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%BER Simulation of BPSK modulation
clc;
close all;
clear all;

bits=1000;
data=randi(2,bits)-ones(bits,bits);
%---debugging---
%data=[1 1 1]
%xxxxxxxxxxx
ebno=0:10;
BER=zeros(1,length(ebno));
%---Transmitter-----
%Gray mapping of bits into symbols
col=length(data)/2;
I=zeros(1,col);
Q=I;
I=data(1:2:bits-1);
Q=data(2:2:bits);
I= -2.*I+1;
Q= -2.*Q+1;
symb=I+1i.*Q;
%----Filter
psf=ones(1,1);
%----
M=length(psf);
for i=1:length(ebno)
    % inserting zeros between the bits% w.r.t number of coefficients
    of
    % PSF to pass the bit stream from the PSF
    z=zeros(M-1,bits/2);
    upsamp=[symb;z];
    upsamp2=reshape(upsamp,1,(M)*bits/2);
    %Passing the symbols from PSF
    %tx_symb=conv(real(upsamp2),psf)+j*conv(imag(upsamp2),psf);
    tx_symb=conv(upsamp2,psf);
    %-----CHANNEL-----
    %Random noise generation and addition to the signal
    npsd=10.^(ebno(i)/10);
    n_var=1/sqrt(2.*npsd);
    rx_symb=tx_symb
    +(n_var*randn(1,length(tx_symb))+1i*n_var*randn(1,length(tx_symb)));
    %xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
    %-----RECEIVER-----
    rx_match=conv(rx_symb,psf);
    rx=rx_match(M:M:length(rx_match));
    rx=rx(1:1:bits/2);
    recv_bits=zeros(1,bits);
    %demapping
    k=1;
    for ii=1:bits/2

