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% Name Lamin Jammeh
% CLass: EE417 Summer 2024
% Lesson 10 HW Question 3
% Group: Ron Kalin/ Lamin Jammeh
% Project Description: The verilog coeff are used for creating the filter
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% Defining the parameters of the synthetic input signal:
% Creating a sine signal

fs   = 2000;     % the sampling frequency = 2KHz
fmax = fs/2;     % Maximum fundamental frequency that can be sampled by fs

f1 = 50;       % frequency f1 is 50Hz
f2 = 800;      % frequency f2 is 800Hz
f3 = 900;      % frequency f3 is 900Hz

A1 = 10;       % Amplitude of the sine wave s1
A2 = 5;        % Amplitude of the sine wave s2
A3 = 8;        % Amplitide of the sine wave s3

L = 200;       % the number of samples

t = (0:L-1)/fs;           % Generating the time vector for L samples

s = A1*sin(2*pi*t*f1) + A2*sin(2*pi*t*f2) + A3*sin(2*pi*t*f3);

%-------------------------------------------------------------------------
% Defining the filter parameters:
% Use the filter coeff from verilog and create Sampling signal in matlab

fc = 400;      % the filter cutoff frequency is 400Hz
Wn = fc/fmax;  % Wn = fc/fmax
order = 4;     % the order of the filter

%coeff = fir1(order,Wn,'low');   % low pass filter
%coeff = fir1(order,Wn,'high');   % high pass filter
coeff = [3, 7, 20, 7, 3];           % same coefficient used in verilog code

%-------------------------------------------------------------------------
%              Filtering the signal using 3 approaches
%-------------------------------------------------------------------------
% 1. Filtering the signal in MATLAB using the 'filter' function:
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output_signal = filter(coeff,1,s);

% Plotting the input signal & the filtered signals in the time domain

subplot(2,2,1)
plot(t,s)
title("Original Signal Created with matlab")
subplot(2,2,2)
plot(t,output_signal)
title("Filtered Signal")
xlabel("Time in s")

%--------------------------------------------------------------------------
% Creating the fft for the signals:

f = fs/L*(0:(L/2));

Y = fft(s);
P2 = abs(Y/L);
P1 = P2(1:L/2+1);
P1(2:end-1) = 2*P1(2:end-1);

Y_out = fft(output_signal);
P2_out = abs(Y_out/L);
P1_out = P2_out(1:L/2+1);
P1_out(2:end-1) = 2*P1_out(2:end-1);



subplot(2,2,3)
stem(f,P1,"LineWidth",2)
title("fft Spectrum in the Positive Frequencies")
xlabel("f (Hz)")
ylabel("|fft(input signal)|")

subplot(2,2,4)
stem(f,P1_out,"LineWidth",2)
title("fft Spectrum in the Positive Frequencies")
xlabel("f (Hz)")
ylabel("|fft(output filtered signal)|")


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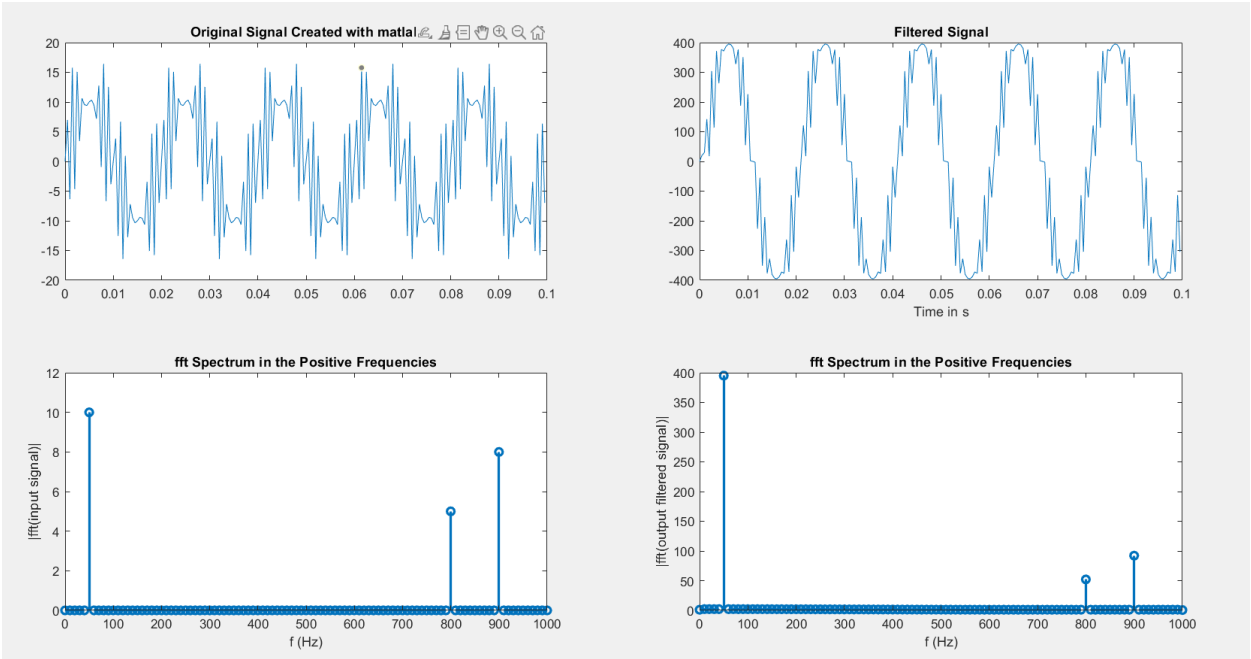
Original Signal Created with matlal
Filtered Signal
Time in s
fft Spectrum in the Positive Frequencies
|fft(input signal)|
f (Hz)
fft Spectrum in the Positive Frequencies
|fft(output filtered signal)|
f (Hz)