Digital Signal Processing

Lab3: signal convolution

Instructor: Eng\ Samar Shaaban
E-mail: ssa10@fayoum.edu.eg

Github Repo: https://github.com/SamarShabanCS/DSP

Slack workspace: https://fayoum-university-fci.slack.com

Sheet2 Discussion

Sinusoidal Wave Signal

- **Why is it so Important?**

  Sinusoidal signals are important in both electrical and electronic engineering domains. According to Fourier Series Theory, any signal (Periodic Signal) can be written in terms of only sine and cosine Signals of different frequencies. Therefore a complex signal can be broken-down into simple sine and cosine signals and mathematical analysis becomes easy. Hence it is widely used in electrical and electronic analysis.

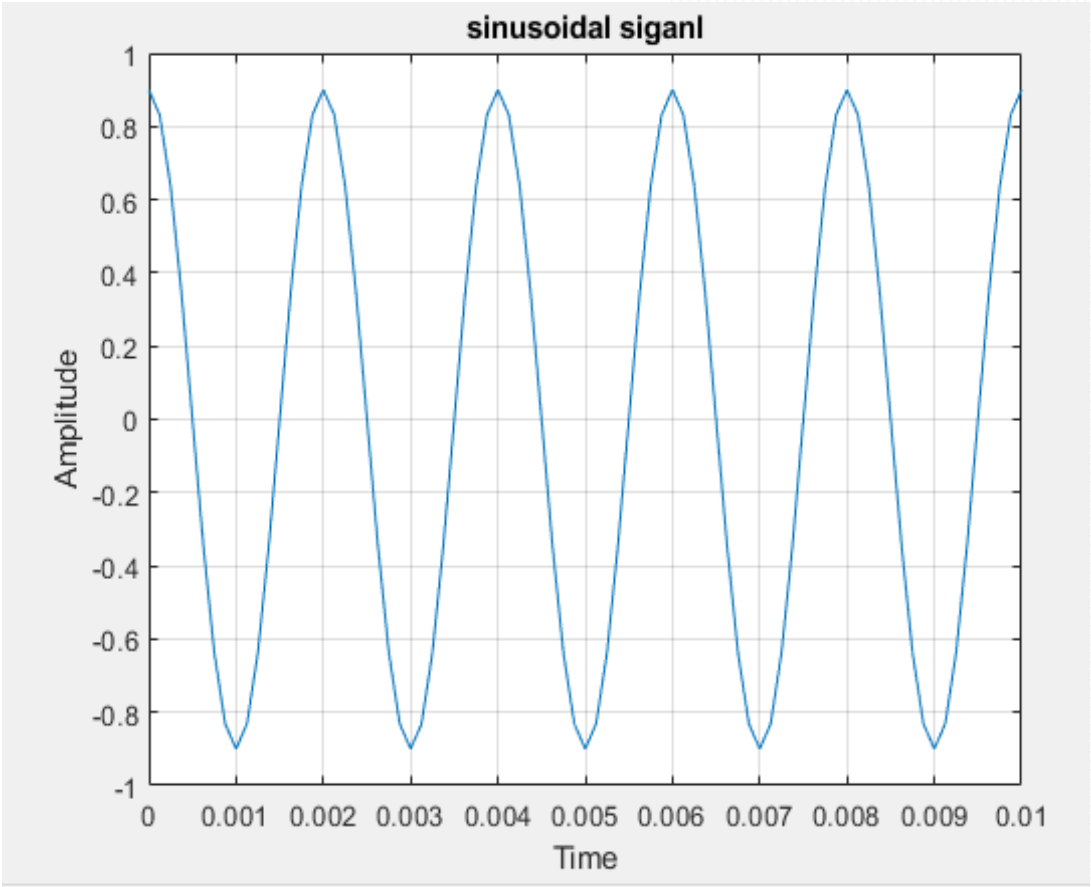
Generate Sinusoidal Signal (matlab): Beep sound

- General form :

$$x = A \cos(2 * pi * fm * t)$$

  - Where A → signal amplitude
  - Fm → signal fequency

```
%generate sinosoidal signal
%x=A cos (2 pi fm t)
fs=8000;
time=1;
t=0:(1/fs):time;
fm=500;
A=0.9;
x=A*cos(2*pi*fm*t);
sound(x,fs)

figure()
plot(t,x)
xlabel('Time');
ylabel('Amplitude');
title('sinusoidal siganl')
%plot(t(1:100),x(1:100));grid;
xlim([0 0.01]), grid
```



