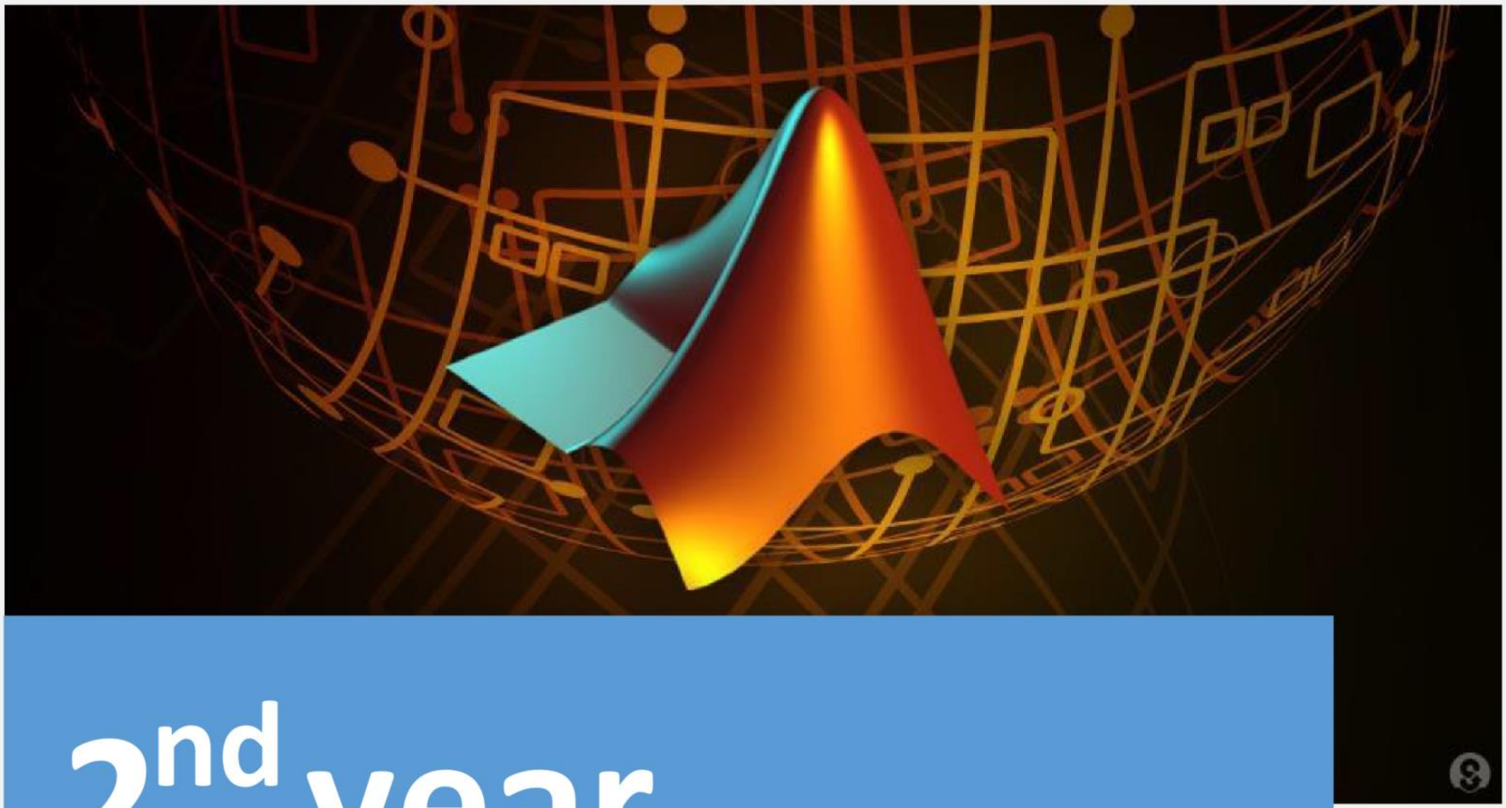
SIGNALS & SYSTEMS

[redacted]



2nd year communications & Electronics program

Alexandria University

Faculty of Engineering

Electronics and communication department

second Year 2020-2021

Participate

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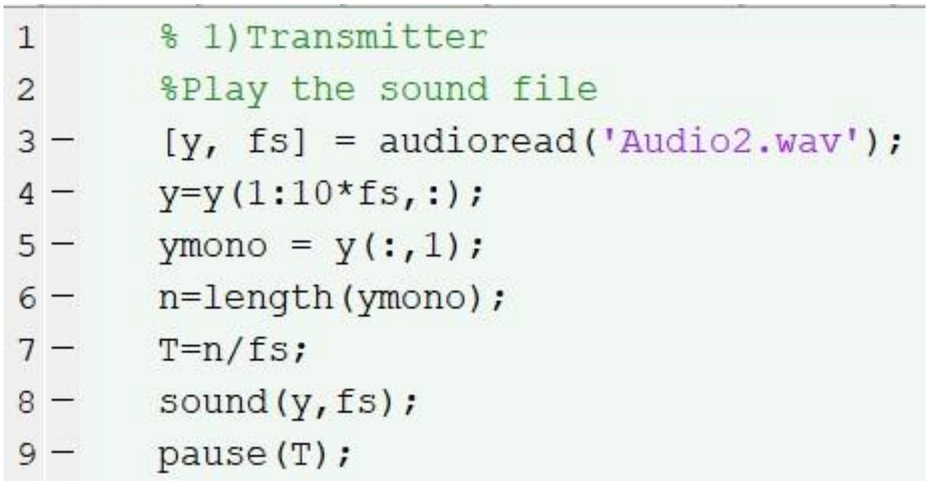
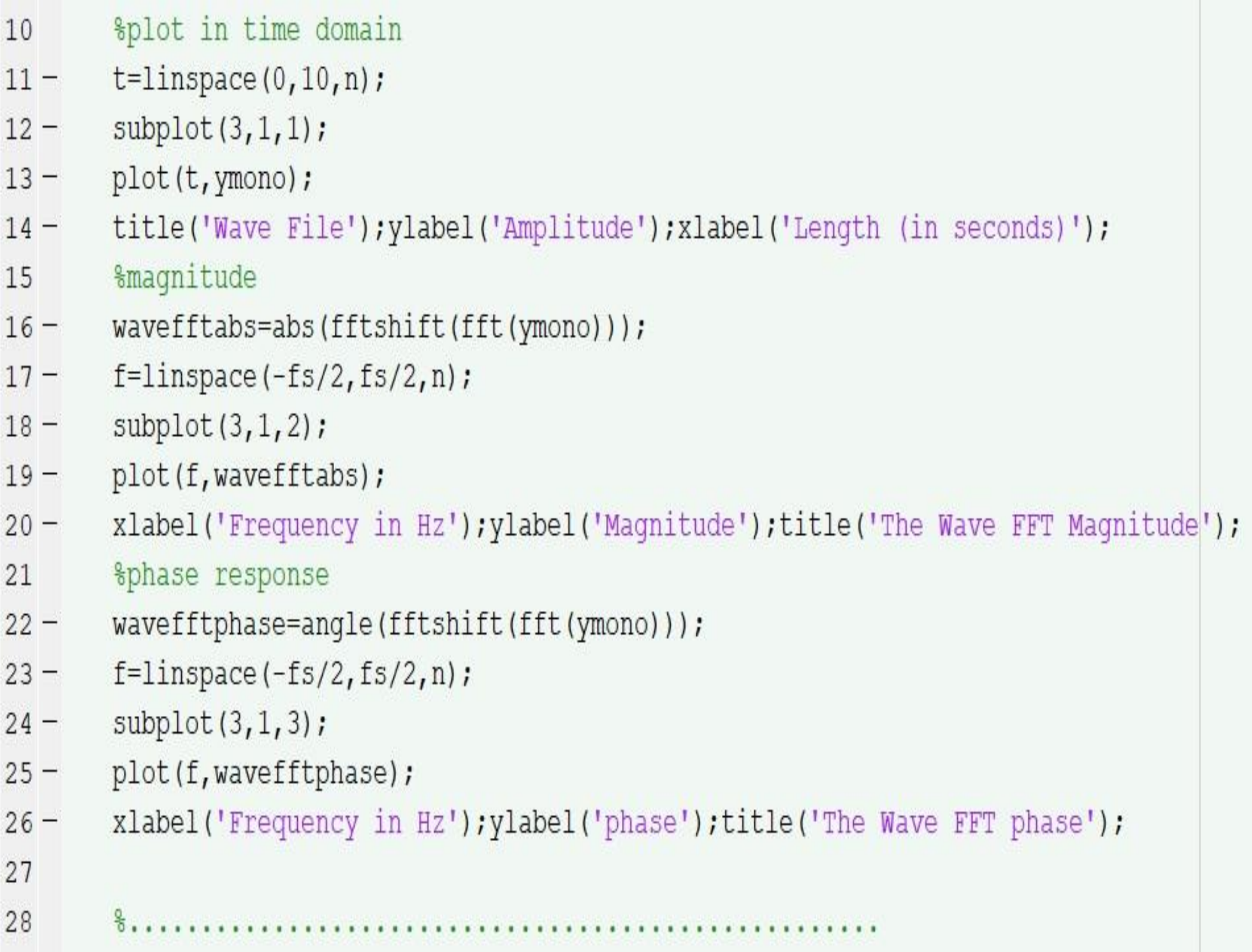
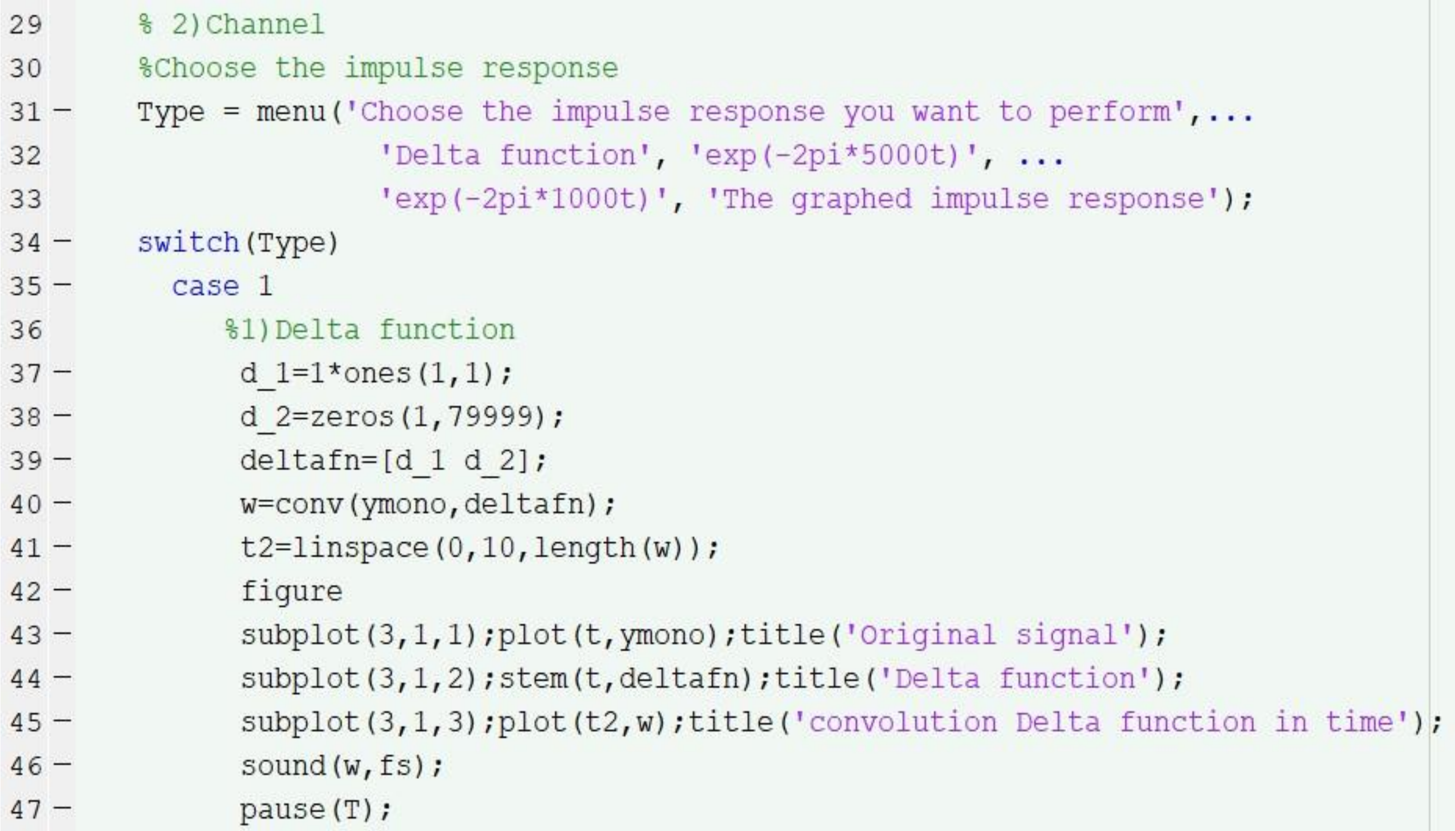
- **MATLAB code**



