```
% Daniel Pacheco
%
% Matlab 4
%1
%y(t)
clear;
clc;
close all;
b = 0.01;
t_extended = -20:0.01:20;
sequence = [0,1,1,1,1,1,0,0,0,1,1,0,1,0,1,1];
Amplitude = 3;
Width = 1;
w = -20:20;
y_extended = zeros(1, length(t_extended));
startIndx = find(t_extended == -1);
for i = 1:length(sequence)
    SI = startIndx + (i-1)*Width/0.01;
    EI = startIndx + i*Width/0.01 - 1;
    if sequence(i) == 0
        y_extended(SI:EI) = Amplitude;
    else
        y_extended(SI:EI) = -Amplitude;
    end
end
Yjw = y_extended*exp(-1i*t_extended.'*w).*b;
% Calculate the magnitude
Magnitude_Yjw = abs(Yjw);

%unipolar
uniAmplitude = 4;
z = zeros(1,length(t_extended));
for i = 1:length(sequence)
    SI = ((i-1)*Width/0.01) + 1;
    EI = (i*Width/0.01);
    if sequence(i)== 0
        z(SI:EI) = uniAmplitude;
    else
        z(SI:EI) = 0;
    end
end
Zjw = z*exp(-1i*t_extended.'*w).*b;
Magnitude_Zjw = abs(Zjw);
% Plotting the magnitude
figure();
plot([-20,20],[0,0],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
hold on;
plot([0,0],[0,20],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
p1=plot(w,Magnitude_Yjw,'LineStyle','-','Color',[0,0,0.9],'LineWidth',2);
p2 = plot(w,Magnitude_Zjw,'LineStyle','--','Color',[0,0.9,0],'LineWidth',2);
