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Wireless Communication, Intake 42 %%%%%%%%%%

%%%%%%%%%%

LTE, LAB 1 %%%%%%%%%%

%%%

Initializtion

```
clc
clear all

% System Paramters
EbNo_range=0:20;
N_OFDMsymbols=1;
ModulationOrder=64;
N_Subcarriers=512;
N_DataSubcarriers=300;    % 300 Subcarriers corresponding to 5MHz BW
SamplingRate=7.68e6;
CP_length=4.7e-6;        %normal CP=4.7us, extended=16.67us
maxDelay=3e-6;
iteration=1e3;
berl=0;
N_CP_Bits =round(SamplingRate*CP_length);

% Derived Paramters
N_Bits=N_DataSubcarriers*log2(ModulationOrder);
N_Bits=N_Bits*N_OFDMsymbols;
no_Path=round(maxDelay*SamplingRate);

BER = [];
for EbNo=EbNo_range
```

```
for x=1:iteration
```

Transmitter Side

Bit Stream Generation

```
T_Bits = randi([0 1],N_Bits,1);

% Symbol Mapper
Symbols=qammod(T_Bits,ModulationOrder,'InputType','Bit');

% Series to Parallel

SymbolsParallel=reshape(Symbols,N_DataSubcarriers,N_OFDMsymbols);

% Guard add
GuardSide=(N_Subcarriers-N_DataSubcarriers)/2;

InputIFFT=[zeros(GuardSide,N_OFDMsymbols);SymbolsParallel;zeros(GuardSide,N_OFDMsymbols)];

% IFFT
OutputIFFT=ifft(InputIFFT);

% CP Insertion
[Rows ,Cols] = size(OutputIFFT);
OFDMsymbols=[OutputIFFT((Rows-N_CP_Bits+1):Rows,:);
OutputIFFT];
h=sqrt(1/(2*no_Path))*(randn(no_Path,1)+1i*randn(no_Path,1));

% Parallel to Series
Transmitted_Sig=reshape(OFDMsymbols,(Rows+N_CP_Bits),1);
```

AWGN

```
Eb = ((ModulationOrder-1)*2^2)/
(6*log2(ModulationOrder)*N_Subcarriers);
No = Eb/(10^(EbNo/10));
```

Receiver Side

```
Received_Sig=(conv(h,Transmitted_Sig));
Received_Signal=Received_Sig(1:N_Subcarriers+N_CP_Bits,:);
[R ,C] = size(Received_Signal);
Noise = randn(R,1)+1i*randn(R,1);
Received_Signal=(Received_Signal+sqrt(No/2)*Noise);

% CP Removal
CP_removal=Received_Signal(N_CP_Bits+1:end-N_CP_Bits,:);

% FFT
OutputFFT=fft(CP_removal,N_Subcarriers);
```

```
% Equalization
H=fft(h,N_Subcarriers);
%H=H(:,N_CP_Bits+1:end-N_CP_Bits);
R_Signal=OutputFFT./H;

% Guard removal
R_Symbols=R_Signal(GuardSide+1:Rows-GuardSide,:);

% Symbol Demapper
R_Bits1 =
gamdemod(R_Symbols,ModulationOrder,'OutputType','Bit');
[r ,c]=size(R_Bits1);
R_Bits = reshape(R_Bits1,c*r,1);
[ber , berRatio] = biterr(R_Bits,T_Bits);
ber1=ber1+berRatio;

end
% Bit Error Rate
BER = [BER ber1/iteration];
ber1=0;
end

semilogy(EbNo_range,BER)
title('Bit Error Rate of OFDM')
xlabel('SNR')
ylabel('BER')
```

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