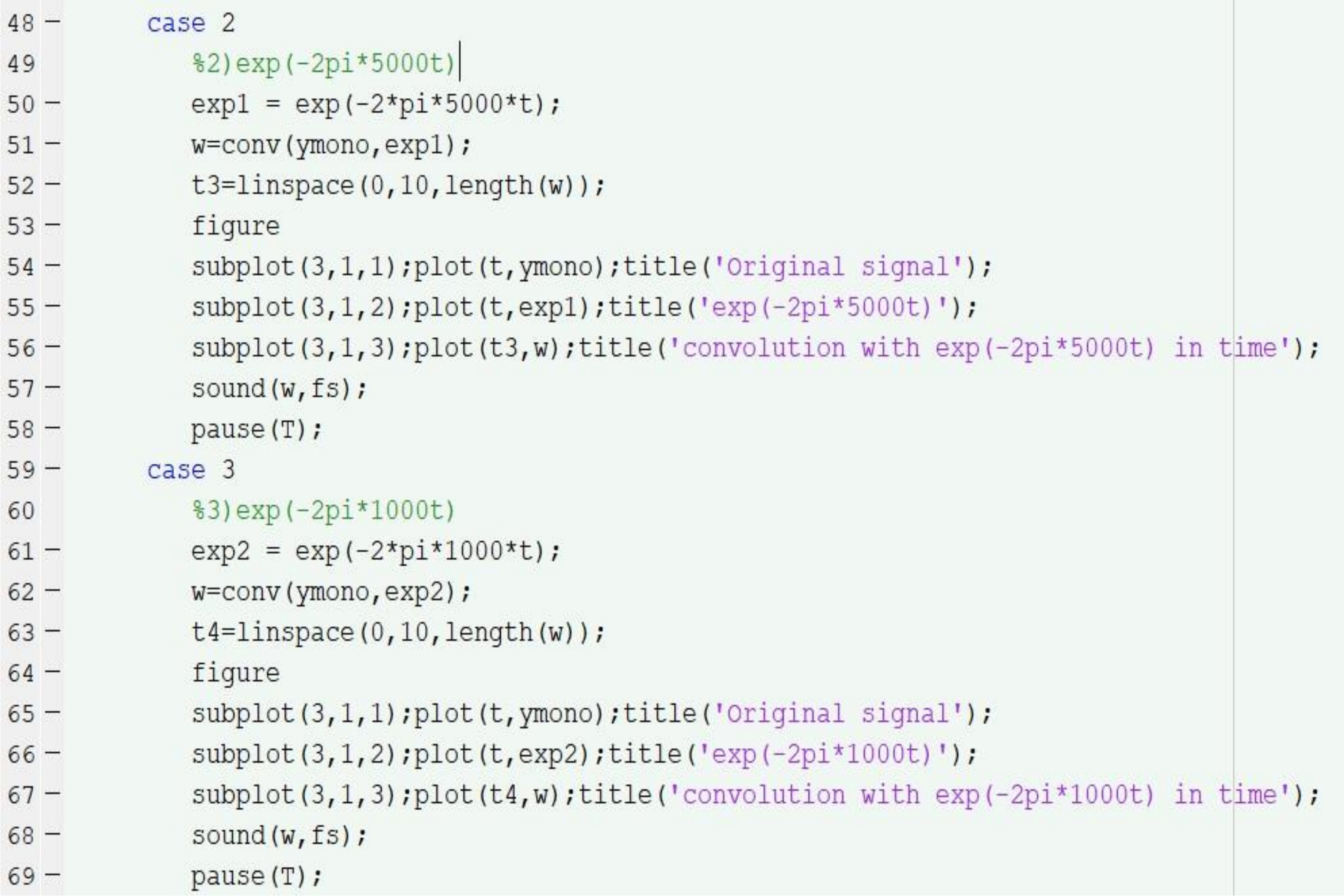
```
% 1)Transmitter
%Play the sound file
[y, fs] = audioread('Audio2.wav');
y=y(1:10*fs,:);
ymono = y(:,1);
n=length(ymono);
T=n/fs;
sound(y,fs);
pause(T);
```



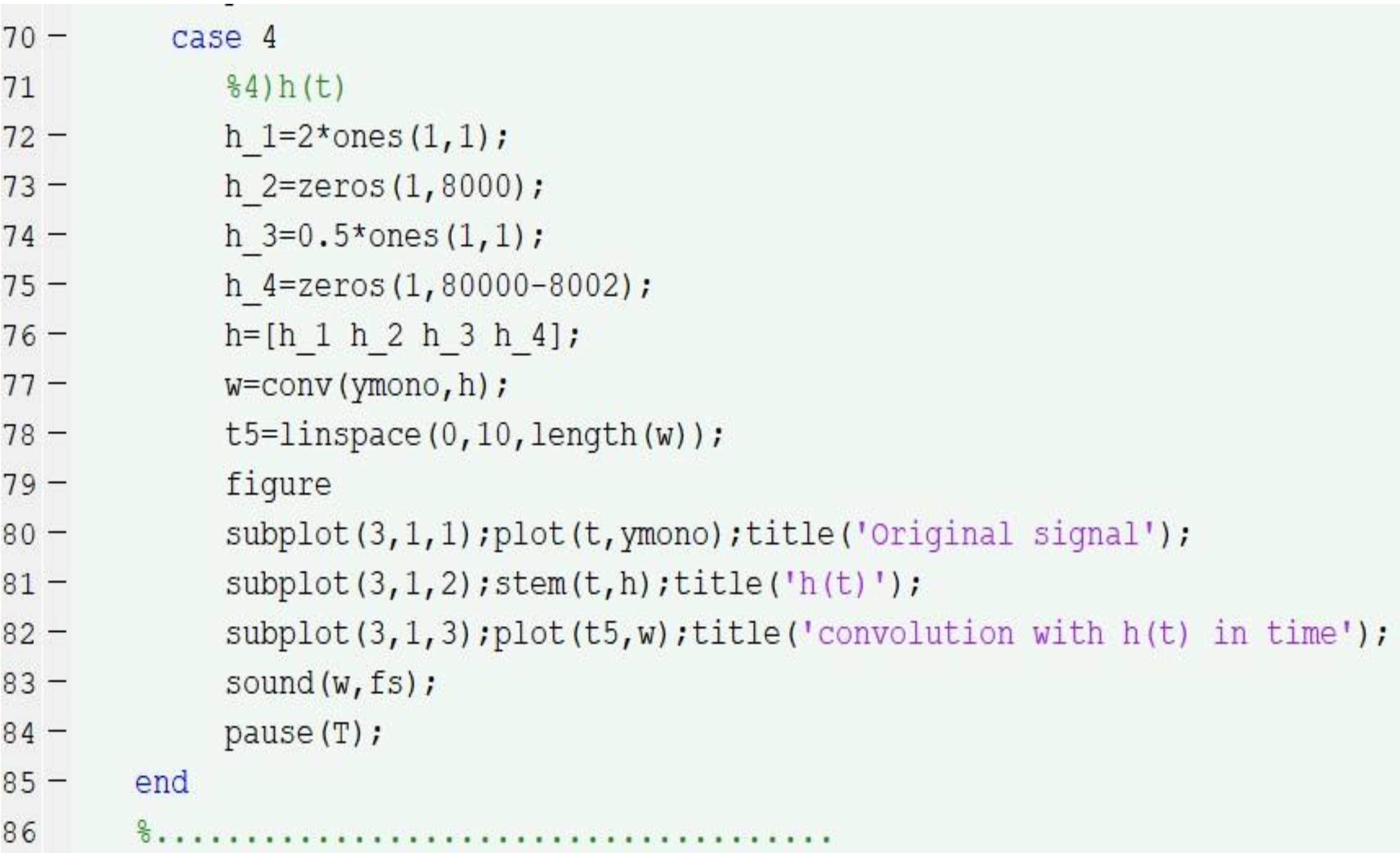
```
%plot in time domain
t=linspace(0,10,n);
subplot(3,1,1);
plot(t,ymono);
title('Wave File');ylabel('Amplitude');xlabel('Length (in seconds)');
%magnitude
wavefftabs=abs(fftshift(fft(ymono)));
f=linspace(-fs/2,fs/2,n);
subplot(3,1,2);
plot(f,wavefftabs);
xlabel('Frequency in Hz');ylabel('Magnitude');title('The Wave FFT Magnitude');
%phase response
wavefftphase=angle(fftshift(fft(ymono)));
f=linspace(-fs/2,fs/2,n);
subplot(3,1,3);
plot(f,wavefftphase);
xlabel('Frequency in Hz');ylabel('phase');title('The Wave FFT phase');

%.............................................
```