hold off;
axis([-21,21,-0.5,25]);
```

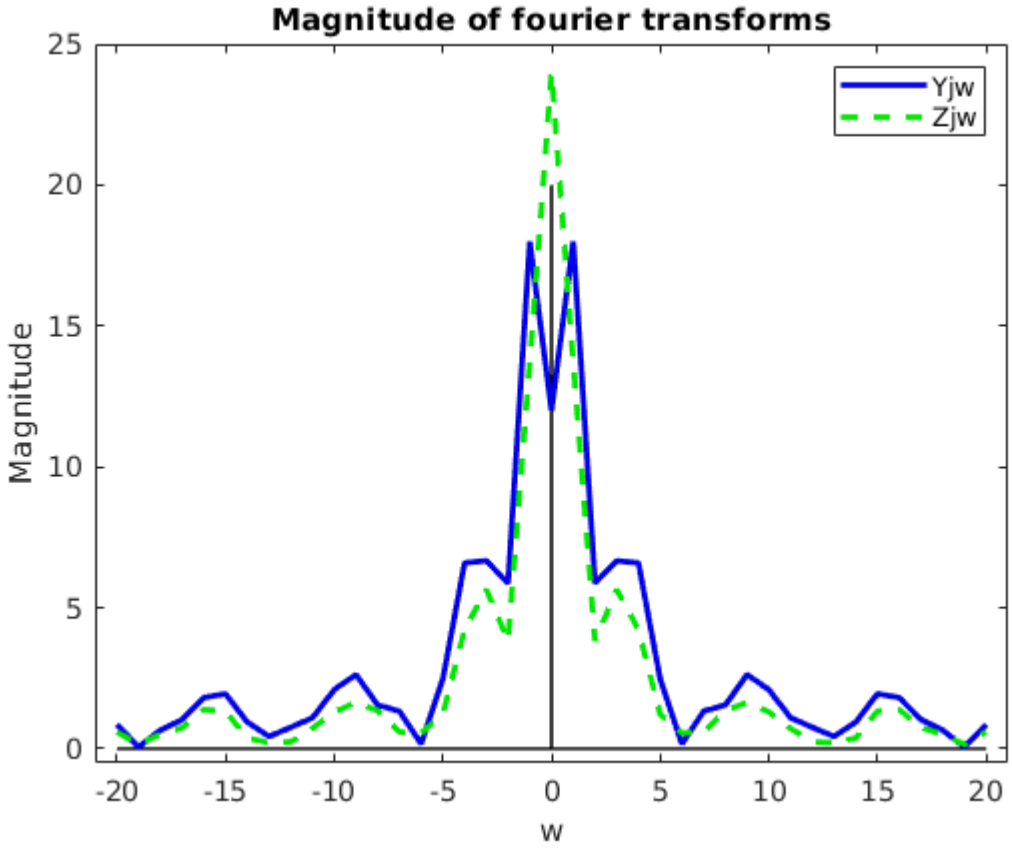
```
title('Magnitude of fourier transforms');
xlabel('w');
ylabel('Magnitude');
legend([p1,p2],'Yjw','Zjw','Location','northeast');
%2
% v(t)
v = y_extended .* abs(sin(pi*t_extended));
Vjw = v*exp(-1i*t_extended.'*w).*b;
Magnitude_Vjw = abs(Vjw);
% Plotting the magnitude
figure();
plot([-20.5,20.5],[0,0],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
hold on;
plot([0,0],[0,20],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
p1=plot(w,Magnitude_Yjw,'LineStyle','-','Color',[0,0,0.9],'LineWidth',2);
p2 = plot(w,Magnitude_Vjw,'LineStyle','--','Color',[0,0.9,0],'LineWidth',2);
hold off;
axis([-20.5,20.5,-0.5,20]);
title('Magnitude of fourier transforms');
xlabel('w');
ylabel('Magnitude');
legend([p1,p2],'Yjw','Vjw','Location','northeast');
%3
t_extended2 = -14:0.01:26;
y_extended2 = zeros(1, length(t_extended2));
for i = 1:length(sequence)
    startIdx = ((i-1)*1/0.01) + 1;
    endIdx = (i*1/0.01);
    if sequence(i) == 0
        y_extended2(startIdx:endIdx) = Amplitude;
    else
        y_extended2(startIdx:endIdx) = -Amplitude;
    end
end
for i = 1:length(sequence)
    startIdx = ((i-1)*1/0.01) + 1;
