Digital Signal Processing
MATLAB HW - q3

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Professor: Dr. Sheikhzadeh Author: [SeyedAli] - [SeyedHosseini] E-mail: [alisnake@aut.ac.ir] %which I`m about to change ASAP University: Amirkabir University of Technology

Clear recent data

```
clear; close all; clc;
```

M = 50 and defining Variables and Windows

```
M = 50;
n = 0 : 1 : M ;
[R , n1] = stepseq(0,0,M);
% R = heaviside(n ); %%Rectangular Window
% R = rectangle('Position',[0 0 M 1])
C1 = 0.5*(1 - cos((2*pi.*n)/(M - 1)));
Cm = C1.* R; %Hannig window
T1 = ( 1 - ((abs(M - 1 - 2.*n))/M -1));
Tm = T1.* R ; %triangular Window
H1 = 0.5*(0.56 - 0.46.*(cos((2*pi.*n)/(M - 1))));
Hm = H1.* R; %Hamming Window
w = -pi : 2*pi/M : pi;
```

plotting DTFTs

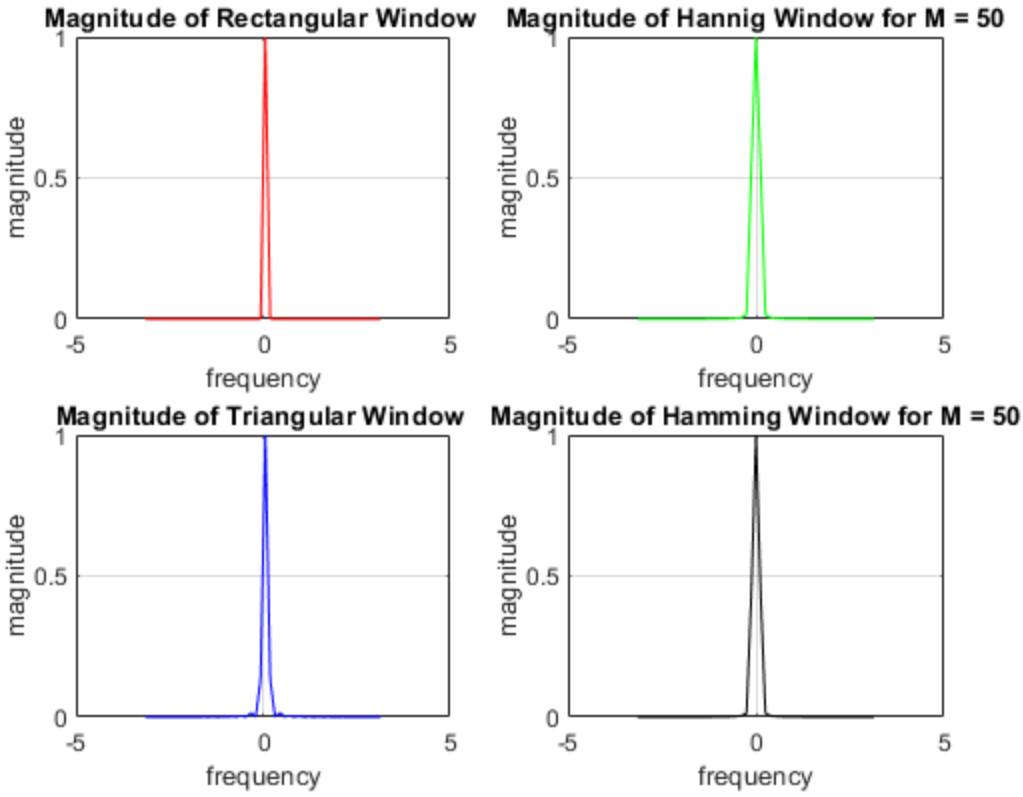
```
clc;
%Rectangular DTFT
[f ,Rf]= DTFT(R , M); % fourier Transform of R window
Rf = Rf/max(abs(Rf)); %Normalized Rf so that max value is 1
figure(1)
subplot(221)
plot(f,abs(Rf),'r')
grid on;
title("Magnitude of Rectangular Window ")
axis([-5 5 0 1])
```

```
ylabel("magnitude")
xlabel("frequency")

%Hannig DTFT
Cf = fftshift(fft(Cm)); %DTFT of hannig window
Cf = Cf/max(abs(Cf)); %Normalized Cf so that max value is 1
subplot(222)
plot(w,abs(Cf),'g')
grid on;
title("Magnitude of Hannig Window for M = 50")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")

%Triangular DTFT
[f1 ,Tf]= DTFT(Tm , M); % fourier Transform of R window
Tf = Tf/max(abs(Tf)); %Normalized Rf so that max value is 1
subplot(223)
plot(f1,abs(Tf),'b')
grid on;
title("Magnitude of Triangular Window ")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")

%Hamming DTFT
Hf = fftshift(fft(Hm)); %DTFT of hannig window
Hf = Hf/max(abs(Hf)); %Normalized Cf so that max value is 1
subplot(224)
plot(w,abs(Hf),'k')
grid on;
title("Magnitude of Hamming Window for M = 50")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")
```