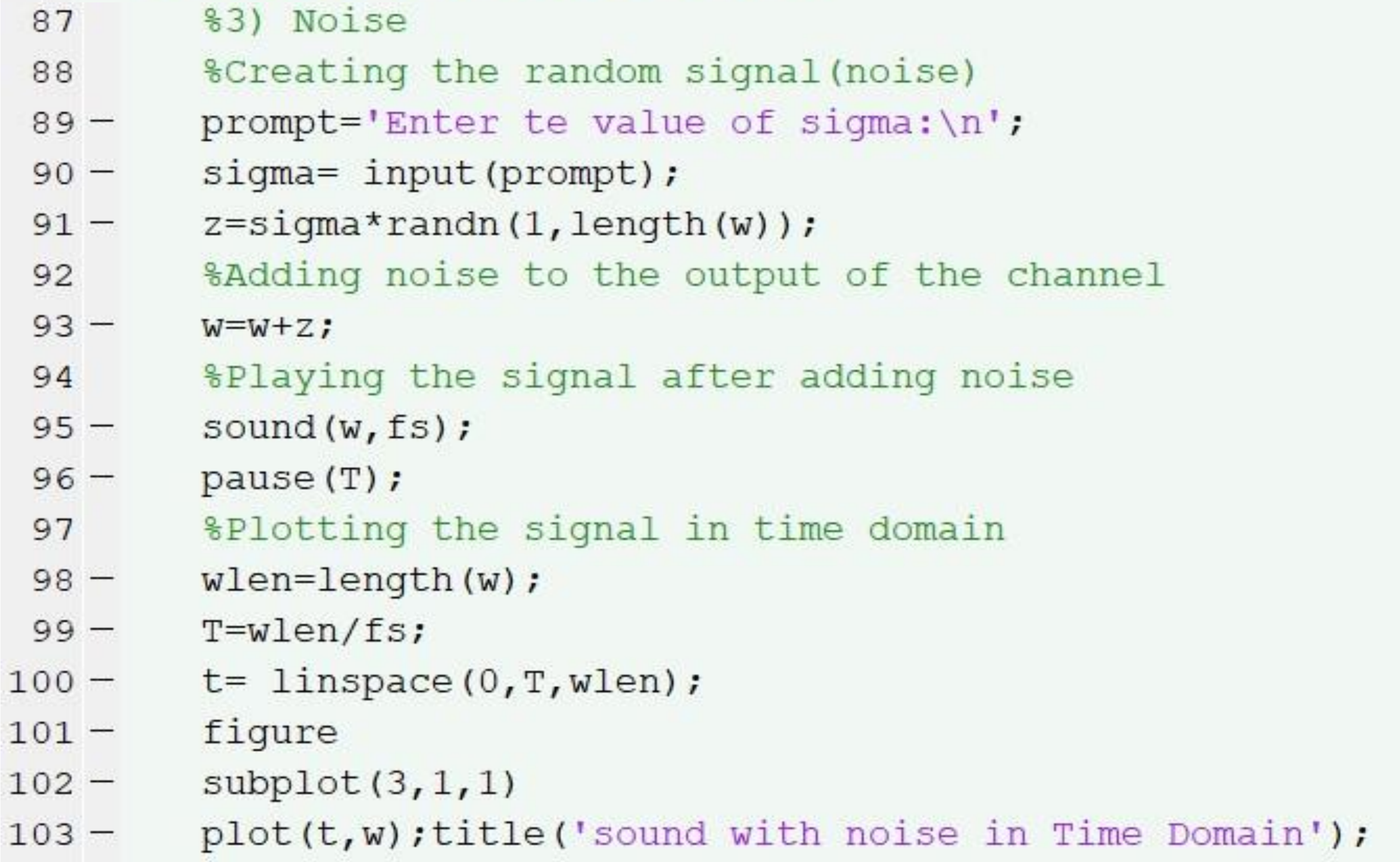
```
% 2)Channel
%Choose the impulse response
Type = menu('Choose the impulse response you want to perform',...
               'Delta function', 'exp(-2pi*5000t)', ...
               'exp(-2pi*1000t)', 'The graphed impulse response');
switch(Type)
  case 1
     %1)Delta function
      d_1=1*ones(1,1);
      d_2=zeros(1,79999);
      deltafn=[d_1 d_2];
      w=conv(ymono,deltafn);
      t2=linspace(0,10,length(w));
      figure
      subplot(3,1,1);plot(t,ymono);title('Original signal');
      subplot(3,1,2);stem(t,deltafn);title('Delta function');
      subplot(3,1,3);plot(t2,w);title('convolution Delta function in time');
      sound(w,fs);
      pause(T);
```



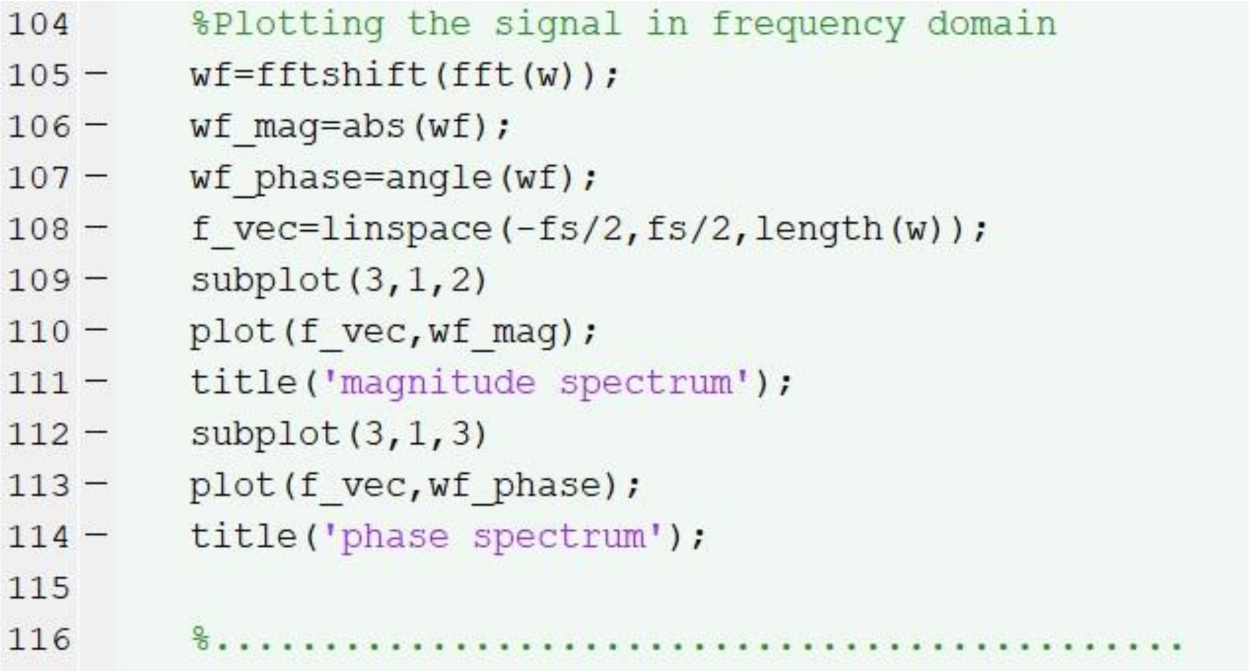
```
 case 2
    %2)exp(-2pi*5000t)
    exp1 = exp(-2*pi*5000*t);
    w=conv(ymono,exp1);
    t3=linspace(0,10,length(w));
    figure
    subplot(3,1,1);plot(t,ymono);title('Original signal');
    subplot(3,1,2);plot(t,exp1);title('exp(-2pi*5000t)');
    subplot(3,1,3);plot(t3,w);title('convolution with exp(-2pi*5000t) in time');
    sound(w,fs);
    pause(T);
 case 3
    %3)exp(-2pi*1000t)
    exp2 = exp(-2*pi*1000*t);
    w=conv(ymono,exp2);
    t4=linspace(0,10,length(w));
    figure
    subplot(3,1,1);plot(t,ymono);title('Original signal');
    subplot(3,1,2);plot(t,exp2);title('exp(-2pi*1000t)');
    subplot(3,1,3);plot(t4,w);title('convolution with exp(-2pi*1000t) in time');
    sound(w,fs);
    pause(T);
```



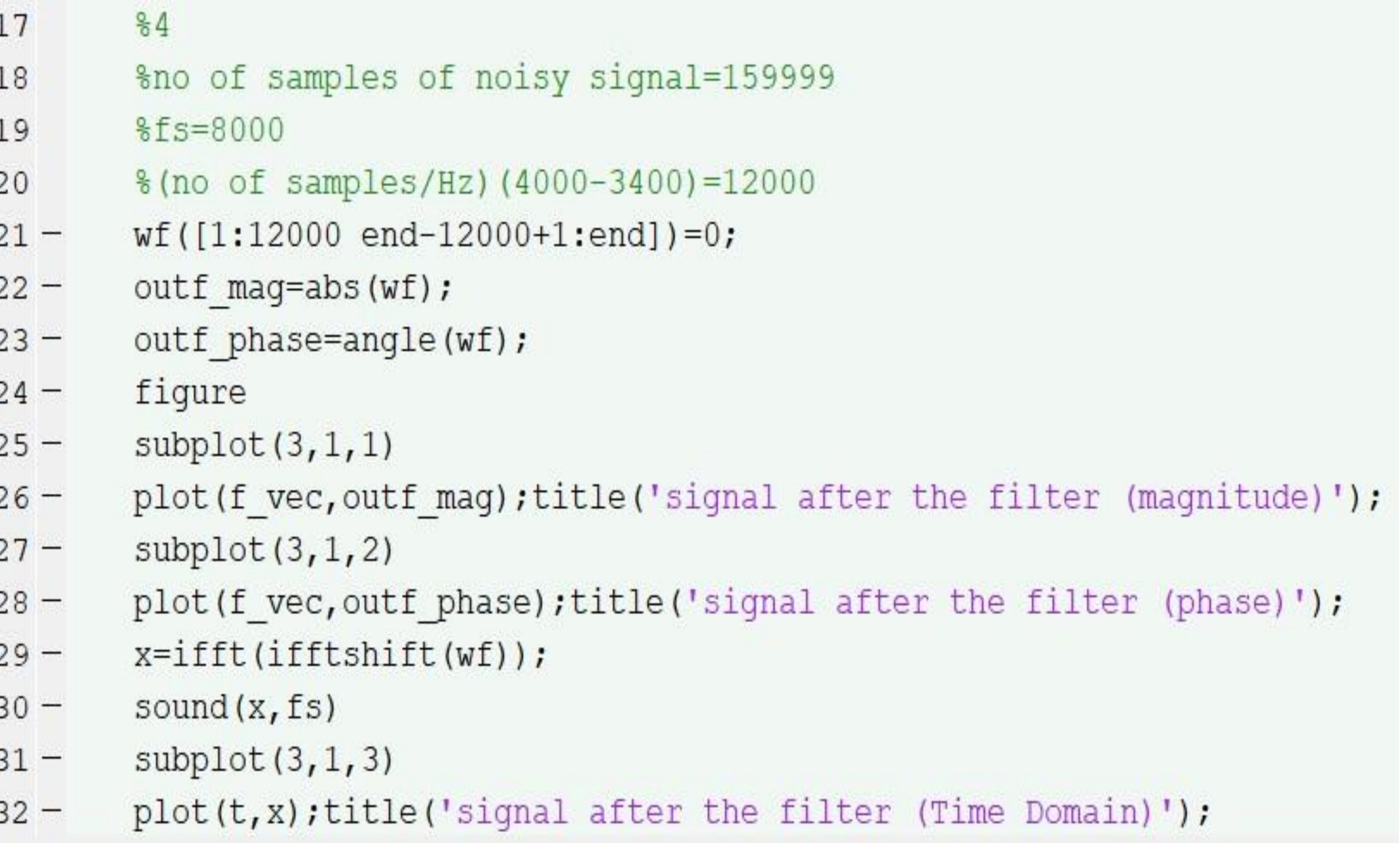
```
  case 4
    %4)h(t)
    h_1=2*ones(1,1);
    h_2=zeros(1,8000);
    h_3=0.5*ones(1,1);
    h_4=zeros(1,80000-8002);
    h=[h_1 h_2 h_3 h_4];
    w=conv(ymono,h);
    t5=linspace(0,10,length(w));
    figure
    subplot(3,1,1);plot(t,ymono);title('Original signal');
    subplot(3,1,2);stem(t,h);title('h(t)');
    subplot(3,1,3);plot(t5,w);title('convolution with h(t) in time');
    sound(w,fs);
    pause(T);
end
%.................................
```