    endIdx = (i*1/0.01);
    if sequence(i) == 0
        z(startIdx:endIdx) = uniAmplitude;
    else
        z(startIdx:endIdx) = 0;
    end
end
h1 = exp(-t_extended2).*(heaviside(t_extended2) - heaviside(t_extended2 - 8));
h2 = (t_extended2.^2).*exp(-t_extended2).*(heaviside(t_extended2) -
heaviside(t_extended2 - 8));
p = conv(y_extended2, h1, 'same') * 0.01;
Pjw = p*exp(-1i*t_extended2.'*w).*b;
Magnitude_Pjw = abs(Pjw);
% Plotting the magnitude
figure();
plot([-20.5,20.5],[0,0],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
hold on;
plot([0,0],[0,20],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
```

```
p1=plot(w,Magnitude_Yjw,'LineStyle','-','Color',[0,0,0.9],'LineWidth',2);
p2 = plot(w,Magnitude_Pjw,'LineStyle','--','Color',[0,0.9,0],'LineWidth',2);
hold off;
axis([-24.5,26.5,-0.5,20]);
title('Magnitude of fourier transforms');
xlabel('w');
ylabel('Magnitude');
legend([p1,p2],'Yjw','Pjw','Location','northeast');
%4
a = conv(y_extended2, h2, 'same') * 0.01;
Ajw = a*exp(-1i*t_extended2.'*w).*b;
Magnitude_Ajw = abs(Ajw);
% Plotting the magnitude
figure();
plot([-20.5,20.5],[0,0],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
hold on;
plot([0,0],[0,20],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
