Appendix

```
%% ..... {ACO-OFDM for visible ilght communicayion systems}.....
% zero forcing equalizer M-QAM modulation
clc;
clf;
clear all;
close all;
N=2048;%Total number of subcarier to be transmitted at the transmitter
Ncp =2; %Length of the cyclic prefix
ptxmin=90*10^-3;
ptxmax=400*10^-3;
%% case one
ptx_mean1=100*10^-3;
ptx_bias1=95*10^-3;% ptx_bias1 >= ptxmin
sigmax1=ptx_mean1*sqrt(2*pi);
epslontop1=ptxmax-ptx_bias1;
epslonbottom1=max((ptxmin-ptx_bias1),0);
lamdatop1=epslontop1/sigmax1;
lamdabottom1=epslonbottom1/sigmax1;
Ps_elec1=sigmax1^2;
K1 = qfunc(lamdabottom1)-qfunc(lamdatop1);%attenuation factor
fylamdatop1=normpdf(lamdatop1,0,1);
fylamdabottom1=normpdf(lamdabottom1,0,1);
polk1=lamdabottom1*(fylamdabottom1-fylamdatop1);
mshe1=fylamdatop1*(lamdatop1-lamdabottom1);
sigma_clip_squ1=          Ps_elec1*((K1*(lamdabottom1^2+1))-(2*K1^2)-
(polk1)-(mshe1)+(qfunc(lamdatop1)*(lamdatop1-lamdabottom1 )^2));
```

```
GDc1=(sqrt(2*pi)*sigmax1^2)/((sqrt(2*pi)*sigmax1^2)+(4*sigmax1*ptx_
bias1)+(2*sqrt(2*pi)*ptx_bias1^2));
%% case two
ptx_mean2=100*10^-3;
ptx_bias2=50*10^-3;%ptxbias < ptxmin
%sigmax2=ptx_mean2*sqrt(2*pi);
sigmax2=ptx_mean2*sqrt(2*pi);
epslontop2=ptxmax-ptx_bias2;
epslonbottom2=max((ptxmin-ptx_bias2),0);
%lamdatop2=1.54;
%lamdabottom2=0.07;
lamdatop2=epslontop2/sigmax2;
lamdabottom2=epslonbottom2/sigmax2;
K2 = qfunc(lamdabottom2)-qfunc(lamdatop2);%attenuation factor
fylamdatop2=normpdf(lamdatop2,0,1);
fylamdabottom2=normpdf(lamdabottom2,0,1);
polk2=lamdabottom2*(fylamdabottom2-fylamdatop2);
mshe2=fylamdatop2*(lamdatop2-lamdabottom2);
sigma_clip_squ2=          Ps_elec2*((K2*(lamdabottom2^2+1))-(2*K2^2)-
(polk2)-(mshe2)+(qfunc(lamdatop2)*(lamdatop2-lamdabottom2 )^2));
GDc2=(sqrt(2*pi)*sigmax2^2)/((sqrt(2*pi)*sigmax2^2)+(4*sigmax2*ptx_
bias2)+(2*sqrt(2*pi)*ptx_bias2^2));
gh_opt=1;
%the electricalSNR per bit for ZF equalizer
GB=(( N-2)/N)*0.5;
Gt=N/(N+Ncp);
eyta_elecdB=0:10:50;
eyta_elecr=10.^(eyta_elecdB./20);
```

```
M=[2 4 8 16 32 64 ];
pb_elec1=Ps_elec1./log2(M);
pb_elec2=Ps_elec2./log2(M);
ss1=(GB*sigma_clip_squ1)./pb_elec1;
%ee1=(GB.*eyta_elecr.^-1)/(Gt*GDc1*gh_opt);
%effectiveSNR1=K1^2./(ss1+ee1);
mm1=(GB.*eyta_elecr.^-1)/(GDc1*gh_opt^2);
effectiveSNR1=K1^2./(ss1+mm1);
ss2=(GB*sigma_clip_squ2)./pb_elec2;
ee2=(GB.*eyta_elecr.^-2)/(Gt*GDc2*gh_opt^2);
mm2=(GB.*eyta_elecr.^-1)/(GDc2*gh_opt^2*gh_opt^2);
effectiveSNR2=K2^2./(ss2+mm2);
%BER calculation
%case one
BER11=(4*(sqrt(M(1))1)/(log2(M(1))*sqrt(M(1))))*qfunc(real(sqrt((3*log
