ELEG 4603/5173L Lab # 9
FIR Filters

I. Bandstop Filter

1. Use the Matlab filter design tool: fdatool, to design a FIR bandstop filter centered at 1000 Hz as shown in the Figure 1. The sampling frequency is 8 KHz. Save the coefficients into a vector x in the workspace by using "File -> Export…" as shown in Figure 2.

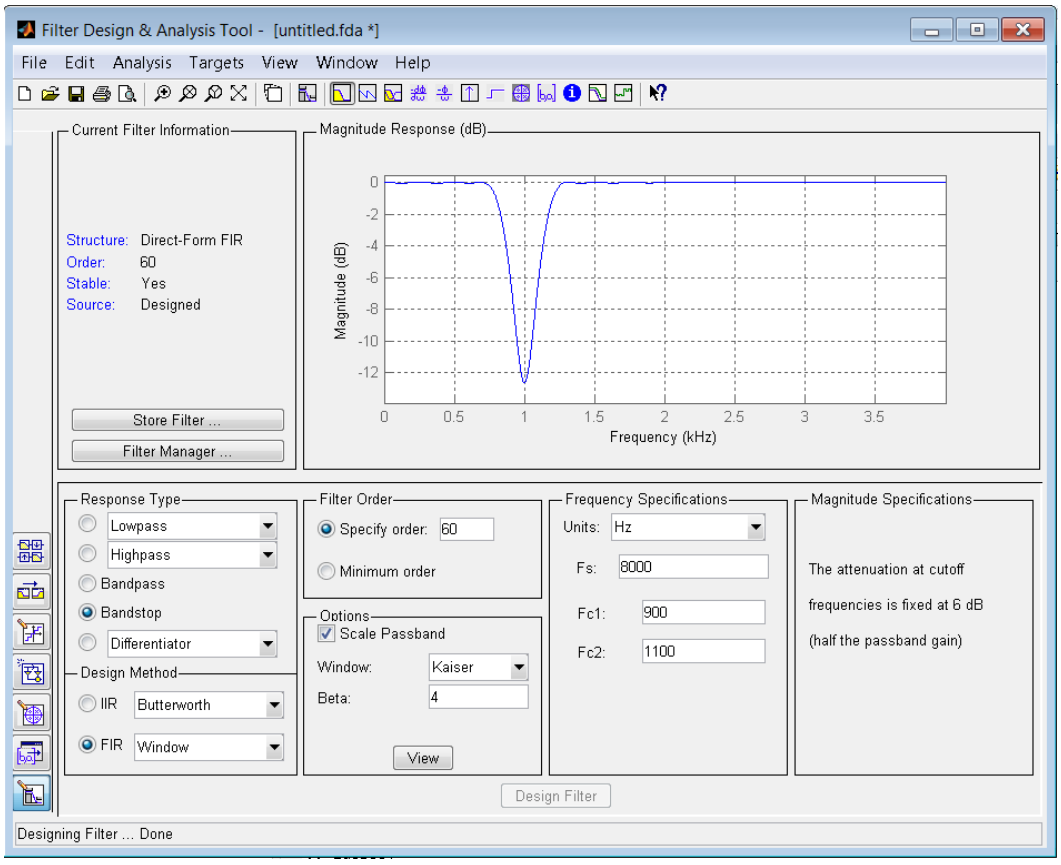

Fig. 1. Filter parameters in Matlab fdatool

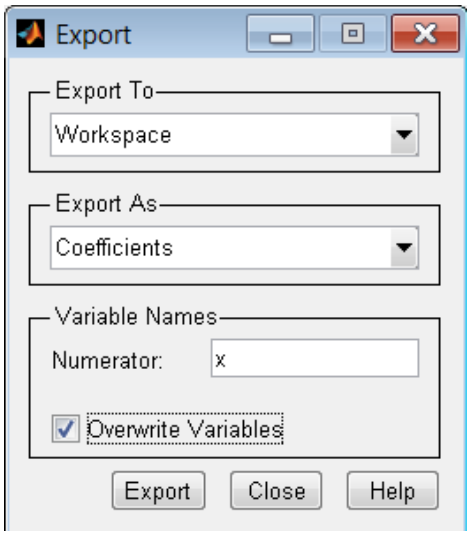

Fig. 2 “File -> Export …” in Matlab fdatool

2. Use Matlab to plot the amplitude (in dB) and phase response of the filter.

3. Write a Matlab code that adds a 1000 Hz tone to music.wav in lab 2, and play it through the computer speaker.

4. Pass the distorted sound through the band stop filter, and play it through the computer speaker.

II. Graphic Equalizer

A music equalizer can adjust the amplitude of the audio signal at different frequency bands. You will implement a 3-band music equalizer. The audio spectrum will be divided into 3 bands: 20 Hz – 200 Hz, 200 Hz – 2 KHz, 2 KHz – 20 KHz, each with adjustable gains. The block diagram of the 3-band equalizer is shown as follows, where $G_n \in [0,1]$ is the gain of the *n*-th band.

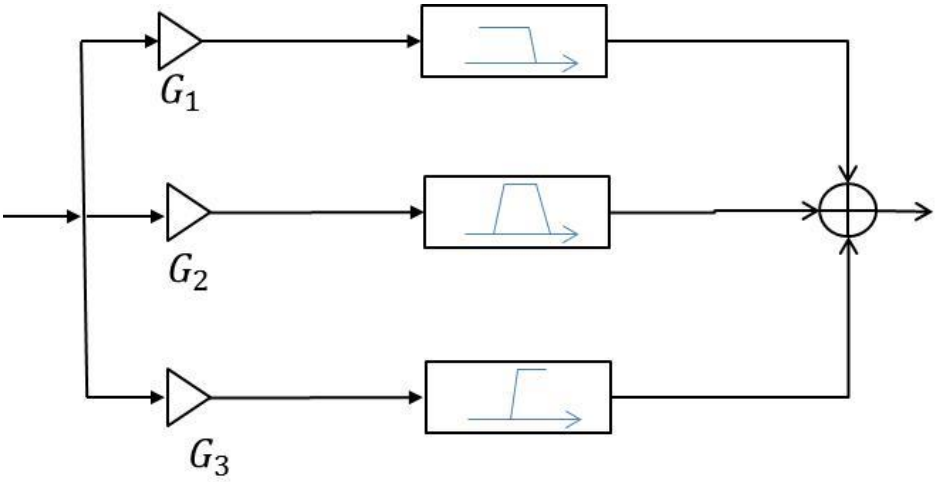

Fig. 3 3-band graphic equalizer

1. Use fdatool in Matlab to design the three filters (low pass filter, band-pass filter, and high pass filter). Use FIR filter with Kaiser window, beta = 0.5, order = 80, Fs = 8 KHz. Convert the filter parameters into coefficient vectors to be used in Matlab.
2. Implement the equalizer with Matlab. Adjust the gains at different bands and listen to the effects. (IMPORTANT: to avoid clipping, please divide the gain of the original audio signal by 3 before passing it through the equalizer).