p1=plot(w,Magnitude_Yjw,'LineStyle','-','Color',[0,0,0.9],'LineWidth',2);
p2 = plot(w,Magnitude_Ajw,'LineStyle','--','Color',[0,0.9,0],'LineWidth',2);
hold off;
axis([-20.5,20.5,-0.5,20]);
title('Magnitude of fourier transforms');
xlabel('w');
ylabel('Magnitude');
legend([p1,p2],'Yjw','Ajw','Location','northeast');
%5
sd = 0.1;
noise = sd * randn(size(t_extended));
r_t = y_extended + noise;
Rjw = r_t*exp(-1i*t_extended.'*w).*b;
Magnitude_Rjw = abs(Rjw);
% Plotting the magnitude
figure();
plot([-20.5,20.5],[0,0],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
hold on;
plot([0,0],[0,20],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
p1=plot(w,Magnitude_Yjw,'LineStyle','-','Color',[0,0,0.9],'LineWidth',2);
p2 = plot(w,Magnitude_Rjw,'LineStyle','--','Color',[0,0.9,0],'LineWidth',2);
hold off;
axis([-20.5,20.5,-0.5,20]);
title('Magnitude of fourier transforms');
xlabel('w');
ylabel('Magnitude');
legend([p1,p2],'Yjw','Rjw','Location','northeast');
%6
noise_new = 1 * randn(size(y_extended));
s_t = y_extended + noise_new;
Sjw = s_t*exp(-1i*t_extended.'*w).*b;
Magnitude_Sjw = abs(Sjw);
figure();
plot([-20.5,20.5],[0,0],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