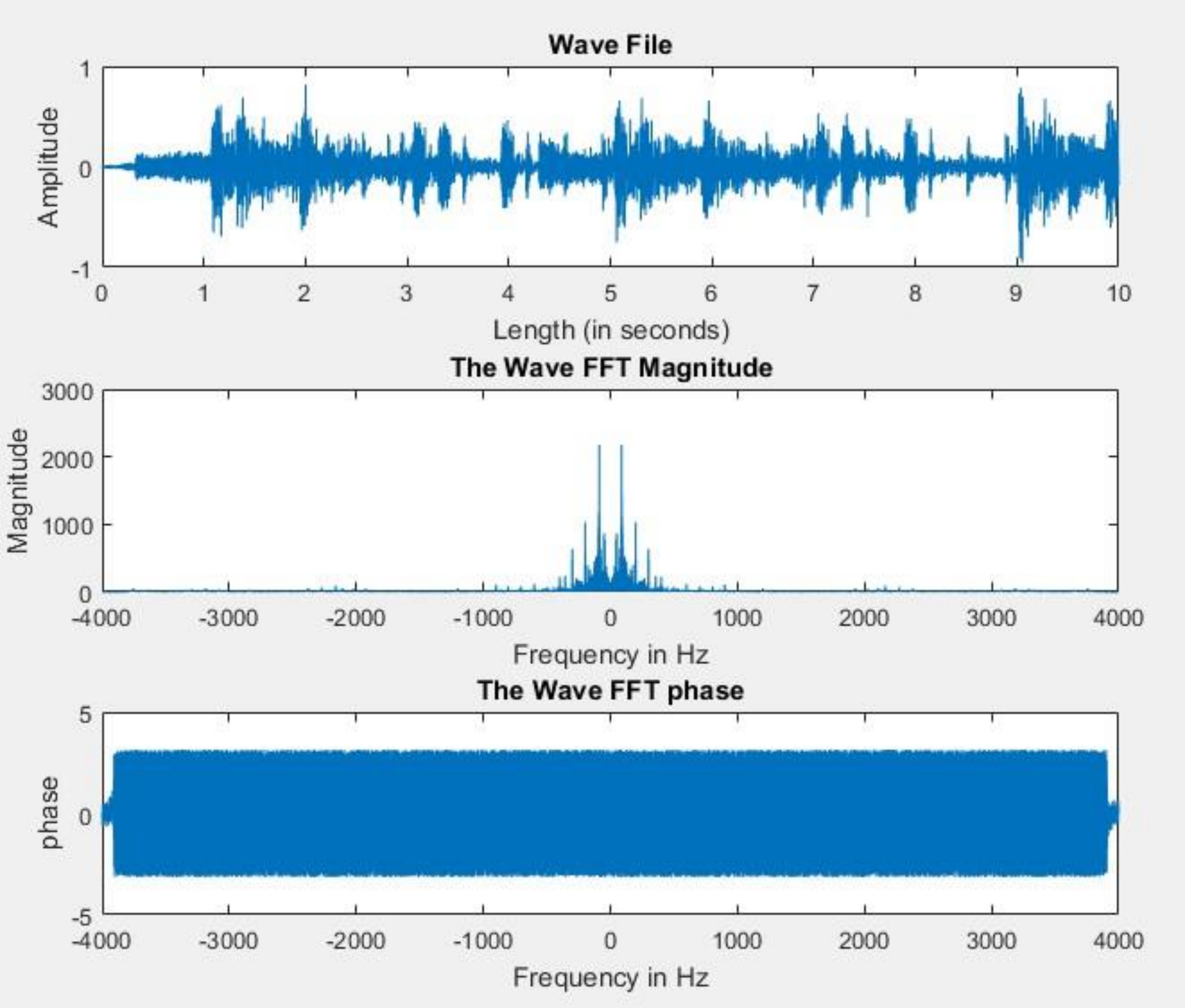
```
%3) Noise
%Creating the random signal(noise)
prompt='Enter te value of sigma:\n';
sigma= input(prompt);
z=sigma*randn(1,length(w));
%Adding noise to the output of the channel
w=w+z;
%Playing the signal after adding noise
sound(w,fs);
pause(T);
%Plotting the signal in time domain
wlen=length(w);
T=wlen/fs;
t= linspace(0,T,wlen);
figure
subplot(3,1,1)
plot(t,w);title('sound with noise in Time Domain');
```

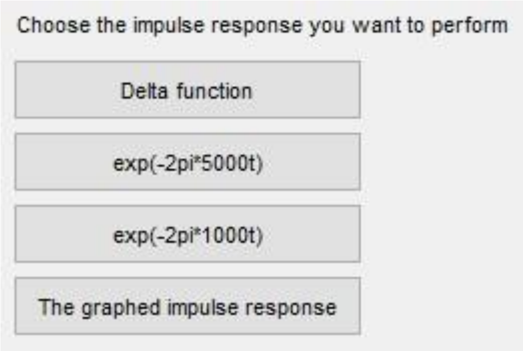


```matlab
%Plotting the signal in frequency domain
wf=fftshift(fft(w));
wf_mag=abs(wf);
wf_phase=angle(wf);
f_vec=linspace(-fs/2,fs/2,length(w));
subplot(3,1,2)
plot(f_vec,wf_mag);
title('magnitude spectrum');
subplot(3,1,3)
plot(f_vec,wf_phase);
title('phase spectrum');

%.............................................
```



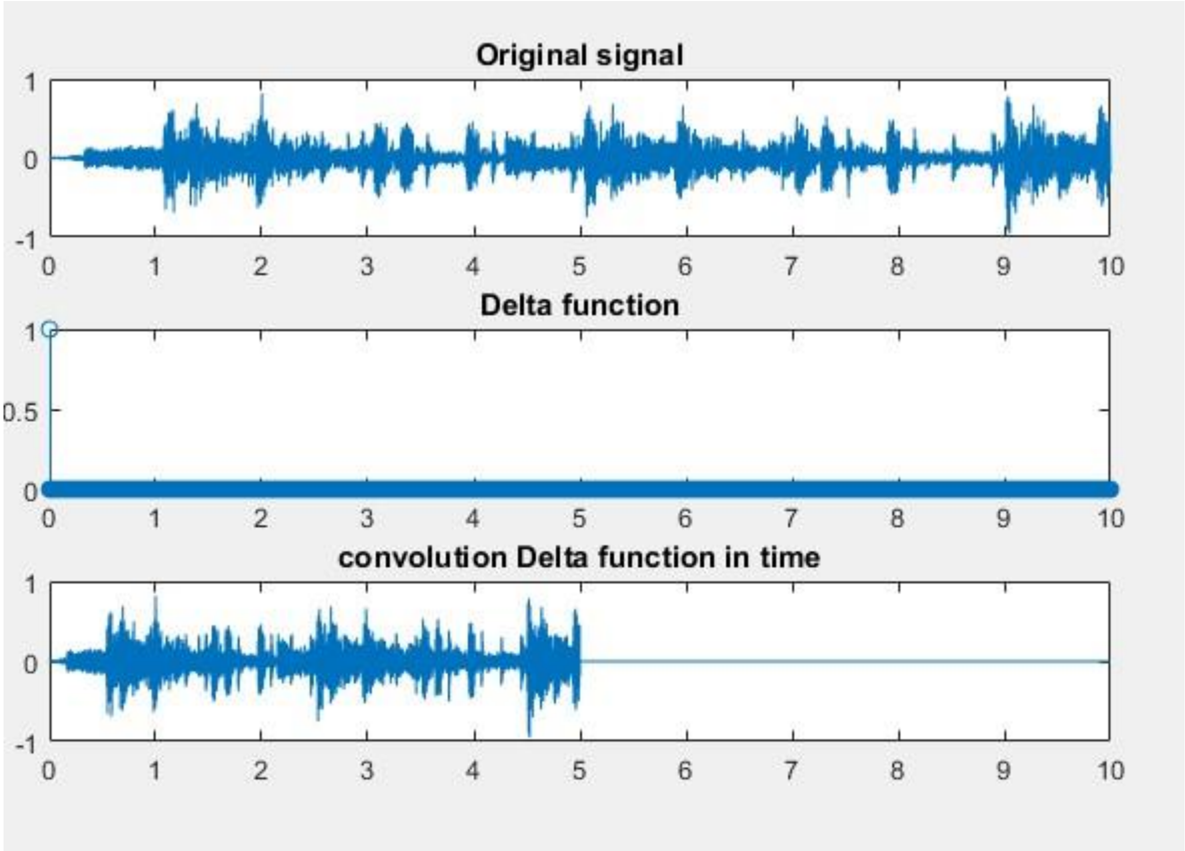
```matlab
%4
%no of samples of noisy signal=159999
%fs=8000
%(no of samples/Hz)(4000-3400)=12000
wf([1:12000 end-12000+1:end])=0;
outf_mag=abs(wf);
outf_phase=angle(wf);
figure
subplot(3,1,1)
plot(f_vec,outf_mag);title('signal after the filter (magnitude)');
subplot(3,1,2)
plot(f_vec,outf_phase);title('signal after the filter (phase)');
x=ifft(ifftshift(wf));
sound(x,fs)
subplot(3,1,3)
plot(t,x);title('signal after the filter (Time Domain)');
```





