

National Institute of Technology Calicut

Department of Electronics and Communication Engineering

EC 3093D DIGITAL SIGNAL PROCESSING LAB

Sixth Semester B Tech Electronics & Communication Engineering

Experiment 4: Linear phase FIR filter and FIR filter design (Matlab and Python Implementation).

Note: All the experiments must be implemented in both Matlab and Python.

Linear Phase FIR Filters

1. Write a program to plot the impulse response coefficients and zero locations for the 4 types of linear phase FIR filters

FIR Filter Design

2. (a) Using the function `firpmord`, estimate the order of a linear-phase low-pass FIR filter with the following specifications: passband edge=2kHz, stopband edge=2.5kHz, passband ripple $\delta_p = 0.005$, stopband ripple $\delta_s = 0.005$, and sampling rate of 10kHz
(b) Repeat Part a. for the following cases: (i)sampling rate of 20kHz,(ii) $\delta_p = 0.002$ and $\delta_s = 0.002$, and (iii)stopband edge=2.3kHz. Compare the filter length obtained in each case with that obtained in part a. Comment on the effect of the sampling rate, ripples, and the transition bandwidth on the filter order.
(c) Repeat Part a. using the function `kaiserord`. Compare the value of the filter order obtained with that obtained in Part a.
(d) Using the function `firpmord`, estimate the order of a linear-phase bandpass FIR filter with the following specifications: passband edges = 1.8 and 3.6 KHz, stopband edges 1.2 and 4.2 kHz, passband ripple $\delta_p = 0.1$, stopband ripple $\delta_s = 0.02$, and sampling rate of 12kHz.

- (e) Repeat Part d. using the function `kaiserord`. Compare the value of the filter order obtained with that obtained in Part d.
 - (f) Using the function `fir1`, design a linear-phase FIR lowpass filter meeting the specifications given in Part a. and plot its gain and phase responses. Use the order estimated using `firpmord` in Part a.
 - (g) Repeat Part f. using Hanning and Blackman windows
 - (h) Using the function `firpm`, design a linear-phase FIR lowpass filter meeting the specifications given in Part a. and plot its gain and phase responses.
 - (i) Design an FIR lowpass filter using a Kaiser window. The filter specifications are: $\omega_p = 0.3\pi$, $\omega_s = 0.4\pi$, and $A_s = 50dB$
 - (j) Using `firpm`, design the bandpass filter with specifications in Part d. and order estimated using `firpmord`.
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