2(M(1)).*effectiveSNR1)/(M(1)-1))))+(4*(sqrt(M(1))2)/(log2(M(1)) *
sqrt(M(1))))*qfunc(real(3*sqrt((3*log2(M(1)).*effectiveSNR1)/(M(1)-
1))));
BER12=(4*(sqrt(M(2))1)/(log2(M(2))*sqrt(M(2))))*qfunc(real(sqrt((3*log
2(M(2)).*effectiveSNR1)/(M(2)1))));+(4*(sqrt(M(2))2)/(log2(M(2))*sqrt(
M(2))))*qfunc(real(3*sqrt((3*log2(M(2)).*effectiveSNR1)/(M(2)-1))));
BER13=(4*(sqrt(M(3))1)/(log2(M(3))*sqrt(M(3))))*qfunc(real(sqrt((3*log
2(M(3)).*effectiveSNR1)/(M(3)1))))+(4*(sqrt(M(3))2)/(log2(M(3))*sqrt(M
(3))))*qfunc(real(3*sqrt((3*log2(M(3)).*effectiveSNR1)/(M(3)-1))));
BER14=(4*(sqrt(M(4))1)/(log2(M(4))*sqrt(M(4))))*qfunc(real(sqrt((3*log
2(M(4)).*effectiveSNR1)/(M(4)1))))+(4*(sqrt(M(4))2)/(log2(M(4))*sqrt(M
(4))))*qfunc(real(3*sqrt((3*log2(M(4)).*effectiveSNR1)/(M(4)-1))));
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BER16=(4*(sqrt(M(6))1)/(log2(M(6))*sqrt(M(6))))*qfunc(real(sqrt((3*log
2(M(6)).*effectiveSNR1)/(M(6)1))))+(4*(sqrt(M(6))2)/(log2(M(6))*sqrt(M
(6))))*qfunc(real(3*sqrt((3*log2(M(6)).*effectiveSNR1)/(M(6)-1))));
%case two
BER21=(4*(sqrt(M(1))1)/(log2(M(1))*sqrt(M(1))))*qfunc(real(sqrt((3*log
2(M(1)).*effectiveSNR2)/(M(1)1))))+(4*(sqrt(M(1))2)/(log2(M(1))*sqrt(M
(1))))* qfunc(real(3*sqrt((3*log2(M(1)).*effectiveSNR2)/(M(1)-1))));
BER22=(4*(sqrt(M(2))1)/(log2(M(2))*sqrt(M(2))))*qfunc(real(sqrt((3*log
2(M(2)).*effectiveSNR2)/(M(2)1))))+(4*(sqrt(M(2)2)/(log2(M(2))*sqrt(M(
2))))*qfunc(real(3*sqrt((3*log2(M(2)).*effectiveSNR2)/(M(2)-1))));
BER23=(4*(sqrt(M(3))1)/(log2(M(3))*sqrt(M(3))))*qfunc(real(sqrt((3*log
2(M(3)).*effectiveSNR2)/(M(3)1))))+(4*(sqrt(M(3))2)/(log2(M(3))*sqrt(M
(3))))*qfunc(real(3*sqrt((3*log2(M(3)).*effectiveSNR2)/(M(3)-1))));
BER24=(4*(sqrt(M(4))1)/(log2(M(4))*sqrt(M(4))))*qfunc(real(sqrt((3*log
2(M(4)).*effectiveSNR2)/(M(4)-1))))+(4*(sqrt(M(4))
2)/(log2(M(4))*sqrt(M(4))))*qfunc(real(3*sqrt((3*log2(M(4)).*effectiveSN
R2)/(M(4)-1))));
BER26=(4*(sqrt(M(6))1)/(log2(M(6))*sqrt(M(6))))*qfunc(real(sqrt((3*log
2(M(6)).*effectiveSNR2)/(M(6)1))))+(4*(sqrt(M(6))2)/(log2(M(6))*sqrt(M
(6))))*qfunc(real(3*sqrt((3*log2(M(6)).*effectiveSNR2)/(M(6)-1))));
figure
hold on
semilogy(eyta_elecdB,BER12,'gd-')
semilogy(eyta_elecdB,BER22,'k^-')
semilogy(eyta_elecdB,BER14,'squ-')
semilogy(eyta_elecdB,BER24,'m<-')
semilogy(eyta_elecdB,BER16,'co-')
semilogy(eyta_elecdB,BER26,'rh-')
```

```
legend('ACO-case one  M=4','ACO-case tow  M=4',4)
title('BER performance of VLC-OFDM in AWGN')
xlabel('SNR=Eb(elec))/No [dB]')
ylabel('BER')
grid on
hold off
%% ..... {ACO-OFDM for visible light communication systems}.....
