Contents


```
%1a

x1 = [0 1 2 3 4];
x2 = [-2 -1 0 1 2];
x3 = ifft( fft(x1,7) .* fft(x2,7));

fprintf('1a, 7-point circular convolution \n');
for i=1:length(x3)
    fprintf('%.2f\n',x3(i));

end
```

```
1a, 7-point circular convolution
10.00
6.00
-5.00
-8.00
-10.00
-0.00
7.00
```

1b

```
y = conv(x1,x2);

fprintf('1b, linear convolution \n');
for i=1:length(y)
    fprintf('%.2f\n',y(i));
end

x_test = ifft( fft(x1,9) .* fft(x2,9));

fprintf('1b, N = 9-point circular convolution \n');

for i=1:length(x_test)
    fprintf('%.2f\n',x_test(i));
end
```

```
1b, linear convolution
0.00
-2.00
-5.00
-8.00
-10.00
0.00
7.00
10.00
```

```
8.00
1b, N = 9-point circular convolution
0.00
-2.00
-5.00
-8.00
-10.00
0.00
7.00
10.00
8.00
```

1c

```
%testing out higher N > 9 point circular convolutions


x_test2 = ifft( fft(x1,10) .* fft(x2,10));

fprintf('1c, N = 10-point circular convolution \n');

for i=1:10
    fprintf('%.2f\n',x_test2(i));
end


x_test3 = ifft( fft(x1,11) .* fft(x2,11));

fprintf('1c, N = 11-point circular convolution \n');

for i=1:10
    fprintf('%.2f\n',x_test3(i));
end


x_testN = ifft( fft(x1,100) .* fft(x2,100));

fprintf('1c, N = 100-point circular convolution \n');

for i=1:10
    fprintf('%.2f\n',x_testN(i));
end
```

```
1c, N = 10-point circular convolution
0.00
-2.00
-5.00
-8.00
-10.00
0.00
7.00
10.00
8.00
0.00
1c, N = 11-point circular convolution
```

```
  0.00
 -2.00
 -5.00
 -8.00
-10.00
 -0.00
  7.00
 10.00
  8.00
  0.00
1c, N = 100-point circular convolution
  0.00
 -2.00
 -5.00
 -8.00
-10.00
  0.00
  7.00
 10.00
  8.00
  0.00
```

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Contents


```
% 2a
samp = 512;
beta = [0 2 4 6 8 10];
figure;
hold on;
for i = 1:length(beta)

    w = kaiser(N,beta(i));

    plot(0:N-1,w,'DisplayName', sprintf('\\beta = %g', beta(i)));
end

legend('show','Location','best');
title('Kaiser Windows')
hold off;
```

```
Unrecognized function or variable 'N'.

Error in hmw4q2 (line 8)
    w = kaiser(N,beta(i));
               ^
```

2b , 2c

```
samp = 512;
beta = [0 2 4 6 8 10];

NFFT = 16*1024; %fft sample size


figure;
hold on;

for i = 1:length(beta)
    w = kaiser(samp, beta(i));
    w_fft = fft(w,NFFT);
    f = linspace(0,1,NFFT);
    w_fft_dB = 20 * log10(abs(w_fft)+0.000000001); %doesn't like log10(0)
    plot(f(f <= 0.01),w_fft_dB(f <= 0.01),'DisplayName', ['\beta = ', num2str(beta(i))]);

    fprintf('For beta = %.0f\n',beta(i)); %2c segment
    fprintf('W(0) = %.4f\n', abs(w_fft(1)));
    fprintf('Window function sum = %.4f\n',sum(w)); % sum of w[n]
    fprintf('\n');
end

hold off;
```

```
xlabel('f');
ylabel('dB');
title('Kaiser Window DTFT');
legend('show','Location','best');

%ylim([-100,60]);
```

2d

```
%i - Width increases for increasing beta.

%ii - Height decreases for increasing beta.
```

