)));
[mac,mdc]=dwt(ch,wt{j});
rdata=[conj(mac) conj(mdc)]; rdata=qamdemod(rdata,M);
[n,br(i)]=biterr(data,rdata(1:length(data))); end
 semilogy(E,br,cl{j});hold on
 end
% clc;
% clear all
% M=16;
% rand('state',0)
% data=randi([0 M-1],1,20000);
% modd=qammod(data,M);
% dataif=ifft(modd);
% E=[0:12];
% for i=1:length(E)
%ch=awgn(dataif,E(i)-db(std(dataif)));
%dataf=fft(ch);
%rdata=qamdemod(dataf,M);
%[n1,br1(i)]=biterr(data,rdata(1:length(data)));
% end
 fori=1:length(E) dmod=qammod(data,M);
dataif=ifft(dmod); cho=awgn(dataif,E(i)-db(std(dataif)));
dataf=fft(cho); daDmod=qamdemod(dataf,M);
 %disp('Number of errors and error rate, withinterleaving:'); [nb(i),br1(i)] = biterr(data,daDmod); % Errorstatistics
end
semilogy(E,br1,'-k');hold on title('BER vs SNR using 16 QAM'); xlabel('SNR');ylabel('BER')
gridon
legend('DWT-Haar','DWT-db2','FFT')
```

Code for BER analysis using 64-QAM modulation:

```
Clclclearall closeall
 % st1=2;st2=7; st1 = 27221;
st2 = 4831; % States for random number generator n = 7; k = 4; % Parameters for Hamming code M=64;
EE=[0:12];
type={'haar','db2'};cl={'-r','-b'};
 msg = randi([0 1],100*200,1); % Data to encode
 code = encode(msg,n,k,'hamming/binary'); % Encoded data

 % With Interleaving
%
inter = randintrlv(code,st2); % Interleave.
 dataMod=qammod(inter,M);
dataMod=[dataMod;dataMod(1:10)]; for j=1:length(type)
wn=type{j}; fori=1:length(EE)
a=dataMod(1:end/2);b=dataMod(end/2+1:end);
x=idwt(a,b,wn); chx=awgn(x,EE(i)-db(std(x)));
[a1,b1]=dwt(chx,wn);
 rMod=zeros(size(dataMod));
 rMod(1:end/2)=conj(a1); rMod(end/2+1:end)=conj(b1);
rMod=rMod(1:end-10);
inter_err1=qamdemod(rMod,M);
deinter = randdeintrlv(inter_err1,st2); % Deinterleave.
deinter(deinter>0)=1;
decoded = decode(deinter,n,k,'hamming/binary');
 % Decode.
 %disp('Number of errors and error rate, withinterleaving:'); [nb(i),br(i)] = biterr(msg,decoded); % Errorstatistics
end semilogy(EE,smooth(br),cl{j});hold on end
fori=1:length(EE) dmod=qammod(code,M);
dataif=ifft(dmod); cho=awgn(dataif,EE(i)-db(std(dataif)));
dataf=fft(cho); daDmod=qamdemod(dataf,M);
daDmod(daDmod>0)=1;
decoded = decode(daDmod,n,k,'hamming/binary'); % Decode.
 %disp('Number of errors and error rate, withinterleaving:'); [nb(i),br(i)] = biterr(msg,decoded); % Errorstatistics
End
semilogy(EE,smooth(br),'-m');hold off;gridon
legend('Haar','db2','fFT'),title('BER analysis using 64-QAM modulation')
```

IV. SIMULATION RESULTS AND DISCUSSION

In this section various results have been compared based on proposed method with exiting design and discussed the simulation result. Also code behinds output are also discussed. It is obvious from the fig. 6.1(b), fig. 6.1(c) and fig. 6.1(d) that the BER execution of wavelet based OFDM is superior to the DFT based OFDM. Fig. 6.1(b) demonstrates that db2 performs better when QPSK is utilized. Fig. 6.1(d) shows that when 16-QAM is utilized db2 and haar have comparative execution however much better than DFT. Fig. 6.1(e) , where 64-QAM is utilized haar and db2 performs better compared to DFT.

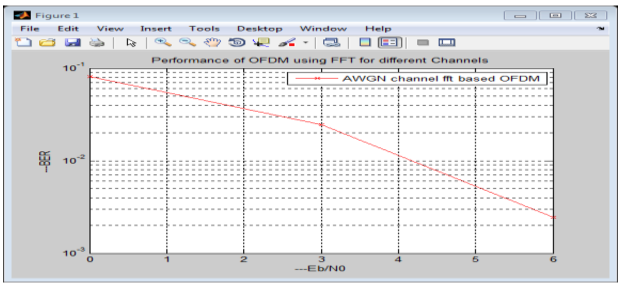

Fig 1: BER of Conventional OFDM using FFT.