% zero forcing equalizer, variable p_tx,mean
clc;
clf;
clear all;
close all;
N=2048;%Total number of subcarier to be transmitted at the transmitter
Ncp =2; %Length of the cyclic prefix
ptxmin=90*10^-3;
ptxmax=400*10^-3;
%% case two
ptx_mean2=300*10^-3;
ptx_mean2a=150*10^-3;
ptx_mean2b=95*10^-3;
ptx_biasc=0;%ptxbias < ptxmin
sigmax=ptx_mean2*sqrt(2*pi);
sigmax2a=ptx_mean2a*sqrt(2*pi);
sigmax2b=ptx_mean2b*sqrt(2*pi);
epslontopc=ptxmax-ptx_biasc;
epslonbottomc=max((ptxmin-ptx_biasc),0);
lamdatop2=epslontopc/sigmax2;
lamdabottom2=epslonbottomc/sigmax2;
```

```
lamdatop2a=epslontopc/sigmax2a;
lamdabottom2a=epslonbottomc/sigmax2a;
lamdatop2b=epslontopc/sigmax2b;
lamdabottom2b=epslonbottomc/sigmax2b;
Ps_elec2=sigmax2^2;
Ps_elec2a=sigmax2a^2;
Ps_elec2b=sigmax2b^2;
K2 = qfunc(lamdabottom2)-qfunc(lamdatop2);%attenuation factor
K2a = qfunc(lamdabottom2a)-qfunc(lamdatop2a);%attenuation factor
K2b = qfunc(lamdabottom2b)-qfunc(lamdatop2b);%attenuation factor
fylamdatop2=normpdf(lamdatop2,0,1);
fylamdabottom2=normpdf(lamdabottom2,0,1);
fylamdatop2a=normpdf(lamdatop2a,0,1);
fylamdabottom2a=normpdf(lamdabottom2a,0,1);
fylamdatop2b=normpdf(lamdatop2b,0,1);
fylamdabottom2b=normpdf(lamdabottom2b,0,1);
%%%%%
polk2=lamdabottom2*(fylamdabottom2-fylamdatop2);
mshe2=fylamdatop2*(lamdatop2-lamdabottom2);
sigma_clip_squ2=          Ps_elec2*((K2*(lamdabottom2^2+1))-(2*K2^2)-
(polk2)-(mshe2)+(qfunc(lamdatop2)*(lamdatop2-lamdabottom2 )^2));
polk2a=lamdabottom2a*(fylamdabottom2a-fylamdatop2a);
mshe2a=fylamdatop2a*(lamdatop2a-lamdabottom2a);
sigma_clip_squ2a=    Ps_elec2a*((K2a*(lamdabottom2a^2+1))-(2*K2a^2)-
(polk2a)-(mshe2a)+(qfunc(lamdatop2a)*(lamdatop2a-lamdabottom2a )^2));
polk2b=lamdabottom2b*(fylamdabottom2b-fylamdatop2b);
mshe2b=fylamdatop2b*(lamdatop2b-lamdabottom2b);
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```
sigma_clip_squ2b=    Ps_elec2b*((K2b*(lamdabottom2b^2+1))-(2*K2b^2)-
(polk2b)-(mshe2b)+(qfunc(lamdatop2b)*(lamdatop2b-lamdabottom2b
)^2));
GDc2=(sqrt(2*pi)*sigmax2^2)/((sqrt(2*pi)*sigmax2^2)+(4*sigmax2*ptx_
biasc)+(2*sqrt(2*pi)*ptx_biasc^2));
GDca=(sqrt(2*pi)*sigmax2a^2)/((sqrt(2*pi)*sigmax2a^2)+(4*sigmax2a*pt
x_biasc)+(2*sqrt(2*pi)*ptx_biasc^2));
GDcb=(sqrt(2*pi)*sigmax2b^2)/((sqrt(2*pi)*sigmax2b^2)+(4*sigmax2b*p
