Problem Set #2, SP part

Issue date: Nov. 28, 2021; Deadline: 23:59, Dec. 12, 2021

Student Name:_____Student No.: _____

1. *Denoising and filtering (Small Lowpass Signal with Large Extra-Highpass Noise)*

   (1) *Load file*

   The input file is given as "Q1.mat". You should use "load Q1.mat" command to load it. The input file Q1.mat includes a sampling frequency Fs and a noised measurement xs_noised which is produced by addition of a lowpass signal and a highpass noise. You are required to write a .mlx file named **Q1.mlx** where you perform the following steps **IN GIVEN ORDER** (you should properly comment the code so that the steps can be identified clearly):

   (2) Load the measurement and plot it in the time domain.

   (3) Plot the amplitude spectrum of the measurement in the frequency domain. You should use **disp** command to give an estimated frequency bound of the desired lowpass signal.

   (4) Denoise the measurement using FFT through **fft** command. You should also plot the denoised signal both in time domain as a waveform and frequency domain as its amplitude spectrum.

   (5) Design an FIR filter use **fdatool** command and filter the signal with filter command. You are required to declare the filter type you used and briefly explain the design parameters you choose. You are then required to plot: (1) The magnitude response of the filter in frequency domain; (2) the filtered signal in time domain; (3) the amplitude spectrum of the filtered signal in frequency domain.

2. *Cleaning human voice (Recorded Human Voice with Additive White Gaussian Noise)*

   (1) *Load file*

   The input file is given as "Q2.mat". You should use "load Q2.mat" command to load it. The input file Q2.mat includes a sampling frequency Fs, the quantization bit length n_bits and a recorded human voice waveform (polluted with AWGN) xs_noised. You are required to write a .mlx file named **Q2.mlx** where you perform the following steps **IN GIVEN ORDER** (you should properly comment the code so that the steps can be identified clearly):

   (2) Load the waveform and plot it in the time domain.

   (3) Use **soundsc** to play and identify the time range of the announced characters. You should use **pause** command to block the execution until the sound is played over. The time range should be announced through **disp** command.

   (4) Plot the amplitude spectrum of each character in the frequency domain. You should use **subplot, title or legend** to tell out the correspondence among the plots and the characters.

   (5) Denoise the signal use FFT per character. You should also plot the denoised signal both in time domain as a waveform and frequency domain as its amplitude spectrum per character. You should use **soundsc** to play the denoised signal per character with proper **pause**.

   (6) Filter the signal use with FIR per character. You should also plot the filtered signal both in time domain as a waveform and frequency domain as its amplitude spectrum per character. You should use **soundsc** to play the filtered signal per character with proper **pause**.

3. *Submission*

   You should first convert the .mlx files to .pdf files including the running results. **MAKE SURE** that the codes and plots are presented correctly. Then you should merge Q1.pdf and Q2.pdf **IN ORDER** using https://smallpdf.com/merge-pdf/ to one single .pdf file. Finally you are required to submit the .pdf file on gradescope.

** Discussion on methodology is allowed, yet, the assignment should be done individually. Plagiarism, once found, grades zero for the whole homework assignment!!!*