M = 101 and defining Variables and Windows

```
clear; clc;
M = 101;
n = 0 : 1 : M ;
[R , n1] = stepseq(0,0,M);
% R = heaviside(n ); %%Rectangular Window
% R = rectangle('Position',[0 0 M 1])
C1 = 0.5*(1 - cos((2*pi.*n)/(M - 1)));
Cm = C1.* R; %Hannig window
T1 = ( 1 - ((abs(M - 1 - 2.*n))/M -1));
Tm = T1.* R ; %triangular Window
H1 = 0.5*(0.56 - 0.46.*(cos((2*pi.*n)/(M - 1))));
Hm = H1.* R; %Hamming Window
w = -pi : 2*pi/M : pi;
```

plotting DTFTs for M = 101

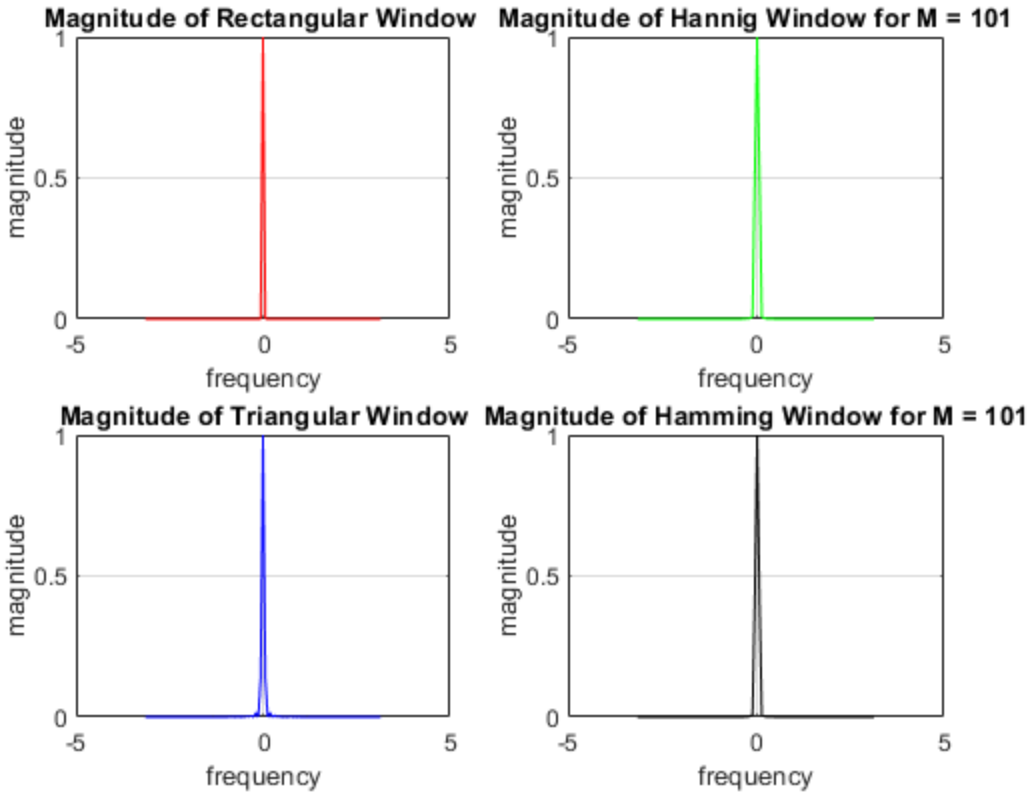
```
clc;
%Rectangular DTFT
[f ,Rf]= DTFT(R , M); % fourier Transform of R window
Rf = Rf/max(abs(Rf)); %Normalized Rf so that max value is 1
figure(2)
subplot(221)
plot(f,abs(Rf),'r')
```

```
grid on;
title("Magnitude of Rectangular Window ")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")

%Hannig DTFT
Cf = fftshift(fft(Cm)); %DTFT of hannig window
Cf = Cf/max(abs(Cf)); %Normalized Cf so that max value is 1
subplot(222)
plot(w,abs(Cf),'g')
grid on;
title("Magnitude of Hannig Window for M = 101")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")

%Triangular DTFT
[f1 ,Tf]= DTFT(Tm , M); % fourier Transform of R window
Tf = Tf/max(abs(Tf)); %Normalized Rf so that max value is 1
subplot(223)
plot(f1,abs(Tf),'b')
grid on;
title("Magnitude of Triangular Window")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")

%Hamming DTFT
Hf = fftshift(fft(Hm)); %DTFT of hannig window
Hf = Hf/max(abs(Hf)); %Normalized Cf so that max value is 1
subplot(224)
plot(w,abs(Hf),'k')
grid on;
title("Magnitude of Hamming Window for M = 101")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")
```