hold on;
plot([0,0],[0,20],'LineStyle','-','Color',[0,0,0],'LineWidth',1);
p1=plot(w,Magnitude_Yjw,'LineStyle','-','Color',[0,0,0.9],'LineWidth',2);
```

```
p2 = plot(w,Magnitude_Sjw,'LineStyle','--','Color',[0,0.9,0],'LineWidth',2);
hold off;
axis([-20.5,20.5,-0.5,20]);
title('Magnitude of fourier transforms');
xlabel('w');
ylabel('Magnitude');
legend([p1,p2],'Yjw','Sjw','Location','northeast');
%7
power_spec = Magnitude_Yjw.^2;
pindices = find(w>=0);
wpositives = w(pindices);
power_specp = power_spec(pindices);
numerator = trapz(wpositives,wpositives.*power_specp);
denominator = trapz(wpositives,power_specp);
W = numerator/denominator
%8
power_spec = Magnitude_Vjw.^2;
pindices = find(w>=0);
wpositives = w(pindices);
power_specp = power_spec(pindices);
numerator = trapz(wpositives,wpositives.*power_specp);
denominator = trapz(wpositives,power_specp);
W2 = numerator/denominator
%9
power_spec = Magnitude_Pjw.^2;
pindices = find(w>=0);
wpositives = w(pindices);
power_specp = power_spec(pindices);
numerator = trapz(wpositives,wpositives.*power_specp);
denominator = trapz(wpositives,power_specp);
W3 = numerator/denominator
%10
power_spec = Magnitude_Ajw.^2;
pindices = find(w>=0);
wpositives = w(pindices);