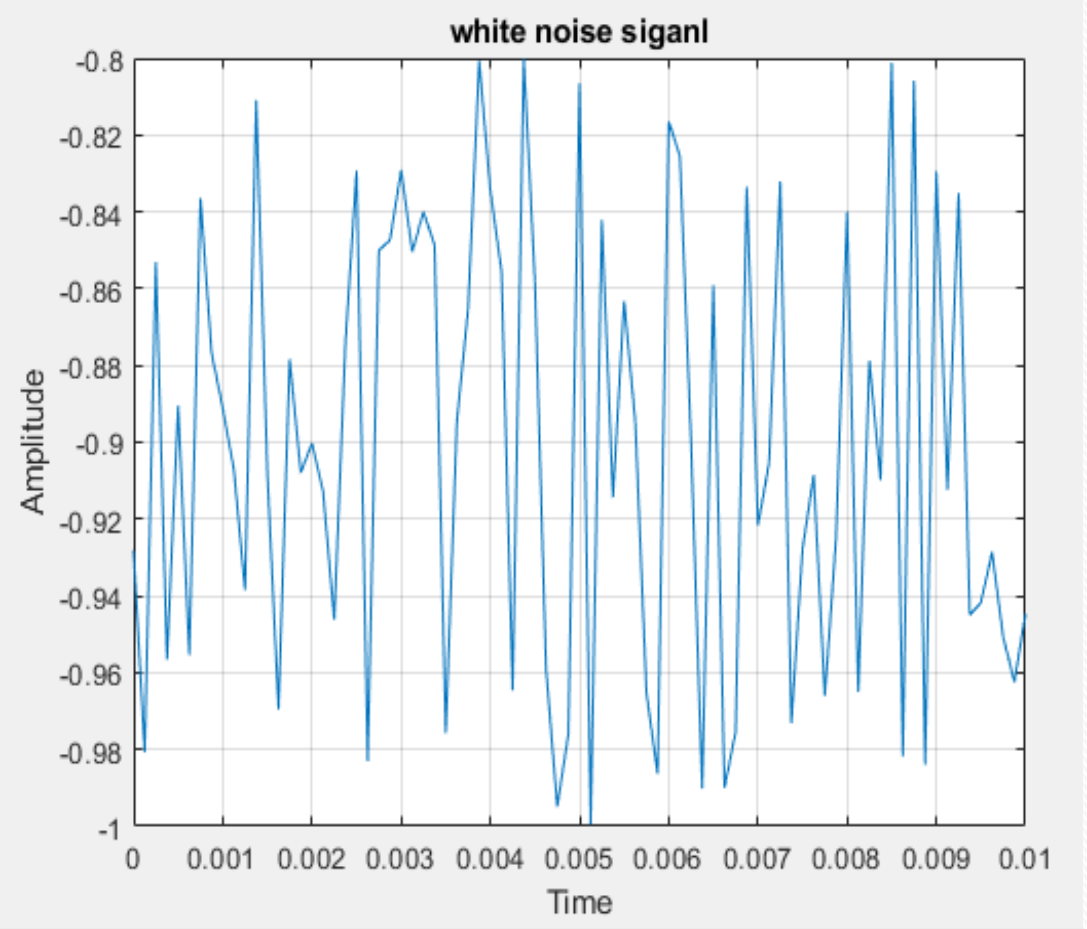
Generate random Signal (matlab): sh sound

- Use rand function to generate random signal follow the uniform distribution.
- values range [0,1].
- to generate the white noise use this form:

$$x = A\ \mathrm{rand}(1,N)*2-1$$

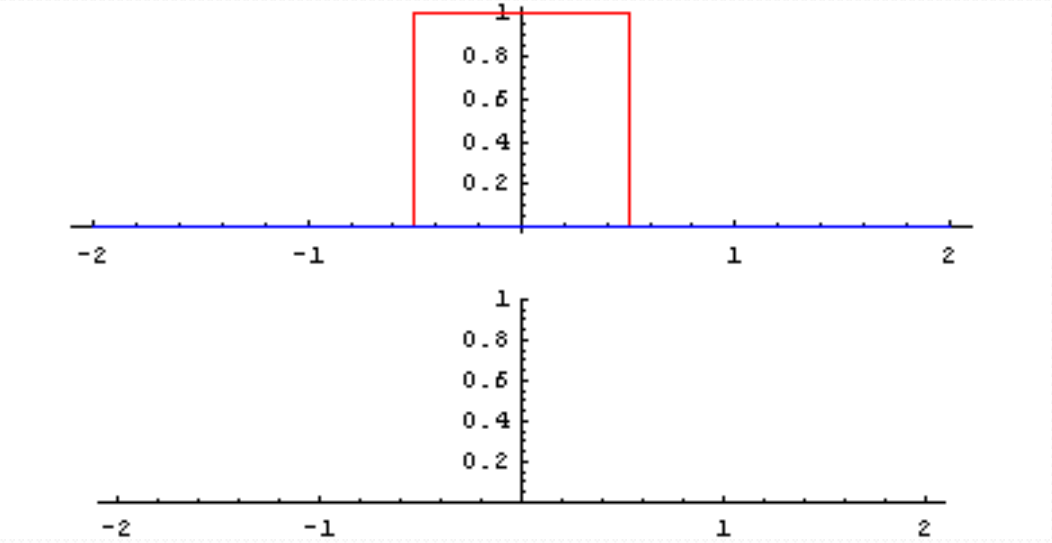
- Where N→signal length or samples number during signal duration ***N=fs*time***.

```
%generate white noise signal
%x=A rand(1,N)*2-1

fs=8000;
time=2;
N=fs*time;
t=linspace(0,time,N);
A=0.1;
x=A*rand(1,N)*2-1;
sound(x,fs)

figure()
plot(t,x)
xlabel('Time');
ylabel('Amplitude');
title('white noise siganl')
%plot(t(1:100),x(1:100));grid;
xlim([0 0.01]), grid
```



Convolution Effect on Audio Processing

- simulate the reverberation effect of a particular area
- merge two sounds



- Use matlab conv() function to do convolution

Filtering a random signal by direct convolution

1. Generate a random input signal of 50 samples whose amplitude is uniformly distributed between -2 and 3.
2. Process the input signal by direct convolution with the filter impulse repose

$$h(n) = \left[\frac{1}{8} \quad \frac{1}{4} \quad \frac{1}{4} \quad \frac{1}{4} \quad \frac{1}{8}\right]$$

3. Plot the input and output signals on the same graph and explain what the filtering effect is

```
a = -2;
b = 3;
r = (b-a).*rand(50,1) + a;
u = [1/8 1/4 1/4 1/4 1/8];
w = conv(r,u);
x1=0:49;
x2=0:53;
figure()
plot(x1,r, 'r')
hold on
plot(x2,w, 'g')
```