tx_biasc)+(2*sqrt(2*pi)*ptx_biasc^2));
gh_opt=1;
%the electricalSNR per bit for ZF equalizer
GB=0.5;
Gt=N/(N+Ncp);
eyta_elecdB=0:10:50;
eyta_elecr=10.^(eyta_elecdB./20);
M=[2 4 8 16 32 64 ];
pb_elec2=Ps_elec2./log2(M);
pb_elec2a=Ps_elec2a./log2(M);
pb_elec2b=Ps_elec2b./log2(M);
ss2=(GB*sigma_clip_squ2)./pb_elec2;
ee2=(GB.*eyta_elecr.^-1)/(Gt*GDc2*gh_opt);
mm2=(GB.*eyta_elecr.^-1)/(GDc2*gh_opt^2);
effectiveSNR2=K2^2./(ss2+mm2);
ss2a=(GB*sigma_clip_squ2a)./pb_elec2a;
eea=(GB.*eyta_elecr.^-1)/(Gt*GDca*gh_opt);
mma=(GB.*eyta_elecr.^-1)/(GDca*gh_opt^2);
effectiveSNRa=K2a^2./(ss2a+mma);
ss2b=(GB*sigma_clip_squ2b)./pb_elec2b;
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```
eeb=(GB.*eyta_elecr.^-1)/(Gt*GDcb*gh_opt);
mmb=(GB.*eyta_elecr.^-1)/(GDcb*gh_opt^2);
effectiveSNRb=K2b^2./(ss2b+mmb);
%BER calculation
%case two 1
BER21=(4*(sqrt(M(1))1)/(log2(M(1))*sqrt(M(1))))*qfunc(real(sqrt((3*log
2(M(1)).*effectiveSNR2)/(M(1)1))))+(4*(sqrt(M(1))2)/(log2(M(1))*sqrt(M
(1))))*qfunc(real(3*sqrt((3*log2(M(1)).*effectiveSNR2)/(M(1)-1))));
BER22=(4*(sqrt(M(2))1)/(log2(M(2))*sqrt(M(2))))*qfunc(real(sqrt((3*log
2(M(2)).*effectiveSNR2)/(M(2)1))))+(4*(sqrt(M(2))2)/(log2(M(2))*sqrt(M
(2))))*qfunc(real(3*sqrt((3*log2(M(2)).*effectiveSNR2)/(M(2)-1))));
BER23=(4*(sqrt(M(3))1)/(log2(M(3))*sqrt(M(3))))*qfunc(real(sqrt((3*log
2(M(3)).*effectiveSNR2)/(M(3)1))))+(4*(sqrt(M(3))2)/(log2(M(3))*sqrt(M
(3))))*qfunc(real(3*sqrt((3*log2(M(3)).*effectiveSNR2)/(M(3)-1))));
BER24=(4*(sqrt(M(4))1)/(log2(M(4))*sqrt(M(4))))*qfunc(real(sqrt((3*log
2(M(4)).*effectiveSNR2)/(M(4)1))))+(4*(sqrt(M(4))2)/(log2(M(4))*sqrt(M
(4))))*qfunc(real(3*sqrt((3*log2(M(4)).*effectiveSNR2)/(M(4)-1))));
BER26=(4*(sqrt(M(6))1)/(log2(M(6))*sqrt(M(6))))*qfunc(real(sqrt((3*log
2(M(6)).*effectiveSNR2)/(M(6)1))))+(4*(sqrt(M(6))2)/(log2(M(6))*sqrt(M
(6))))*qfunc(real(3*sqrt((3*log2(M(6)).*effectiveSNR2)/(M(6)-1))));
%case two a
BERa1=(4*(sqrt(M(1))1)/(log2(M(1))*sqrt(M(1))))*qfunc(real(sqrt((3*log
2(M(1)).*effectiveSNRa)/(M(1)1))))+(4*(sqrt(M(1))2)/(log2(M(1))*sqrt(M
(1))))*qfunc(real(3*sqrt((3*log2(M(1)).*effectiveSNRa)/(M(1)-1))));
BERa2=(4*(sqrt(M(2))1)/(log2(M(2))*sqrt(M(2))))*qfunc(real(sqrt((3*log