Choose the impulse response you want to perform

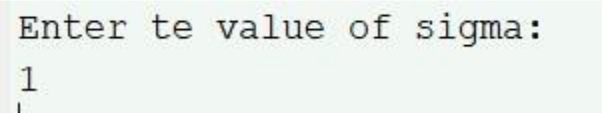
Delta function


Original signal

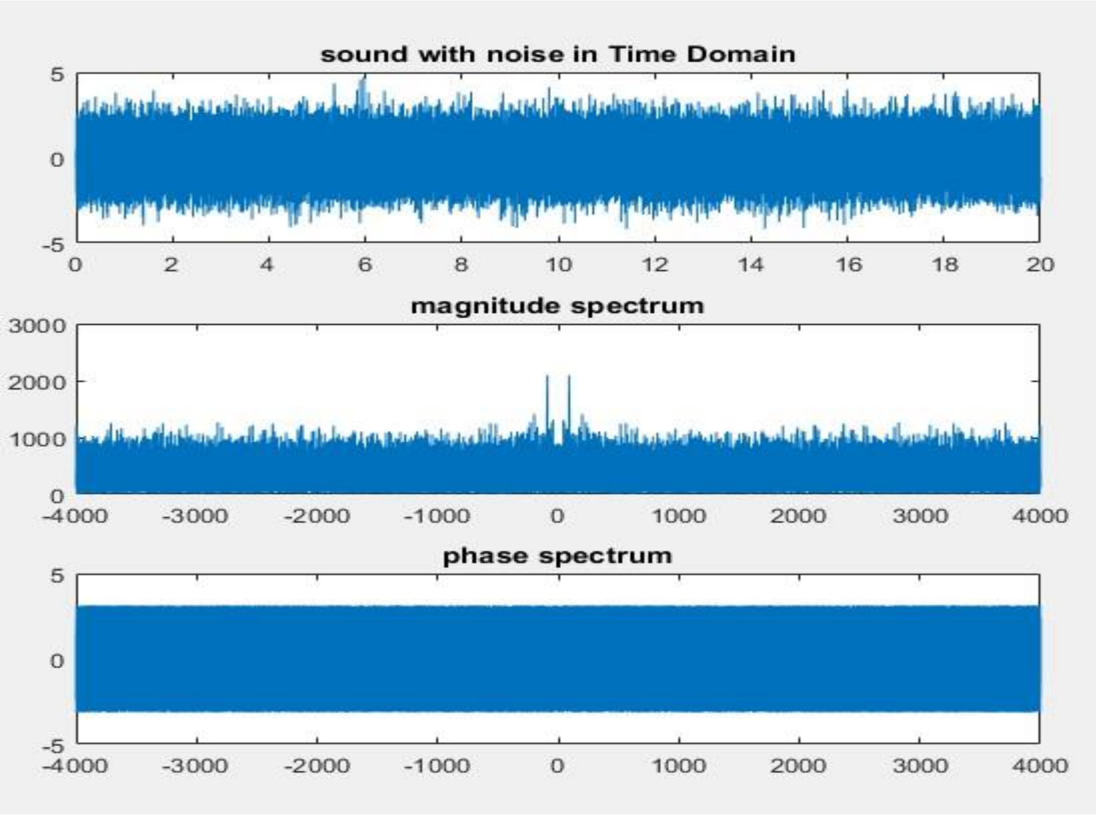
Delta function

convolution Delta function in time

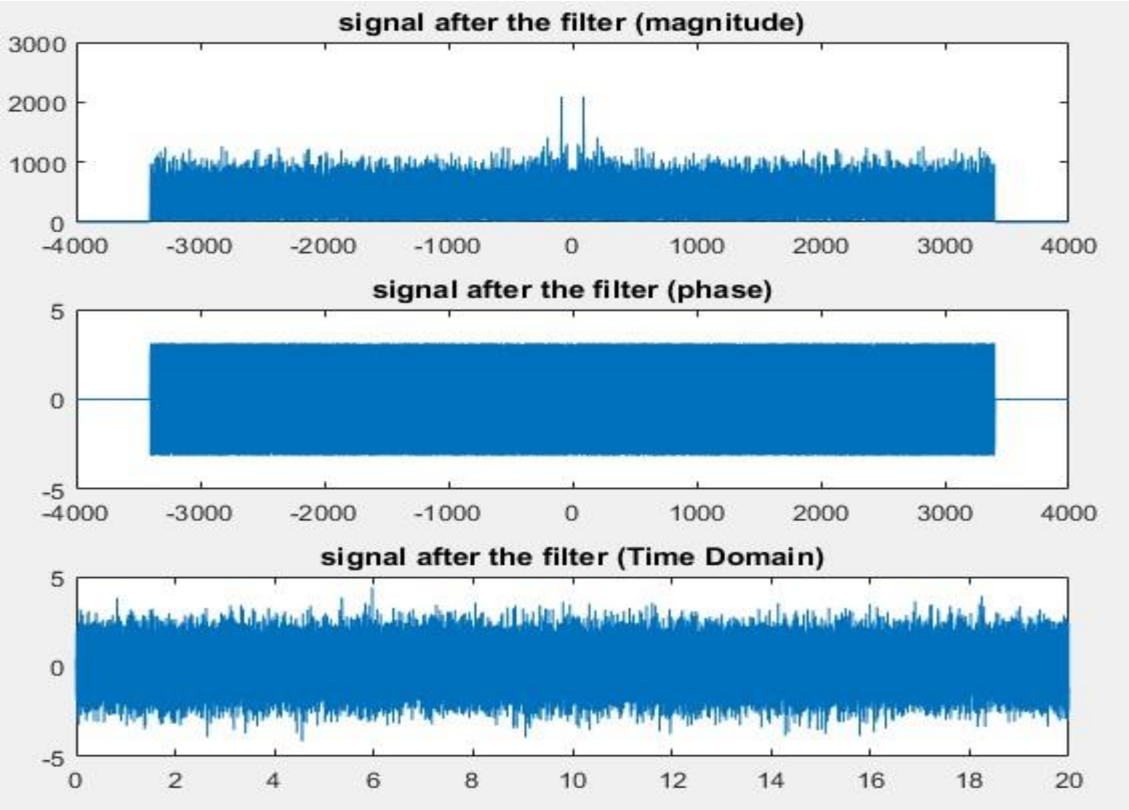
- ## Sigma


```
Enter te value of sigma:
1
```