power_specp = power_spec(pindices);
numerator = trapz(wpositives,wpositives.*power_specp);
denominator = trapz(wpositives,power_specp);
W4 = numerator/denominator
```

```
W =

    1.8983


W2 =

    1.9341


W3 =

    1.6219
```

```
W4 =

    0.6773
```


Magnitude of fourier transforms
Yjw
Zjw
Magnitude
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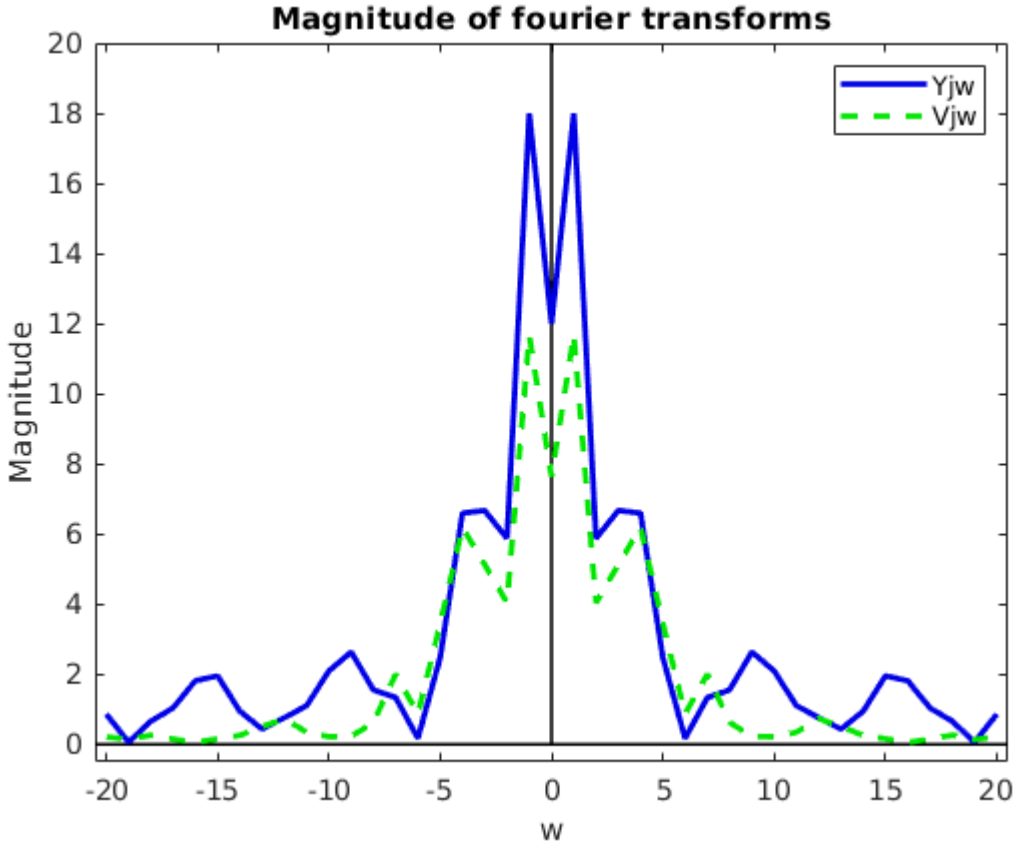
-15
-10
-5
0
5
10
15
20


Magnitude of fourier transforms
Yjw
Vjw
Magnitude
w
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6
4
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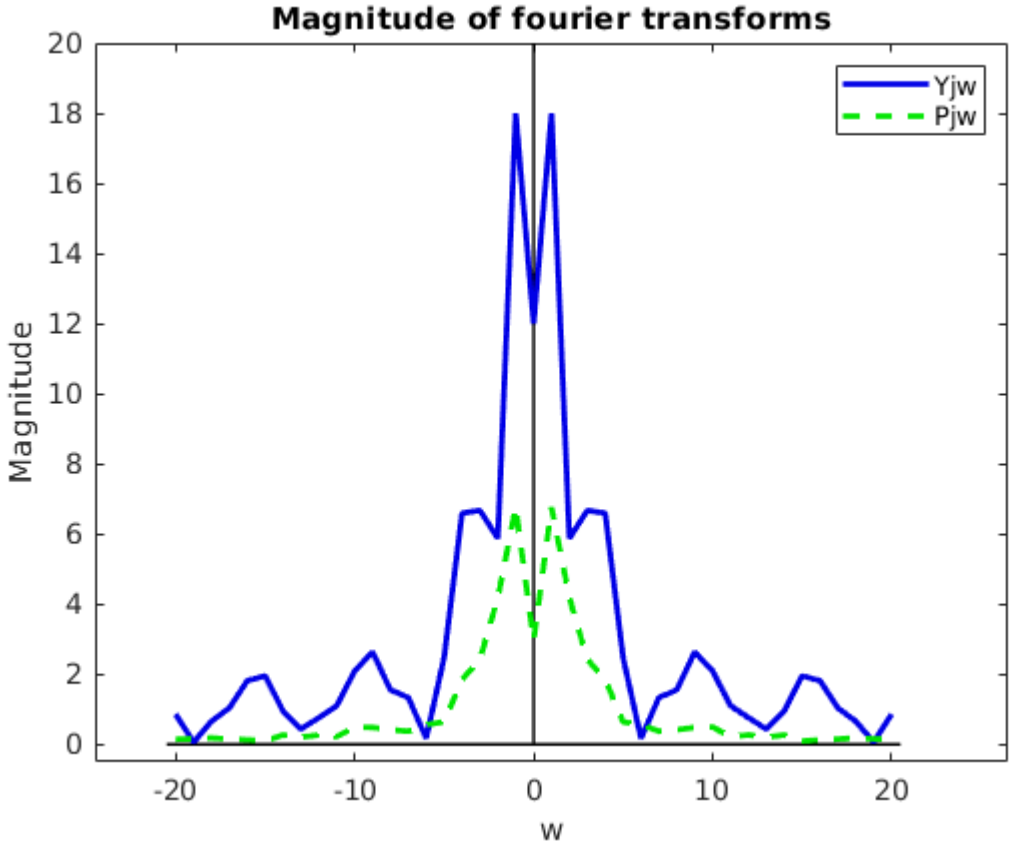
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Yjw
Pjw
Magnitude
w
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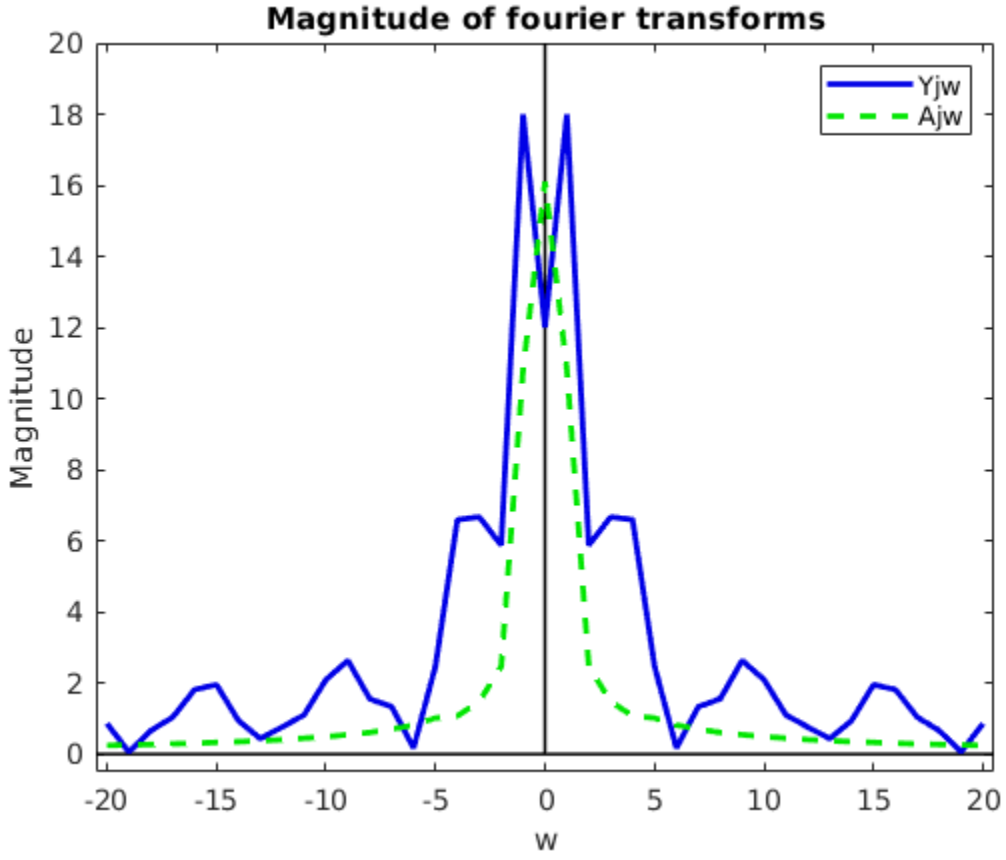
0
10
20


Magnitude of fourier transforms
Yjw
Ajw
Magnitude
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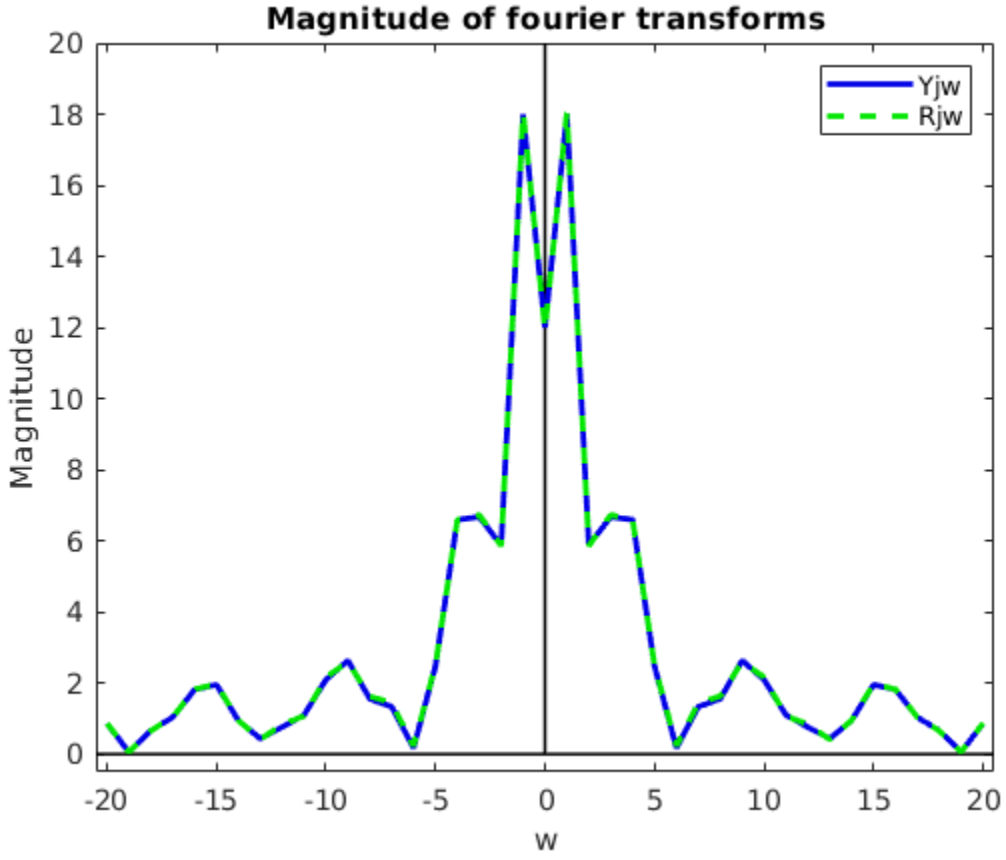
Magnitude of fourier transforms
Yjw
Rjw
Magnitude
w
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-10
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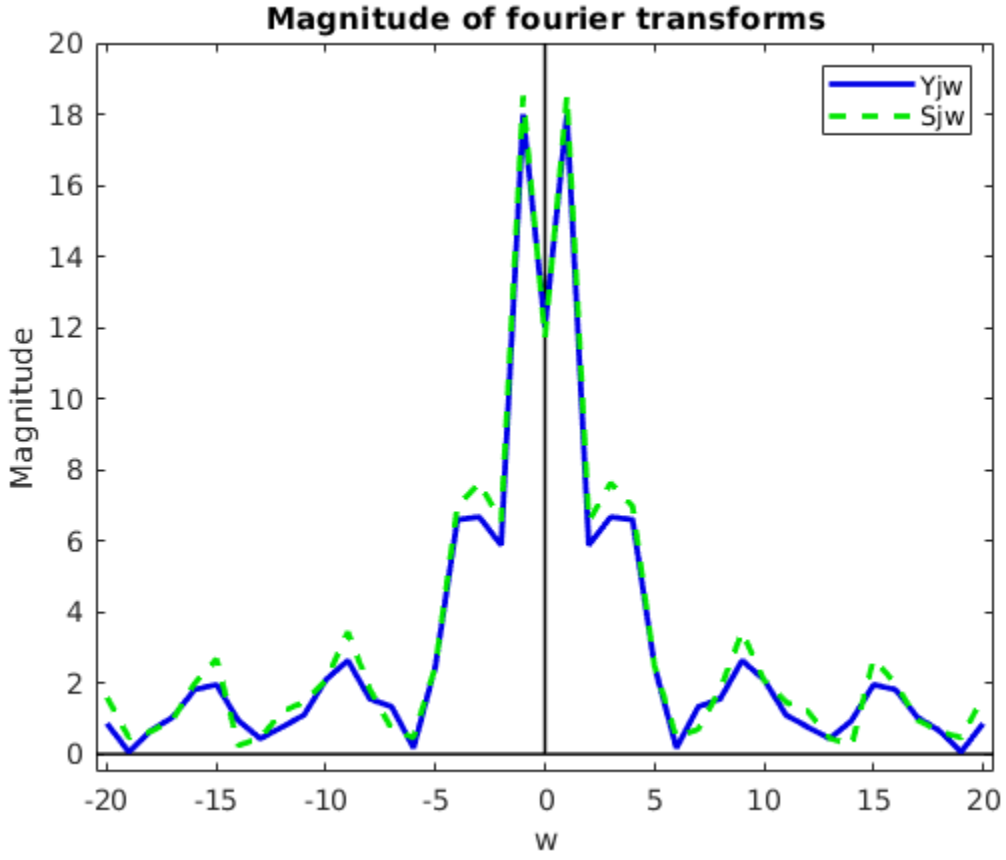
20



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