EE5801: CSP Lab/ EE5301: DSP Lab

EE3701: Communication Systems Lab

Assignment 2

Problem:

Design of digital filters such as Low Pass Filter (LPF), Band Pass Filter (BPF).

Technical details:

1. LPF or Half band filter with $f_c=400~Hz$, $\omega_c=\pi/2$, N=39

$$h_d[n] = \begin{cases} \frac{Sin(\omega_c n)}{\pi n}, & -(N-1)/2 \le n \le (N-1)/2 \\ \frac{\omega_c}{\pi}, & n = 0 \end{cases}$$

2. LPF with $f_c = 400 \; Hz$, $\omega_c = \pi/4$, N = 39, $h_d[n]$ is same as above.

$$\textbf{3. BPF with } f_{c1} = 500 \ Hz, f_{c2} = 1200 \ Hz, f_s = 6000 \ Hz, N = 39 \\ h_d[n] = \begin{cases} \frac{Sin(\omega_{c2}n)}{\pi \ n} - \frac{Sin(\omega_{c1} \ n)}{\pi \ n} \ , & -(N-1)/2 \le n \le (N-1)/2 \\ \frac{\omega_{c2} - \omega_{c1}}{\pi} \ , & n = 0 \end{cases}$$

Window function:

Hamming window

$$W_{H}[n] = \begin{cases} 0.54 - 0.46 \cos\left(\frac{2\pi n}{N-1}\right), & if \ 0 \le n \le N-1 \\ 0, & otherwise \end{cases}$$

Instructions:

- ullet In case of 1 and 2, decide the sampling frequency f_{s} as discussed in lecture.
- Generate the N samples of $h_d[n]$ in time domain for the filter you want to design.

• Generate the window function $W_H[n]$ and multiply with $h_d[n]$ to get practical impulse response h[n].

Submission Details:

- Write C code to implement above system.
- Write main.c and two separate files named common_functions.c which contains 2 separate functions corresponding to LPF and BPF and header file named common_functions.h which contains function declarations.
- For both LPF 1 and LPF 2 you need to call same LPF function with appropriate parameter. Input to any filter functions are f_c , f_s and N. Output of any filter function is h[n].
- Don't keep any 'printf' function inside LPF or BPF functions.
- Take h[n] from your C code output to Matlab and plot magnitude response and impulse response using 'fvtool' command.
- Write your understanding and observation about this experiment in your own words in MS word or latex.
- Upload the below files in a single zip file with your id, Example: EE22MTECH11010_A1.zip.
 - o main.c
 - o common_functions.c
 - o common_functions.h
 - \circ A text file containing your practical impulse response h[n] for all cases.
 - o jpg/pdf files of magnitude and impulse response Matlab plots
 - Pdf of your MS word or latex document.

Grading:

- Output 50%
- coding format 20%
- writting submission(pdf file) 30%
- late submission (-5)%