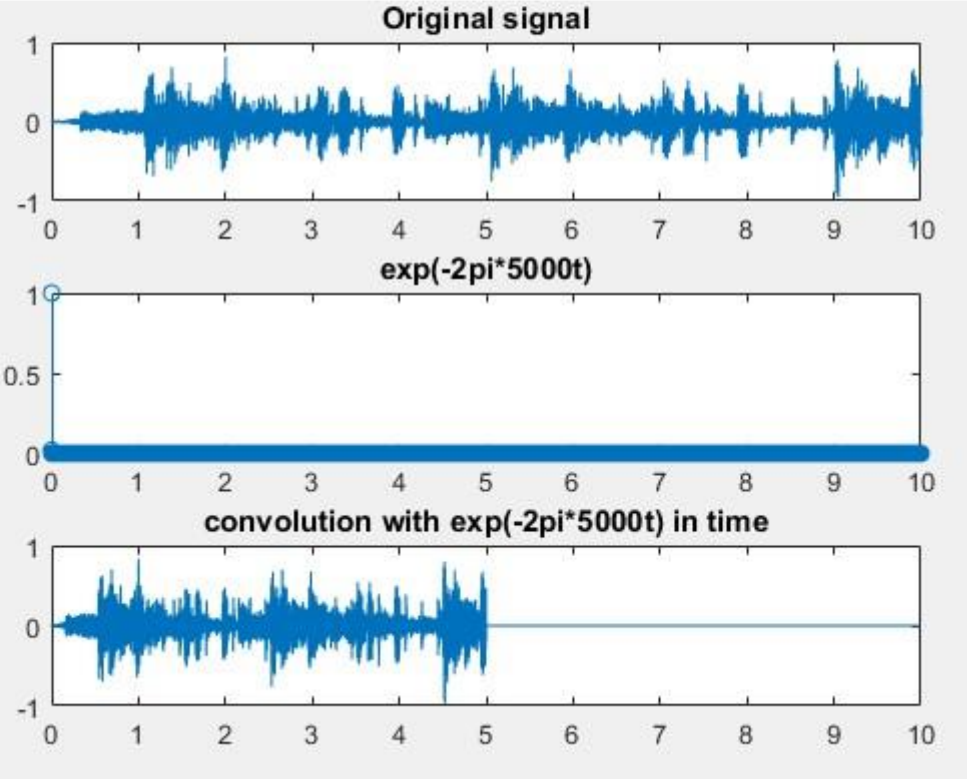
- **Sound with noise**



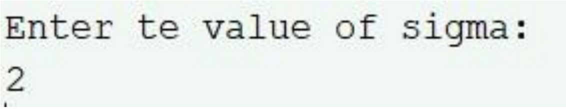
- **Filter noisy sound**



- **exp(-2pi*5000t)**



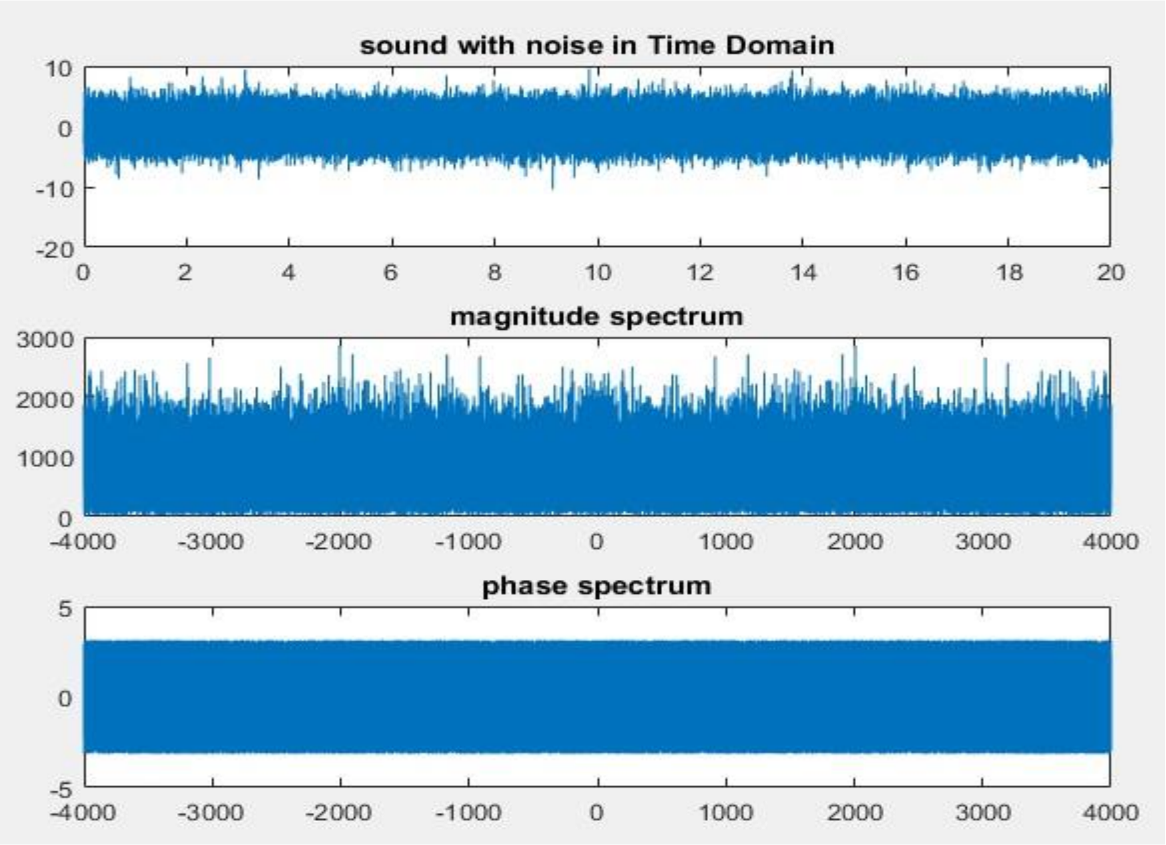
- **Sigma**



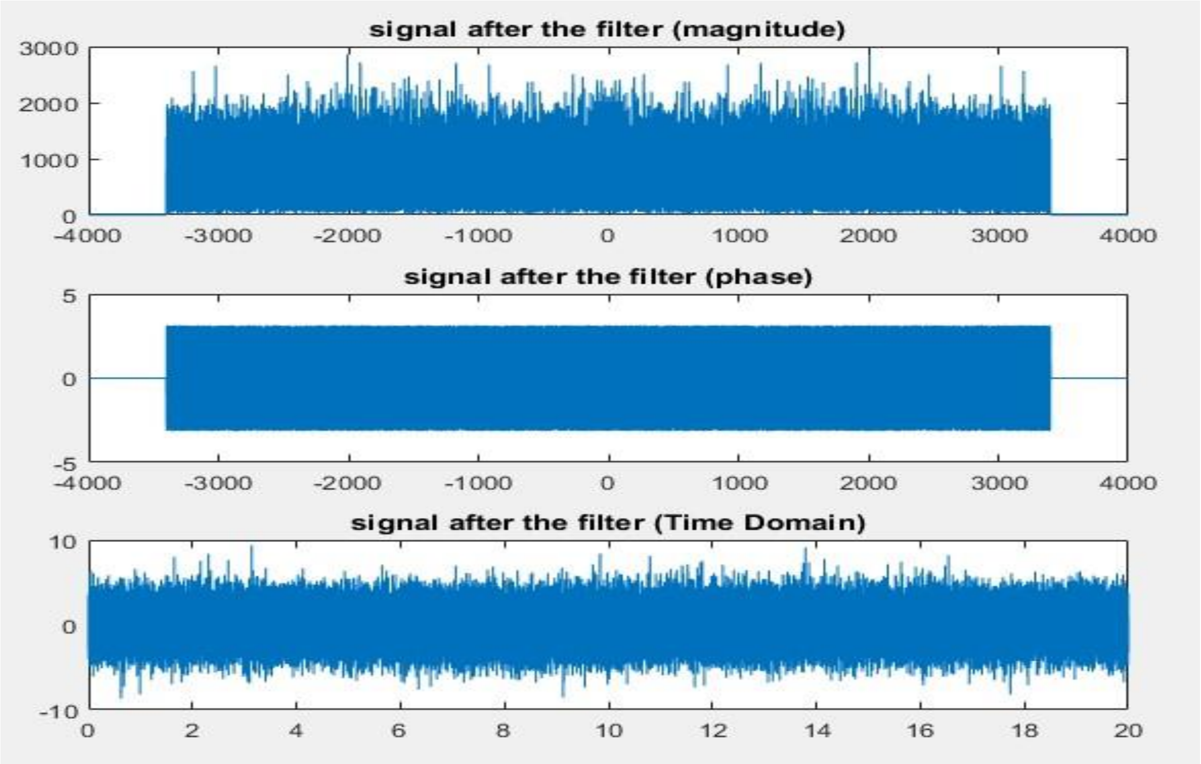
```
Enter te value of sigma:
2
```

-

Sound with noise

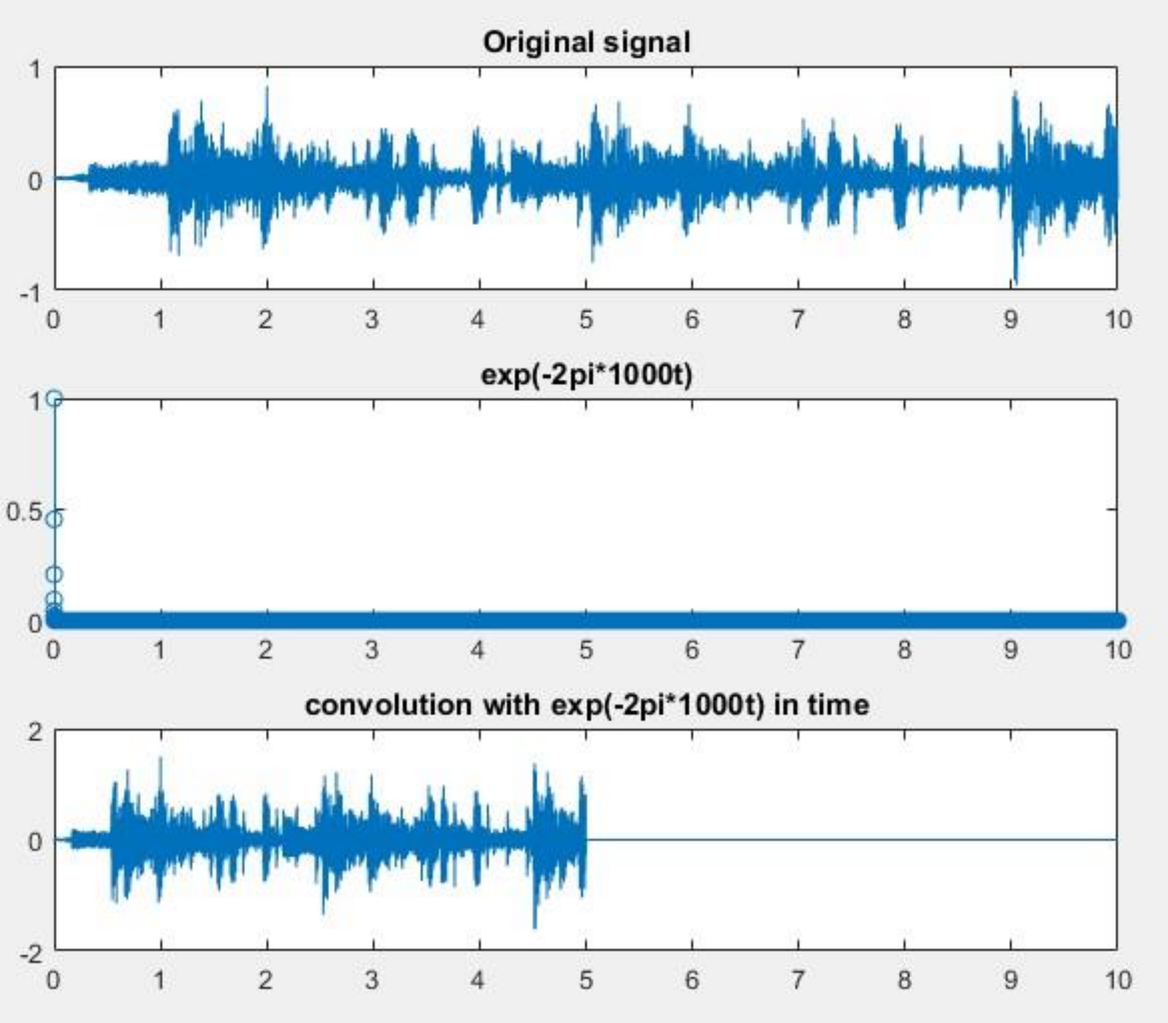


- **Filter noisy sound**



-

exp(-2pi*1000t)

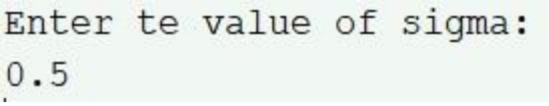


Original signal

exp(-2pi*1000t)

