Wireless Communication Fundamentals Final Project

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%%  Samaa Hany Seif Elyazal            %%%%%%%%%%%%%%%%%
%%  Wireless Communication, Intake 42  %%%%%%%%%%%%%%%%%
%%  Diversity Order BPSK               %%%%%%%%%%%%%%%%%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
close all;
clear
clc;
%% Intialization
SNRV =-5:5:25; %SIGNAL TO NOISE RATIO IN DB
for(K=1:length(SNRV))
SNR = SNRV(K);
snr = 10^(SNR / 10);
snrv(K) = snr;
P=1;
N0 = P / snr;
M = 2; %bits per sympol OF QSPK
NS = 10000;
NB = NS*log2(M); %NO OF BITS PER SYMBOLS
 %NO OF QPSK SYMBOLS

%% Therotical Error Rate
theortical_error(K)=Q_function(sqrt(snr));

%% Generate Symbols
ber=0;
ber_SIC=0;
bermmse=0;
bermmse_SIC=0;
ber=0;
berf=0;
ber_MRC0=0;
ber_MRC1=0;
ber_A0=0;
ber_A1=0;
ber_A2=0;
ber_A3=0;
for k=1:1:NS
I1=randi([0 1],1,1); I2=randi([0 1],1,1);
S1=((2*I1-1))*sqrt(1/2); S2=((2*I2-1))*sqrt(1/2);
%% AWGN
W0=sqrt(N0/2)*(randn(1,1)+1i*randn(1,1));
W1=sqrt(N0/2)*(randn(1,1)+1i*randn(1,1));
W2=sqrt(N0/2)*(randn(1,1)+1i*randn(1,1));
W3=sqrt(N0/2)*(randn(1,1)+1i*randn(1,1));
y_AWGN=(sqrt(P)*S1)+W0;
%% Decoding AWGN
I_HAT=real(y_AWGN)>0;
ber=ber+((I1~=I_HAT));
%% Fading
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h0=sqrt(1/2)*(randn(1,1)+1i*randn(1,1));
h1=sqrt(1/2)*(randn(1,1)+1i*randn(1,1));
h2=sqrt(1/2)*(randn(1,1)+1i*randn(1,1));
h3=sqrt(1/2)*(randn(1,1)+1i*randn(1,1));
y_fading0=h0*S1+W0;
y_fading1=h1*S1+W1;
y_fading2=h2*S1+W2;
y_fading3=h3*S1+W3;
%% MRC Fading
y_MRC1_2=conj(h0)*yfading0+conj(h1)*yfading1; %(1 TX to 1RX)
y_MRC1_4=conj(h0)*yfading0+conj(h1)*yfading1+conj(h2)*yfading2+conj(h3).*yfad
ing3; %(1 TX to 4 RX)
%% Alamouti Fading
yfadingA0=sqrt(P/2)*S1*h0+sqrt(P/2)*S2*h1+W;
yfadingA1=-sqrt(P/2)*conj(S2)*h0+sqrt(P/2)*conj(S1)*h1+W1;
yfadingA2=sqrt(P/2)*S1*h2+sqrt(P/2)*S2*h3+W2;
yfadingA3=-sqrt(P/2)*conj(S2)*h2+sqrt(P/2)*conj(S1)*h3+W3;
%% Alamouti Fading (2 TX to 2 RX)
S_HAT_Alamouti0=(conj(h).*yfadingA0+h1.*conj(yfadingA1));
S_HAT_Alamouti1=(conj(h1).*yfadingA0-h.*conj(yfadingA1));
%% Alamouti Fading (2 TX to 4 RX)
S_HAT_Alamouti2=(conj(h0)*yfadingA0+h1*conj(yfadingA1)+conj(h2)*yfadingA2+h3*
conj(yfadingA3));
S_HAT_Alamouti3=(conj(h1)*yfadingA0-h0*conj(yfadingA1)+conj(h3)*yfadingA2-
h2*conj(yfadingA3));
%% Decoding Fading using (Rayleigh,MRC,Alamouti)
S_HAT=yfading./h;
I_HAT=real(S_HAT)>0;
I_HAT_MRC=real(y_MRC1_2)>0;
I_HAT_MRC1=real(y_MRC1_4)>0;
I_HAT_A0=real(S_HAT_Alamouti0)>0;
I_HAT_A1=real(S_HAT_Alamouti1)>0;
I_HAT_A2=real(S_HAT_Alamouti2)>0;
I_HAT_A3=real(S_HAT_Alamouti3)>0;
berf=berf+((I~=I_HAT));
ber_MRC0=ber_MRC0+((I~=I_HAT_MRC));
ber_MRC1=ber_MRC1+((I~=I_HAT_MRC1));
ber_A0=ber_A0+((I~=I_HAT_A0));
ber_A1=ber_A1+((I_1~=I_HAT_A1));
ber_A2=ber_A2+((I~=I_HAT_A2));
ber_A3=ber_A3+((I_1~=I_HAT_A3));
end
SNRv(n)
BER(n)=ber/Nb;
BERF(n)=berf/Nb;
BER_MRC0(n)=ber_MRC0/Nb;
BER_MRC1(n)=ber_MRC1/Nb;
BER_A0(n)=(ber_A1+ber_A0)/(2*Nb);
BER_A1(n)=(ber_A2+ber_A3)/(2*Nb);
End
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%% Plotting
semilogy(SNRV,BERF,'-g',SNRV,BER_MRC0,'-k',SNRV,BER_MRC1,'-p',SNRV,BER_A0,'-
d',SNRV,BER_A1,'g-^');
legend('no diversity (1 TX,1 RX)','MRRC (1 TX,2 RX)','MRRC (1 TX,4 RX)','
MIMO(2 TX,1 RX)','MIMO(2 TX,2 RX)');
xlabel('SNR(dB)');
ylabel('BER');
axis([min(SNRV),max(SNRV),1e-4,1]);


%% Diversity Order Estimation
d_hat=(log(BERF(end))-log(BERF(end-1)))/(-log(snrv(end))+log(snrv(end-1)));
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