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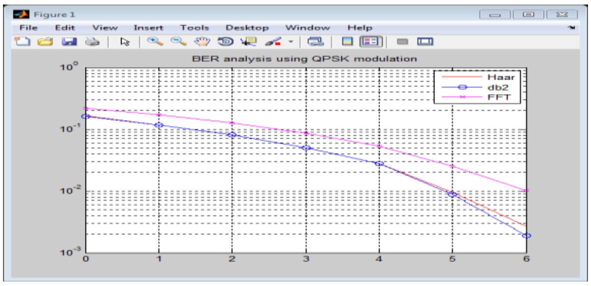

Fig 2: BER using QPSK Modulation.

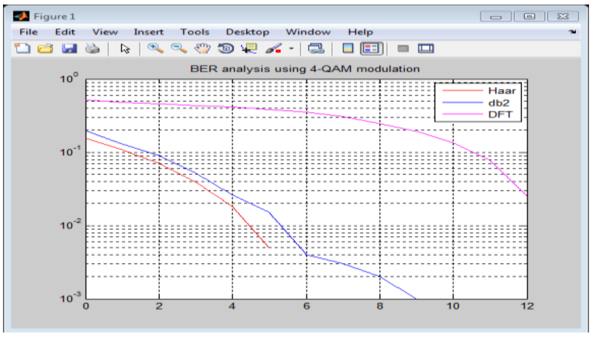

Fig 3: BER vs SNR using 4-QAM.

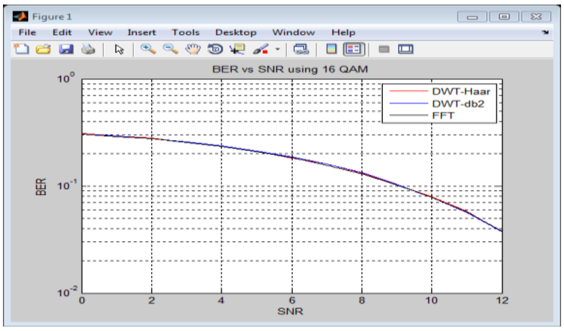

Fig 4 BER vs SNR using 16-QAM.

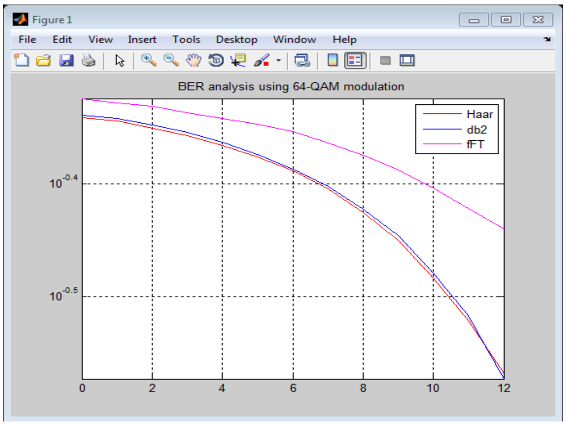

Fig 5: BER vs SNR using 64-QAM

Table 1 BER Performance Of SWT And FFT Based OFDM System Using 64-QAM

S.No	Modulation Techniques	Transformation Techniques	SNR	BER
1	QAM-64	FFT	6db	$0.0415*10^{-1.38}$
2	QAM-64	Haar	6db	$0.01895*10^{-1.7}$
3	QAM-64	Db2	6db	$0.020078*10^{-1.169}$

Table 2 BER Performance Of SWT And FFT Based OFDM System Using 16-QAM.

S.No	Modulation Techniques	Transformation Techniques	SNR	BER
1	QAM-16	FFT	6db	$0.0413*10^{-1.38}$
2	QAM-16	Haar	6db	$0.01896*10^{-1.7}$
3	QAM-16	Db2	6db	$0.02006*10^{-1.169}$

Table 3 BER Performance Of SWT And FFT Based OFDM System 4-QAM

S.No	Modulation Techniques	Transformation Techniques	SNR	BER
1	QAM-4	FFT	6db	$0.0410*10^{-1.38}$
2	QAM-4	Haar	6db	$0.01955*10^{-1.7}$
3	QAM-4	Db2	6db	$0.02004*10^{-1.169}$

V. CONCLUSION

In this paper, we compared the efficiency of a wavelet-based OFDM system to a DFT-based OFDM system. According to the output curve, the BER curves obtained from wavelet-based OFDM are greater than those obtained from DFT-based OFDM. For implementation, we used three modulation techniques: QPSK, 16 QAM, and 64 QAM, which are all used in LTE. Various types of filters can be used for wavelet-based OFDM because of the various wavelets available. We used daubechies2 and haar wavelets, which both provide the best results at different SNR intervals.

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