2(M(2)).*effectiveSNRa)/(M(2)1))))+(4*(sqrt(M(2))2)/(log2(M(2))*sqrt(M
(2))))*qfunc(real(3*sqrt((3*log2(M(2)).*effectiveSNRa)/(M(2)-1))));
```

```
BERa3=(4*(sqrt(M(3))1)/(log2(M(3))*sqrt(M(3))))*qfunc(real(sqrt((3*log
2(M(3)).*effectiveSNRa)/(M(3)1))))+(4*(sqrt(M(3))2)/(log2(M(3))*sqrt(M
(3))))*qfunc(real(3*sqrt((3*log2(M(3)).*effectiveSNRa)/(M(3)-1))));
BERa4=(4*(sqrt(M(4))1)/(log2(M(4))*sqrt(M(4))))*qfunc(real(sqrt((3*log
2(M(4)).*effectiveSNRa)/(M(4)1))))+(4*(sqrt(M(4))2)/(log2(M(4))*sqrt(M
(4))))*qfunc(real(3*sqrt((3*log2(M(4)).*effectiveSNRa)/(M(4)-1))));
BERa6=(4*(sqrt(M(6))1)/(log2(M(6))*sqrt(M(6))))*qfunc(real(sqrt((3*log
2(M(6)).*effectiveSNRa)/(M(6)1))))+(4*(sqrt(M(6))2)/(log2(M(6))*sqrt(M
(6))))*qfunc(real(3*sqrt((3*log2(M(6)).*effectiveSNRa)/(M(6)-1))));
%case two
BERb1=(4*(sqrt(M(1))1)/(log2(M(1))*sqrt(M(1))))*qfunc(real(sqrt((3*log
2(M(1)).*effectiveSNRb)/(M(1)1))))+(4*(sqrt(M(1))2)/(log2(M(1))*sqrt(M
(1))))*qfunc(real(3*sqrt((3*log2(M(1)).*effectiveSNRb)/(M(1)-1))));
BERb2=(4*(sqrt(M(2))1)/(log2(M(2))*sqrt(M(2))))*qfunc(real(sqrt((3*log
2(M(2)).*effectiveSNRb)/(M(2)1))))+(4*(sqrt(M(2))2)/(log2(M(2))*sqrt(M
(2))))*qfunc(real(3*sqrt((3*log2(M(2)).*effectiveSNRb)/(M(2)-1))));
BERb3=(4*(sqrt(M(3))1)/(log2(M(3))*sqrt(M(3))))*qfunc(real(sqrt((3*log
2(M(3)).*effectiveSNRb)/(M(3)1))))+(4*(sqrt(M(3))2)/(log2(M(3))*sqrt(M
(3))))*qfunc(real(3*sqrt((3*log2(M(3)).*effectiveSNRb)/(M(3)-1))));
BERb4=(4*(sqrt(M(4))1)/(log2(M(4))*sqrt(M(4))))*qfunc(real(sqrt((3*log
2(M(4)).*effectiveSNRb)/(M(4)1))))+(4*(sqrt(M(4))2)/(log2(M(4))*sqrt(M
(4))))*qfunc(real(3*sqrt((3*log2(M(4)).*effectiveSNRb)/(M(4)-1))));
BERb6=(4*(sqrt(M(6))1)/(log2(M(6))*sqrt(M(6))))*qfunc(real(sqrt((3*log
2(M(6)).*effectiveSNRb)/(M(6)1))))+(4*(sqrt(M(6))2)/(log2(M(6))*sqrt(M
(6))))*qfunc(real(3*sqrt((3*log2(M(6)).*effectiveSNRb)/(M(6)-1))));
figure
hold on
semilogy(eyta_elecdB,BER22,'gd-')
```

```
semilogy(eyta_elecdB,BERa2,'k^-')
semilogy(eyta_elecdB,BERb2,'squ-')
legend('ACO-case two PTx,mean=300,M=4','ACO-case tow PTx,mean150,M=4','ACO-case two PTx,mean=95,M=4',3)
title('BER performance of VLC-OFDM in AWGN')
xlabel('SNR=Eb(elec))/No [dB]')
ylabel('BER')
grid on
hold off
 %% ..... {ACO-OFDM for visible ilght communicayion systems}.....