convolution with exp(-2pi*1000t) in time

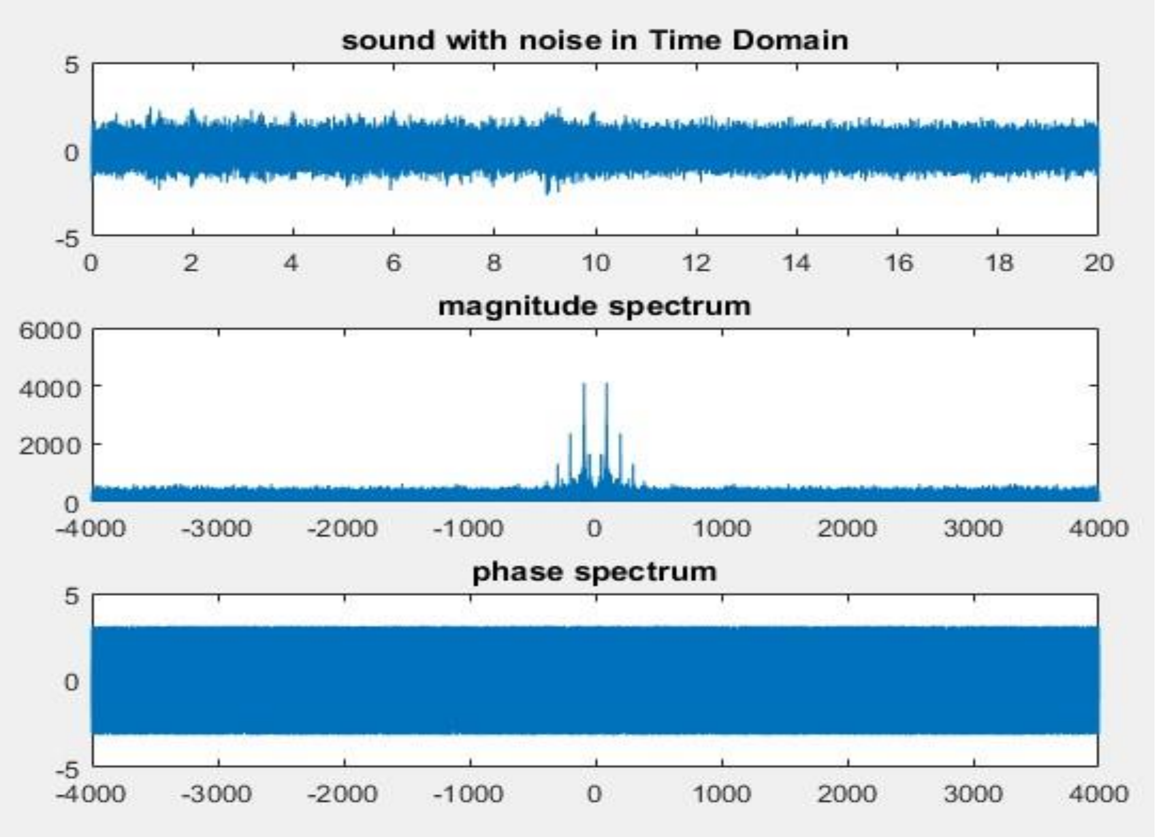
- **Sigma**



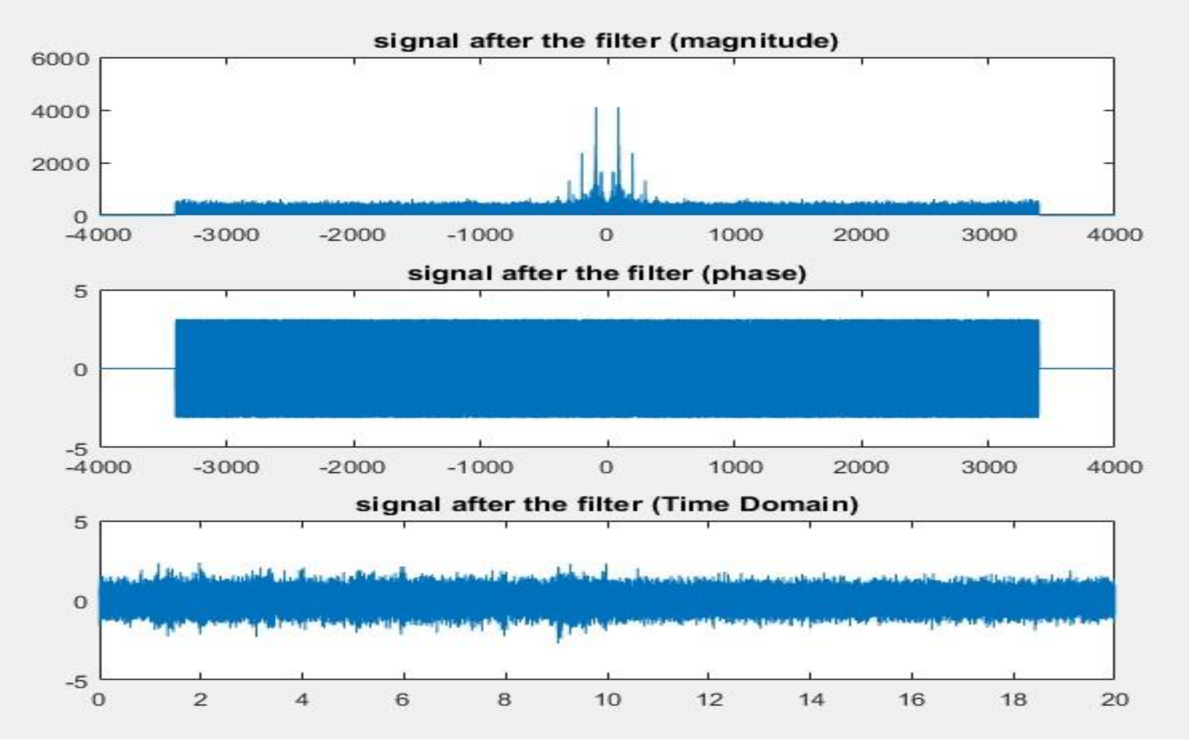
```
Enter te value of sigma:
0.5
```

-

Sound with noise

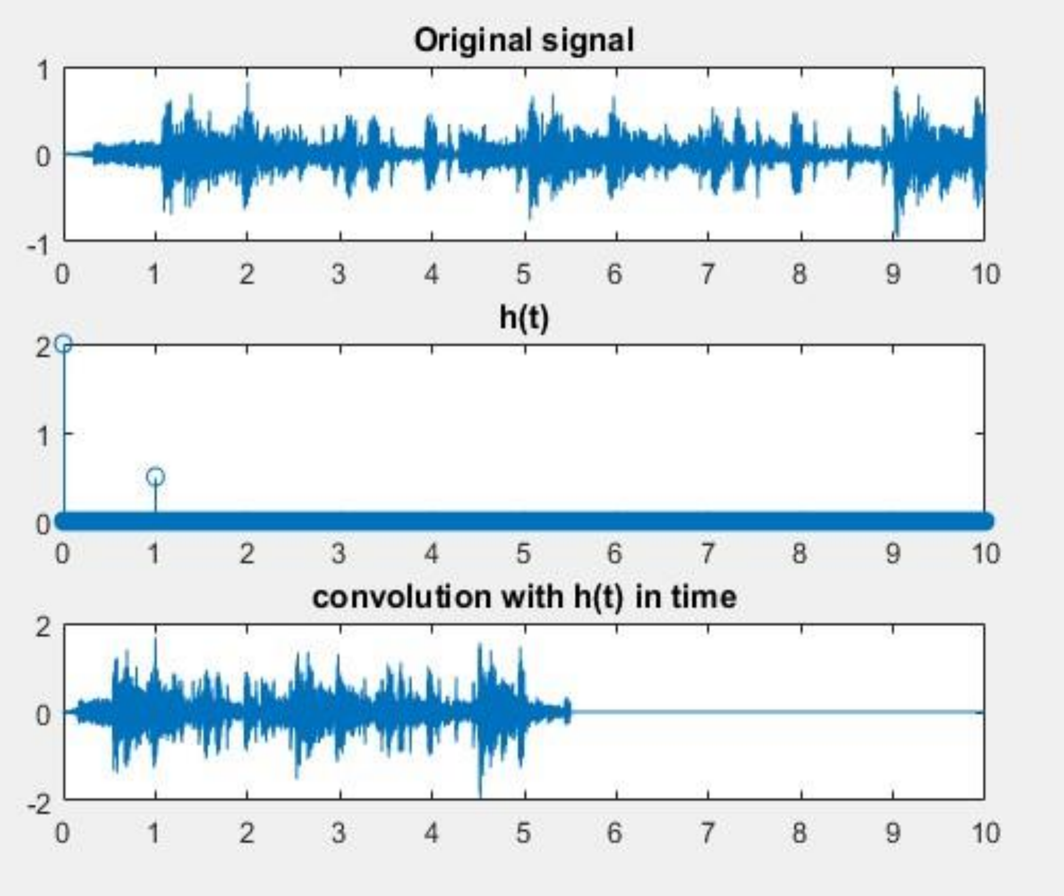


- **Filter noisy sound**

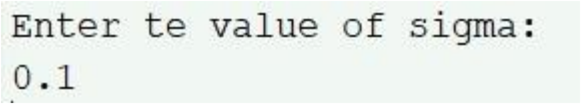


-

- **The graphed impulse response**



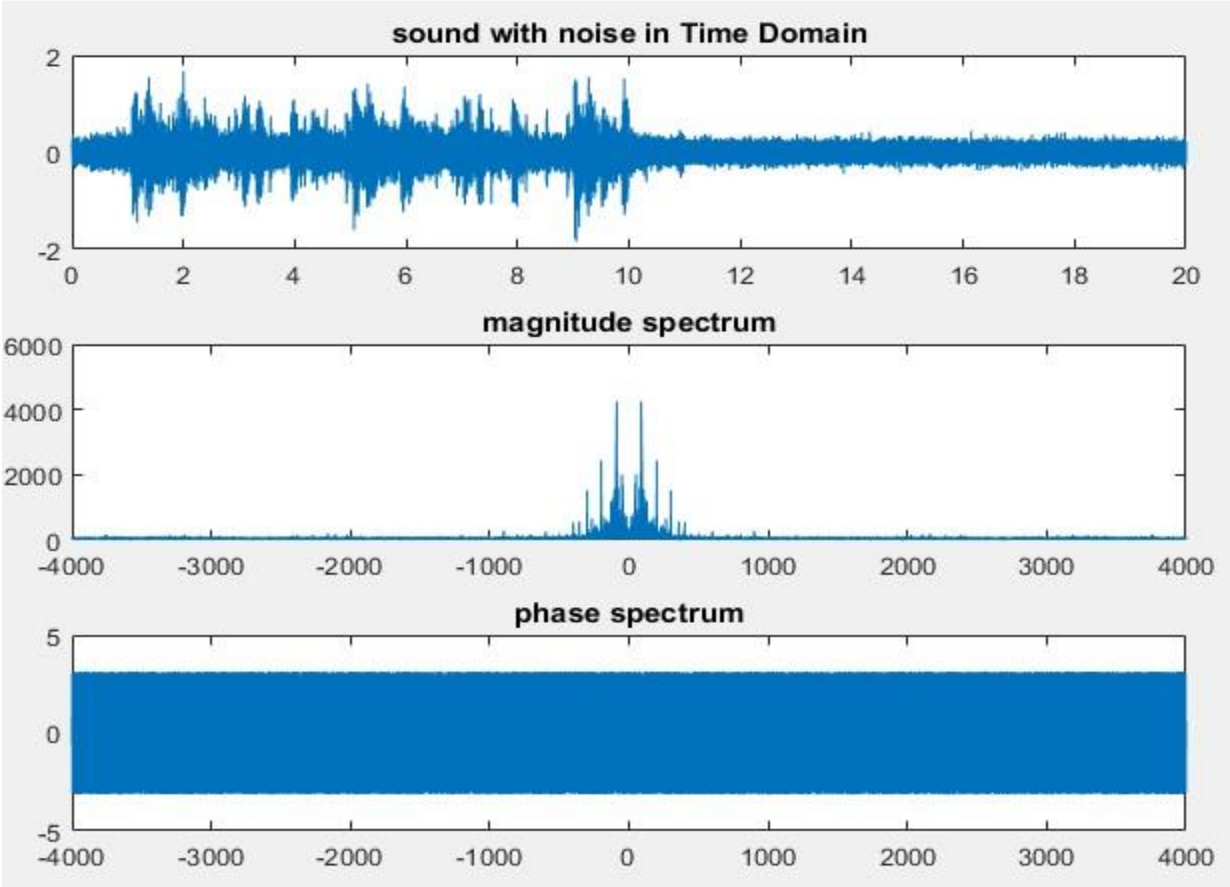
- **Sigma**



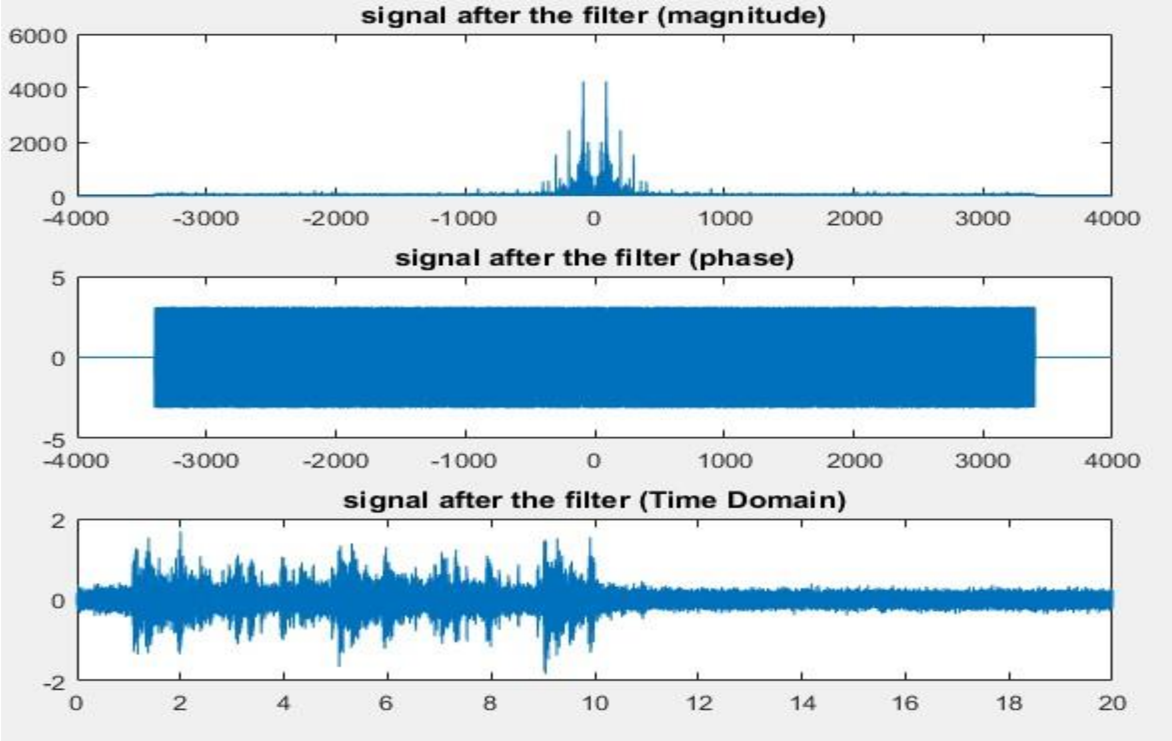
```
Enter te value of sigma:
0.1
```

-

Sound with noise

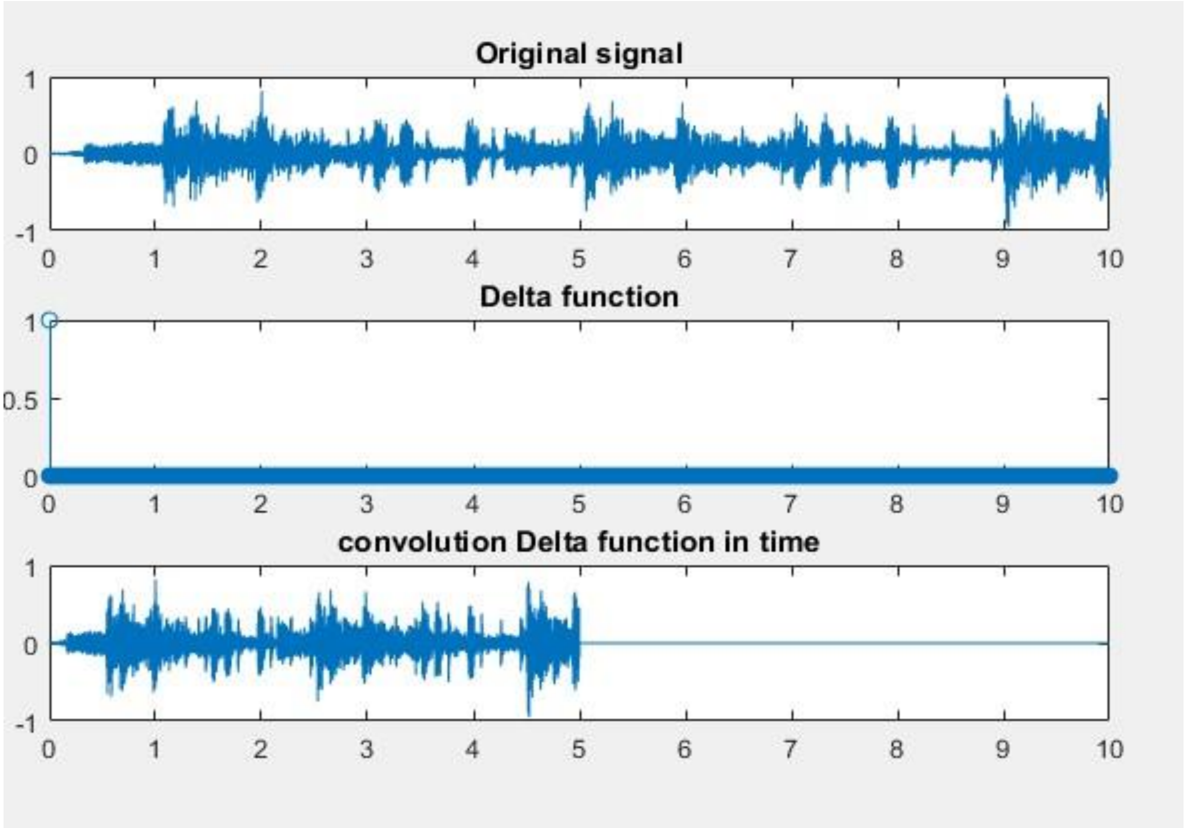