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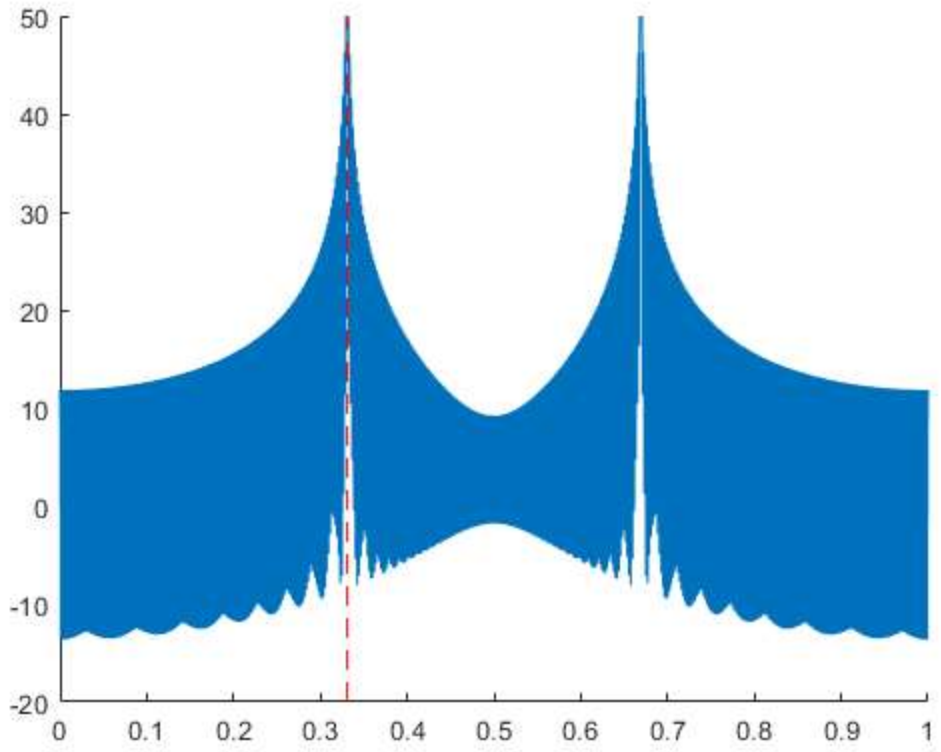
Contents


```
A = 3.7;
f0 = 0.3308;
N = 512;
NFFT = 32768;

n = linspace(0,N-1,N);
x_w = A * cos(2*pi()*f0*n);

fft_x_w = fft(x_w,NFFT);
ffw_x_w_dB = 20 * log10(abs(fft_x_w) + 0.0000000000001);

f = linspace(0,1,NFFT);

figure;
hold on;



plot(f,ffw_x_w_dB);
ylim([-20 50]);



plot([f0 f0], ylim,'--r'); %shows f0

hold off;
```