% zero forcing equalizer, different piasing power……
clc;
clf;
clear all;
close all;
N=2048;%Total number of subcarier to be transmitted at the transmitter
Ncp =2; %Length of the cyclic prefix
ptxmin=90*10^-3;
ptxmax=400*10^-3;
%% case two
ptx_mean2=100*10^-3;
ptx_bias2=50*10^-3;%ptxbias < ptxmin
ptx_biasa=25*10^-3;%ptxbias < ptxmin
ptx_biasb=10*10^-3;%ptxbias < ptxmin
ptx_biasc=0;%ptxbias < ptxmin
sigmax2=ptx_mean2*sqrt(2*pi);
epslontop2=ptxmax-ptx_bias2;
epslonbottom2=max((ptxmin-ptx_bias2),0);
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```
lamdatop2=epslontop2/sigmax2;
lamdabottom2=epslonbottom2/sigmax2;
epslontopa=ptxmax-ptx_biasa;
epslonbottoma=max((ptxmin-ptx_biasa),0);
epslontopb=ptxmax-ptx_biasb;
epslonbottomb=max((ptxmin-ptx_biasb),0);
epslontopc=ptxmax-ptx_biasc;
epslonbottomc=max((ptxmin-ptx_biasc),0);
Ps_elec2=sigmax2^2;
K2 = qfunc(lamdabottom2)-qfunc(lamdatop2);%attenuation factor
fylamdatop2=normpdf(lamdatop2,0,1);
fylamdabottom2=normpdf(lamdabottom2,0,1);
polk2=lamdabottom2*(fylamdabottom2-fylamdatop2);
mshe2=fylamdatop2*(lamdatop2-lamdabottom2);
sigma_clip_squ2=          Ps_elec2*((K2*(lamdabottom2^2+1))-(2*K2^2)-
(polk2)-(mshe2)+(qfunc(lamdatop2)*(lamdatop2-lamdabottom2 )^2));
GDc2=(sqrt(2*pi)*sigmax2^2)/((sqrt(2*pi)*sigmax2^2)+(4*sigmax2*ptx_
bias2)+(2*sqrt(2*pi)*ptx_bias2^2));
GDca=(sqrt(2*pi)*sigmax2^2)/((sqrt(2*pi)*sigmax2^2)+(4*sigmax2*ptx_b
iasa)+(2*sqrt(2*pi)*ptx_biasa^2));
GDcb=(sqrt(2*pi)*sigmax2^2)/((sqrt(2*pi)*sigmax2^2)+(4*sigmax2*ptx_
biasb)+(2*sqrt(2*pi)*ptx_biasb^2));
GDcc=(sqrt(2*pi)*sigmax2^2)/((sqrt(2*pi)*sigmax2^2)+(4*sigmax2*ptx_b
iasc)+(2*sqrt(2*pi)*ptx_biasc^2));
gh_opt=1;
sigmanoisesqu=2*10^-15;
%the electricalSNR per bit for ZF equalizer
GB=0.5;
```

```
Gt=N/(N+Ncp);
eyta_elecdB=0:10:50;
eyta_elecr=10.^(eyta_elecdB./20);
M=[2 4 8 16 32 64 ];
pb_elec2=Ps_elec2./log2(M);
ss2=(GB*0)./pb_elec2;
ee2=(GB.*eyta_elecr.^-1)/(Gt*GDc2*gh_opt);
mm2=(GB.*eyta_elecr.^-1)/(GDc2*gh_opt^2);
effectiveSNR2=K2^2./(ss2+mm2);
eea=(GB.*eyta_elecr.^-1)/(Gt*GDca*gh_opt);
mma=(GB.*eyta_elecr.^-1)/(GDca*gh_opt^2);
effectiveSNRa=K2^2./(ss2+mma);
eeb=(GB.*eyta_elecr.^-1)/(Gt*GDcb*gh_opt);
mmb=(GB.*eyta_elecr.^-1)/(GDcb*gh_opt^2);
effectiveSNRb=K2^2./(ss2+mmb);
eec=(GB.*eyta_elecr.^-1)/(Gt*GDcc*gh_opt);
mmc=(GB.*eyta_elecr.^-1)/(GDcc*gh_opt^2);
effectiveSNRc=K2^2./(ss2+mmc);