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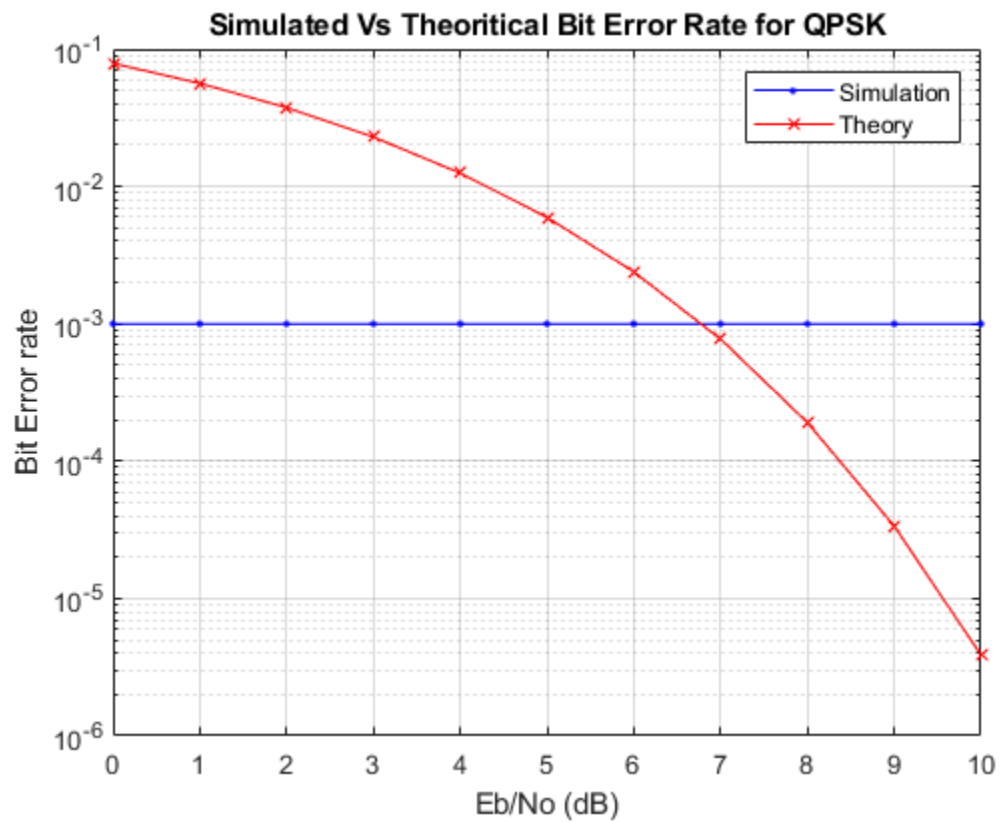
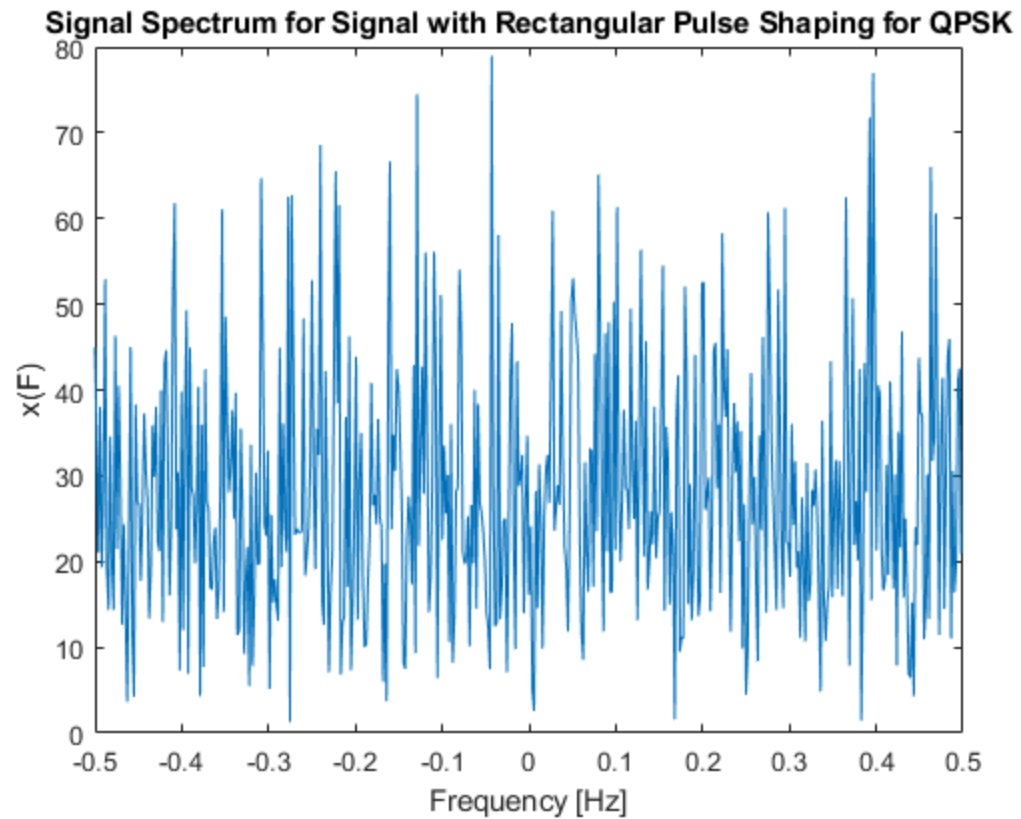
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        recv_bits(k)= -( sign( real( rx(ii))) -1)/2;
        recv_bits(k+1)=-( sign( imag( rx(ii)))-1)/2;
        k=k+2;
    end
    %sign( real( rx ) )
    %sign( imag( rx ) )
    %data
    %tx_symb
    %rx_symb
    %recv_bits
    %XXXXXXXXXXXXXXXXXXXXXXXXXXXX
    %---SIMULATED BIT ERROR RATE---
    errors=find(xor(recv_bits,data));
    errors=size(errors,2);
    BER(i)=errors/bits;
    %XXXXXXXXXXXXXXXXXXXXXXXXXXXX
end
fs=1;
n_pt=2^9;
tx_spec=fft(tx_symb,n_pt);
f= -fs/2:fs/n_pt:fs/2-fs/n_pt;
figure;
plot(f,abs(fftshift(tx_spec)));
title('Signal Spectrum for Signal with Rectangular Pulse Shaping for
QPSK');
xlabel('Frequency [Hz]');
ylabel('x(F)');
figure;
semilogy(ebno,BER,'b.-');
hold on;
thr=0.5*erfc(sqrt(10.^(ebno/10)));
semilogy(ebno,thr,'rx-');
xlabel('Eb/No (dB)')
ylabel('Bit Error rate')
title('Simulated Vs Theoretical Bit Error Rate for QPSK')
legend('Simulation','Theory');
grid on;

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*Published with MATLAB® R2019b*