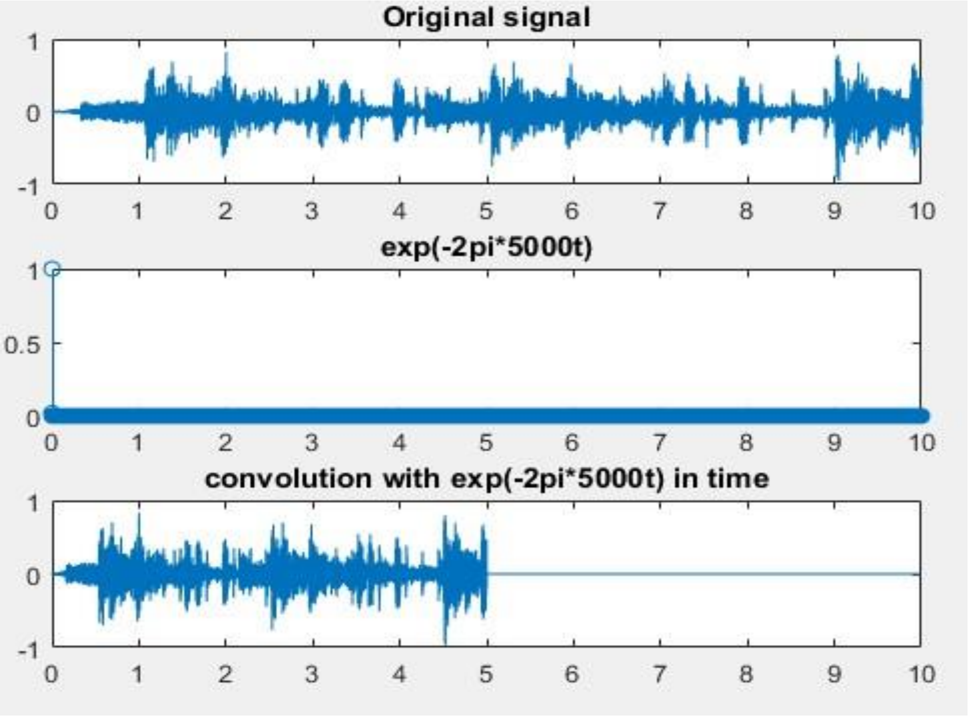
- **Filter noisy sound**

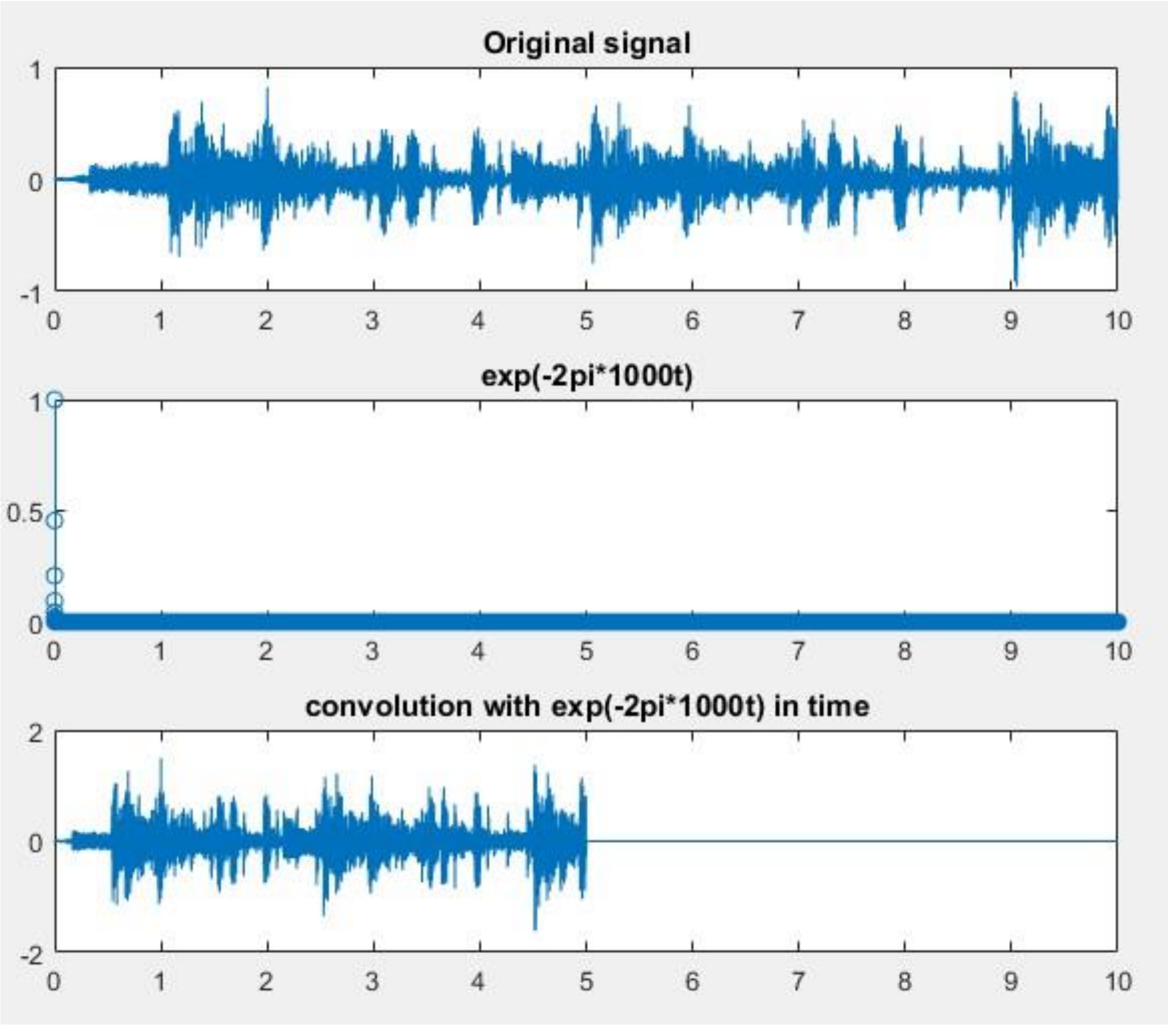


Comparison between the first three channels:

The are all the same because the time factor in exp(-2pi*5000t) which is (5000) and the time factor in exp(-2pi*1000t) which is (1000) are very large so the it decays fast that they are almost look like a delta






Original signal
1
0
-1
0 1 2 3 4 5 6 7 8 9 10
exp(-2pi*1000t)
1
0.5
0
0 1 2 3 4 5 6 7 8 9 10
convolution with exp(-2pi*1000t) in time
2
0
-2
0 1 2 3 4 5 6 7 8 9 10