%BER calculation
%case two 1
BER21=(4*(sqrt(M(1))1)/(log2(M(1))*sqrt(M(1))))*qfunc(real(sqrt((3*log
2(M(1)).*effectiveSNR2)/(M(1)1))))+(4*(sqrt(M(1))2)/(log2(M(1))*sqrt(M
(1))))*qfunc(real(3*sqrt((3*log2(M(1)).*effectiveSNR2)/(M(1)-1))));
BER22=(4*(sqrt(M(2))1)/(log2(M(2))*sqrt(M(2))))*qfunc(real(sqrt((3*log
2(M(2)).*effectiveSNR2)/(M(2)1))))+(4*(sqrt(M(2))2)/(log2(M(2))*sqrt(M
(2))))*qfunc(real(3*sqrt((3*log2(M(2)).*effectiveSNR2)/(M(2)-1))));
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```
BER23=(4*(sqrt(M(3))1)/(log2(M(3))*sqrt(M(3))))*qfunc(real(sqrt((3*log
2(M(3)).*effectiveSNR2)/(M(3)1))))+(4*(sqrt(M(3))2)/(log2(M(3))*sqrt(M
(3))))*qfunc(real(3*sqrt((3*log2(M(3)).*effectiveSNR2)/(M(3)-1))));
BER24=(4*(sqrt(M(4))1)/(log2(M(4))*sqrt(M(4))))*qfunc(real(sqrt((3*log
2(M(4)).*effectiveSNR2)/(M(4)1))))+(4*(sqrt(M(4))2)/(log2(M(4))*sqrt(M
(4))))*qfunc(real(3*sqrt((3*log2(M(4)).*effectiveSNR2)/(M(4)-1))));
BER26=(4*(sqrt(M(6))1)/(log2(M(6))*sqrt(M(6))))*qfunc(real(sqrt((3*log
2(M(6)).*effectiveSNR2)/(M(6)1))))+(4*(sqrt(M(6))2)/(log2(M(6))*sqrt(M
(6))))*qfunc(real(3*sqrt((3*log2(M(6)).*effectiveSNR2)/(M(6)-1))));
%case two a
BERa1=(4*(sqrt(M(1))1)/(log2(M(1))*sqrt(M(1))))*qfunc(real(sqrt((3*log
2(M(1)).*effectiveSNRa)/(M(1)1))))+(4*(sqrt(M(1))2)/(log2(M(1))*sqrt(M
(1))))*qfunc(real(3*sqrt((3*log2(M(1)).*effectiveSNRa)/(M(1)-1))));
BERa2=(4*(sqrt(M(2))1)/(log2(M(2))*sqrt(M(2))))*qfunc(real(sqrt((3*log
2(M(2)).*effectiveSNRa)/(M(2)1))))+(4*(sqrt(M(2))2)/(log2(M(2))*sqrt(M
(2))))*qfunc(real(3*sqrt((3*log2(M(2)).*effectiveSNRa)/(M(2)-1))));
BERa3=(4*(sqrt(M(3))1)/(log2(M(3))*sqrt(M(3))))*qfunc(real(sqrt((3*log
2(M(3)).*effectiveSNRa)/(M(3)1))))+(4*(sqrt(M(3))2)/(log2(M(3))*sqrt(M
(3))))*qfunc(real(3*sqrt((3*log2(M(3)).*effectiveSNRa)/(M(3)-1))));
BERa4=(4*(sqrt(M(4))1)/(log2(M(4))*sqrt(M(4))))*qfunc(real(sqrt((3*log
2(M(4)).*effectiveSNRa)/(M(4)1))))+(4*(sqrt(M(4))2)/(log2(M(4))*sqrt(M
(4))))*qfunc(real(3*sqrt((3*log2(M(4)).*effectiveSNRa)/(M(4)-1))));
BERa6=(4*(sqrt(M(6))1)/(log2(M(6))*sqrt(M(6))))*qfunc(real(sqrt((3*log
2(M(6)).*effectiveSNRa)/(M(6)1))))+(4*(sqrt(M(6))2)/(log2(M(6))*sqrt(M
(6))))*qfunc(real(3*sqrt((3*log2(M(6)).*effectiveSNRa)/(M(6)-1))));
%case two
```

```
BERb1=(4*(sqrt(M(1))1)/(log2(M(1))*sqrt(M(1))))*qfunc(real(sqrt((3*log
2(M(1)).*effectiveSNRb)/(M(1)1))))+(4*(sqrt(M(1))2)/(log2(M(1))*sqrt(M
