Experiment No: 6

Eye Diagram

<u>Objective</u>

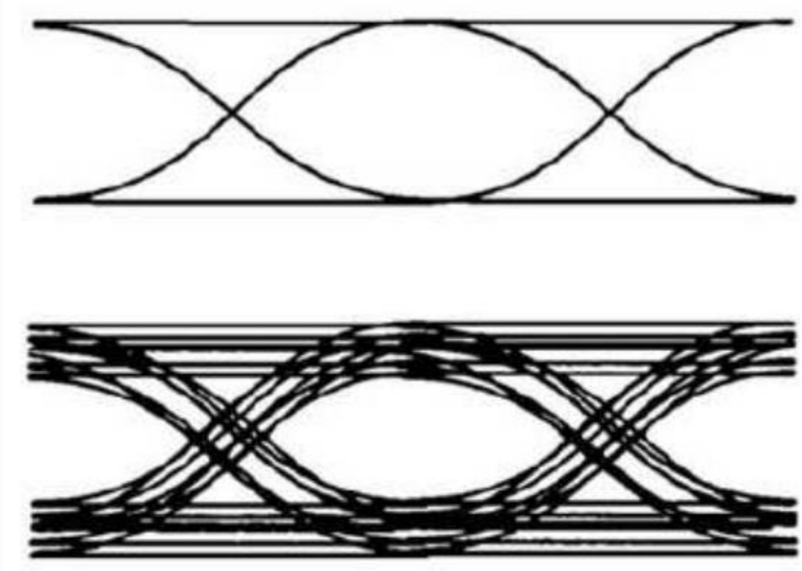
1. Generate a string of message bits.
2. Use raised cosine pulse p(t) as the shapig pulse, and generate the corresponding baseband signal with a fixed bit duration Tb. You may use roll-off factor as $\alpha = 0.4$.
3. Use various roll off factors and plot the eye diagram in each case for the received signal. Make a comparison study among them.

Software Used:

MATLAB R2018a

Theory:

In communications, an eye diagram is used to visually assess the performance of a system in operation. It is called an eye diagram, or eye pattern, because the pattern looks like a series of eyes between a pair of rails for several types of coding schemes. It is created by taking the time domain signal and overlapping the traces for a certain number of symbols. If we are sampling a signal at a rate of 10 samples per second and we want to look at two symbols, then we would cut the signal every 20 samples and overlap them. In digital transmission, a succession of ones and zeroes flows to the receiver. The transmission can consist of a long series of ones, a long series of zeroes, a regular or irregular sequence that repeats periodically, a quasi-random series or any combination. The eye diagram will reveal whether everything works as intended or if there are faults that garble the transmission, causing, for example, the reception of a zero when a one has been sent.



Program:

```
% Script for plotting the eye diagram where transmit filtering
% is performed by raised cosine filtering with alpha=0.5, alpha=1.
clear
N = 10^3; % number of symbols
am = 2*(rand(1,N)>0.5)-1 + j*(2*(rand(1,N)>0.5)-1); % generating
random binary sequence
fs = 10; % sampling frequency in Hz
% defining the sinc filter
sincNum = sin(pi*[-fs:1/fs:fs]); % numerator of the sinc function
sincDen = (pi*[-fs:1/fs:fs]); % denominator of the sinc function
sincDenZero = find(abs(sincDen) < 10^-10);
sincOp = sincNum./sincDen;
sincOp(sincDenZero) = 1; % sin(pix/(pix) =1 for x =0
% raised cosine filter
alpha = 0.5;
cosNum = cos(alpha*pi*[-fs:1/fs:fs]);
cosDen = (1-(2*alpha*[-fs:1/fs:fs]).^2);
cosDenZero = find(abs(cosDen)<10^-10);
cosOp = cosNum./cosDen;
cosOp(cosDenZero) = pi/4;
gt_alpha5 = sincOp.*cosOp;
alpha = 1;
cosNum = cos(alpha*pi*[-fs:1/fs:fs]);
cosDen = (1-(2*alpha*[-fs:1/fs:fs]).^2);
cosDenZero = find(abs(cosDen)<10^-10);
cosOp = cosNum./cosDen;
cosOp(cosDenZero) = pi/4;
gt_alpha1 = sincOp.*cosOp;
% upsampling the transmit sequence
amUpSampled = [am;zeros(fs-1,length(am))];
amU = amUpSampled(:).';
% filtered sequence
st_alpha5 = conv(amU,gt_alpha5);
st_alpha1 = conv(amU,gt_alpha1);
% taking only the first 10000 samples
st_alpha5 = st_alpha5([1:10000]);
st_alpha1 = st_alpha1([1:10000]);
st_alpha5_reshape = reshape(st_alpha5,fs*2,N*fs/20).';
st_alpha1_reshape = reshape(st_alpha1,fs*2,N*fs/20).';
close all
figure;
plot([0:1/fs:1.99],real(st_alpha5_reshape).','b');
title('eye diagram with alpha=0.5');
xlabel('time')
ylabel('amplitude')
axis([0 2 -1.5 1.5])
grid on
figure;
plot([0:1/fs:1.99],real(st_alpha1_reshape).','b');
title('eye diagram with alpha=1')
xlabel('time')
ylabel('amplitude')
axis([0 2 -1.5 1.5 ])
grid on
```

Result

Studied and verified eye diagram