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 $f_c = 400\ Hz$, $\omega_c = \pi/2$, $N = 39$

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

2. **LPF** with $f_c = 400\ Hz$, $\omega_c = \pi/4$, $N = 39$, $h_d[n]$ is same as above.
3. **BPF** with $f_{c1} = 500\ Hz$, $f_{c2} = 1200\ Hz$, $f_s = 6000\ Hz$, $N = 39$

$$h_d[n] = \begin{cases} \dfrac{Sin(\omega_{c2} n)}{\pi\, n} - \dfrac{Sin(\omega_{c1}\, n)}{\pi\, n}, & -(N-1)/2 \le n \le (N-1)/2 \\ \dfrac{\omega_{c2} - \omega_{c1}}{\pi}, & n = 0 \end{cases}$$

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:

- 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.
    - main.c
    - common_functions.c
    - common_functions.h
    - A text file containing your practical impulse response $h[n]$ for all cases.
    - 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)%