(1))))*qfunc(real(3*sqrt((3*log2(M(1)).*effectiveSNRb)/(M(1)-1))));
BERb2=(4*(sqrt(M(2))1)/(log2(M(2))*sqrt(M(2))))*qfunc(real(sqrt((3*log
2(M(2)).*effectiveSNRb)/(M(2)1))))+(4*(sqrt(M(2))2)/(log2(M(2))*sqrt(M
(2))))*qfunc(real(3*sqrt((3*log2(M(2)).*effectiveSNRb)/(M(2)-1))));
BERb3=(4*(sqrt(M(3))1)/(log2(M(3))*sqrt(M(3))))*qfunc(real(sqrt((3*log
2(M(3)).*effectiveSNRb)/(M(3)1))))+(4*(sqrt(M(3))2)/(log2(M(3))*sqrt(M
(3))))*qfunc(real(3*sqrt((3*log2(M(3)).*effectiveSNRb)/(M(3)-1))));
BERb4=(4*(sqrt(M(4))1)/(log2(M(4))*sqrt(M(4))))*qfunc(real(sqrt((3*log
2(M(4)).*effectiveSNRb)/(M(4)1))))+(4*(sqrt(M(4))2)/(log2(M(4))*sqrt(M
(4))))*qfunc(real(3*sqrt((3*log2(M(4)).*effectiveSNRb)/(M(4)-1))));
BERb6=(4*(sqrt(M(6))1)/(log2(M(6))*sqrt(M(6))))*qfunc(real(sqrt((3*log
2(M(6)).*effectiveSNRb)/(M(6)1))))+(4*(sqrt(M(6))2)/(log2(M(6))*sqrt(M
(6))))*qfunc(real(3*sqrt((3*log2(M(6)).*effectiveSNRb)/(M(6)-1))));
%case two
BERc1=(4*(sqrt(M(1))1)/(log2(M(1))*sqrt(M(1))))*qfunc(real(sqrt((3*log
2(M(1)).*effectiveSNRc)/(M(1)1))))+(4*(sqrt(M(1))2)/(log2(M(1))*sqrt(M
(1))))*qfunc(real(3*sqrt((3*log2(M(1)).*effectiveSNRc)/(M(1)-1))));
BERc2=(4*(sqrt(M(2))1)/(log2(M(2))*sqrt(M(2))))*qfunc(real(sqrt((3*log
2(M(2)).*effectiveSNRc)/(M(2)1))))+(4*(sqrt(M(2))2)/(log2(M(2))*sqrt(M
(2))))*qfunc(real(3*sqrt((3*log2(M(2)).*effectiveSNRc)/(M(2)-1))));
BERc3=(4*(sqrt(M(3))1)/(log2(M(3))*sqrt(M(3))))*qfunc(real(sqrt((3*log
2(M(3)).*effectiveSNRc)/(M(3)-1))))+(4*(sqrt(M(3))-
2)/(log2(M(3))*sqrt(M(3))))*qfunc(real(3*sqrt((3*log2(M(3)).*effectiveSN
Rc)/(M(3)-1))));
BERc4=(4*(sqrt(M(4))1)/(log2(M(4))*sqrt(M(4))))*qfunc(real(sqrt((3*log
2(M(4)).*effectiveSNRc)/(M(4)-1))))+(4*(sqrt(M(4))-
```

```
2)/(log2(M(4))*sqrt(M(4))))*qfunc(real(3*sqrt((3*log2(M(4)).*effectiveSN
Rc)/(M(4)-1))));
BERc6=(4*(sqrt(M(6))1)/(log2(M(6))*sqrt(M(6))))*qfunc(real(sqrt((3*log
2(M(6)).*effectiveSNRc)/(M(6)-1))))+(4*(sqrt(M(6))-
2)/(log2(M(6))*sqrt(M(6))))*qfunc(real(3*sqrt((3*log2(M(6)).*effectiveSN
Rc)/(M(6)-1))));
 figure
hold on
semilogy(eyta_elecdB,BER22,'gd-')
semilogy(eyta_elecdB,BERa2,'k^-')
semilogy(eyta_elecdB,BERb2,'squ-')
semilogy(eyta_elecdB,BERc2,'r<-')
legend('ptxbias=50','ptxbias=20','ptxbias=5','ptxbias=0',4)
title('BER performance of VLC-OFDM in AWGN')
xlabel('SNR=Eb(elec))/No [dB]')
ylabel('BER')
grid on
hold off
```