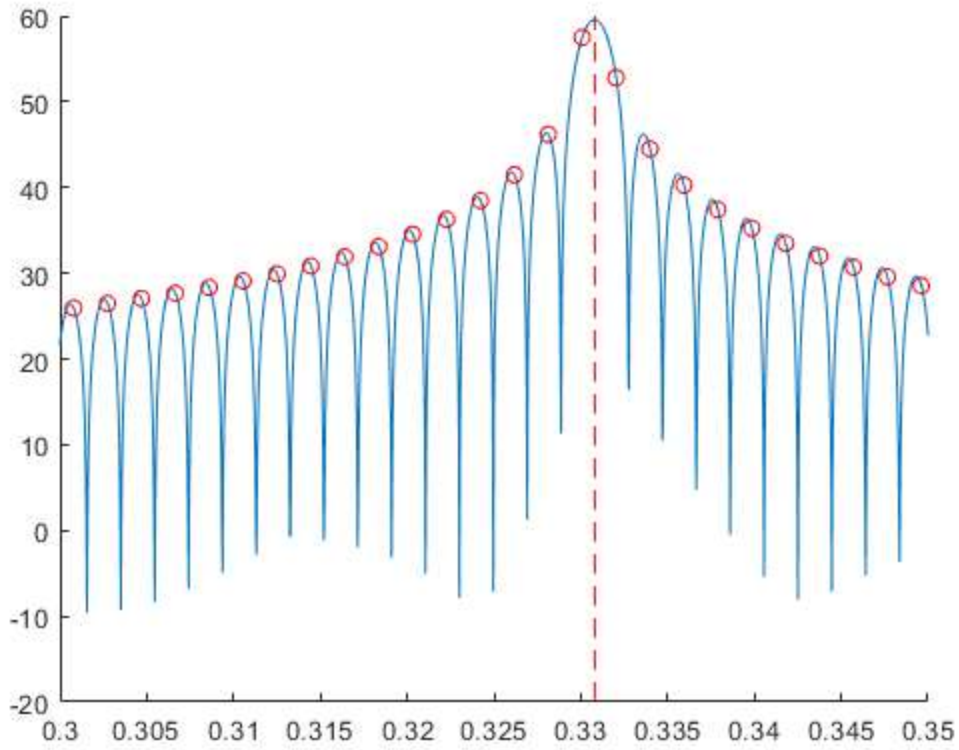


3b, copied 3a code

```
fprintf('NEW INSTANCE \n');

A = 3.7;
f0 = 0.3308;
N = 512;
NFFT = 32768;
n = linspace(0,N-1,N);
x_w = A * cos(2*pi()*f0*n);
fft_x_w = fft(x_w,NFFT);
ffw_x_w_dB = 20 * log10(abs(fft_x_w) + 0.0000000000001);
f = linspace(0,1,NFFT);
figure;
hold on;
plot(f,ffw_x_w_dB);
ylim([-20 60]);
xlim([0.30 0.35]);
plot([f0 f0], ylim,'--r'); %shows f0

%end of 3a code

ffw_x_w_DFT = fft(x_w); %512-point DFT calculation
fft_x_w_DFT_dB = 20 * log10(abs(ffw_x_w_DFT) + 0.00000000000000000001);


f_DFT = linspace(0,1,N+1);%aligns 512 DFT points to 30k point DFT curve


plot(f_DFT(1:N),fft_x_w_DFT_dB,'ro','MarkerSize',6,'DisplayName','512-point DFT');
```

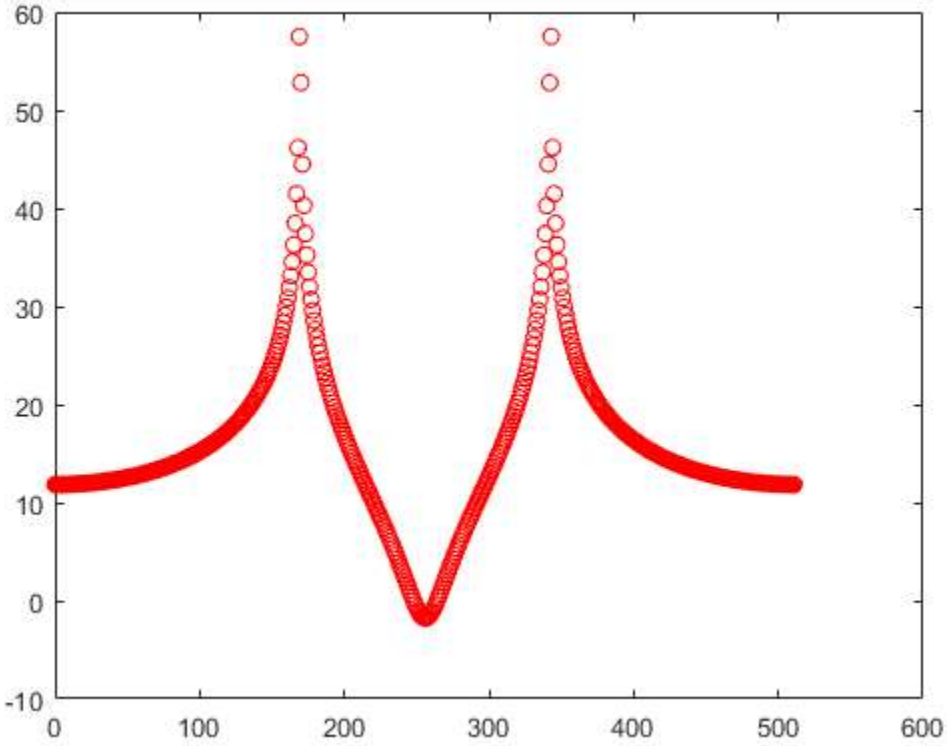
```
ylim([-20 60]);
xlim([0.30 0.35]);
```

NEW INSTANCE




```
hold off;
```

```
plot(n,fft_x_w_DFT_dB,'ro','MarkerSize',6,'DisplayName','512-point DFT');
```



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```
fprintf('NEW INSTANCE \n');


directory = 'C:\Users\vifro\OneDrive\Documents\MATLAB';
file_name = 'hw4data.txt';
file_path = fullfile(directory, file_name);
x = load(file_path);
x = x(:);
```

```
NEW INSTANCE
```

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