M = 10 and defining Variables and Windows

```
clear; clc;
M = 10;
n = 0 : 1 : M ;
[R , n1] = stepseq(0,0,M);
% R = heaviside(n ); %%Rectangular Window
% R = rectangle('Position',[0 0 M 1])
C1 = 0.5*(1 - cos((2*pi.*n)/(M - 1)));
Cm = C1.* R; %Hannig window
T1 = ( 1 - ((abs(M - 1 - 2.*n))/M -1));
Tm = T1.* R ; %triangular Window
H1 = 0.5*(0.56 - 0.46.*(cos((2*pi.*n)/(M - 1))));
Hm = H1.* R; %Hamming Window
w = -pi : 2*pi/M : pi;
```

plotting DTFTs for M = 10

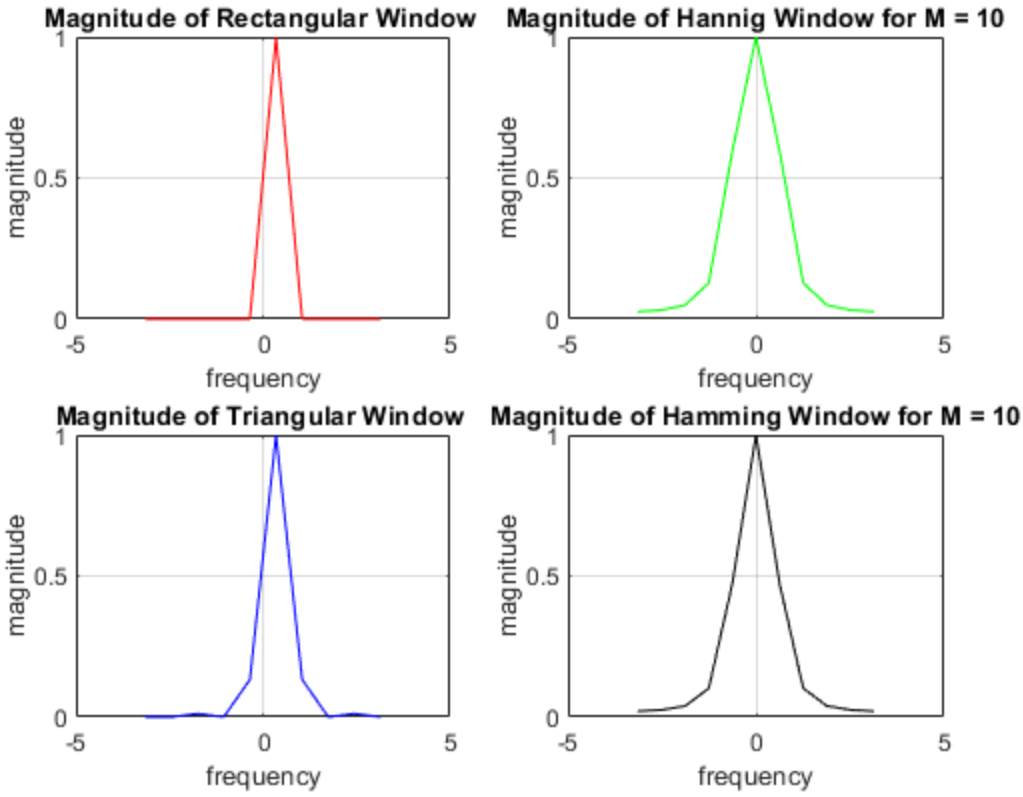
```
clc;
%Rectangular DTFT
[f ,Rf]= DTFT(R , M); % fourier Transform of R window
Rf = Rf/max(abs(Rf)); %Normalized Rf so that max value is 1
figure(3)
subplot(221)
plot(f,abs(Rf),'r')
```

```
grid on;
title("Magnitude of Rectangular Window ")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")

%Hannig DTFT
Cf = fftshift(fft(Cm)); %DTFT of hannig window
Cf = Cf/max(abs(Cf)); %Normalized Cf so that max value is 1
subplot(222)
plot(w,abs(Cf),'g')
grid on;
title("Magnitude of Hannig Window for M = 10")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")

%Triangular DTFT
[f1 ,Tf]= DTFT(Tm , M); % fourier Transform of R window
Tf = Tf/max(abs(Tf)); %Normalized Rf so that max value is 1
subplot(223)
plot(f1,abs(Tf),'b')
grid on;
title("Magnitude of Triangular Window ")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")

%Hamming DTFT
Hf = fftshift(fft(Hm)); %DTFT of hannig window
Hf = Hf/max(abs(Hf)); %Normalized Cf so that max value is 1
subplot(224)
plot(w,abs(Hf),'k')
grid on;
title("Magnitude of Hamming Window for M = 10")
axis([-5 5 0 1])
ylabel("magnitude")
xlabel("frequency")
```



Function Step Sequence

```
function [x,n] = stepseq(n0,n1,n2)
% Generates x(n) = u(n-n0); n1 <= n <= n2
% ---------------------------------------
% [x,n] = stepseq(n0,n1,n2)
%
n = [n1:n2]; x = [(n-n0) >= 0];
end
```

M point DTFT (part a)

```
function [f, fft_sig] = DTFT(signal, M)
    if (length(signal) < M)
        error('M point is not larger than signal length!!');
    end
    fft_sig = abs(fftshift(fft(signal, M)));
    f = linspace(-pi, pi, M);
end
```

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