Lab 0: Learning Matlab

Lab0 is designed to let you familiar with matlab. You don't need to hand in any lab report. But some of the code will be used in the later lab work. Please exercise the following program, understand the command lines, generate the results, change parameters in the program and observe the changes in the results.

1. Convolution of two square wave

```
clear;
a = [1 1 1];                    % define a rect function
alen = length(a)                % return the length of vector a
b = [1 1 1 1];                  % you can change the length of the vectors
blen = length(b);               % return the length of vector b
y = conv(a,b);                  % y equals the convolution of a and b
ylen = length(y);
plot(alen, a, blen, b, ylen, y); % plot Y in the specified range
xlabel('time t');
ylabel('amplitude');
```

observe the length of y when you change the length of a and b. What relation you can obtain?

2. Generate Gaussian random variables, obtain simulated pdf (probability density function) and compare this pdf with the theoretic pdf.

```
clear;
N = 200000;                                  % number of simulation samples
sigma = 2; mean = 0;                         % Gaussian parameter
noise = (sigma)*randn(1,N);                  % generate awgn noise
stepsize = 0.05;                             % define stepsize
xbin = -8:stepsize:8;                        % define x-axis
y = hist(noise,xbin)/N/stepsize;             % retrieve distribution from simulation samples
sum(y*stepsize)                              % verify that pdf sum should be around 1
gauspdf = exp(-(xbin-mean).^ 2/(2*sigma^2))/...
          (sqrt(2*pi)*sigma);                % theoretic values
                                             % ... means command continued in the next line
sum(gauspdf*stepsize)                        % verify that pdf sum
plot(xbin, y, '–', xbin,gauspdf,'-');
legend('simulation','Gaussian pdf');
```

3. This code segment is to read, play and manipulate a Microsoft window wave file.

```
clear;
Y = wavread('pcm.wav');   % read wave file pcm.wav
length(Y)                 % return the length of vector Y
range = 1:40000;          % you can change the range and hear the difference
sound(Y(range));

plot(Y(range));           % plot Y in the specified range
xlabel('time');
ylabel('amplitude');

Y = round(10*Y)/10;       % observe distortion by rounding the first digits
sound(Y)
plot(Y)
```

4. This code segment is to generate random information bits and AWGN channel noise. Then, plot generated noise, histogram of the noise, and received signal.

```
clear;
snrdB = 7;                          % SNR in dB scale
E=1;
SNR=exp(snrdB*log(10)/10);          % SNR in linear scale
sgma=E/sqrt(2*SNR);                 %equivalent Gaussian r.v. standard deviation
N=100;                              %number of generated information bits
dsource=rand(1,N)-0.5;              % generate binary source bits
dsource(dsource >0)=1;
dsource(dsource =1)=0;

noise = (sgma)*randn(1,N);          %generate awgn noise
subplot(3,1,1)
plot(noise)
xbin = -8:0.01:8;
y = hist(noise, xbin);
subplot(3,1,2)
plot(xbin, y)                       %plot histogram (pdf) function of noise

rec-signal = (-1).^ dsource + noise;
subplot(3,1,3)
plot(rec-signal)                    % plot the received signal through AWGN channel
```