EEL 4930/5934 BioSignals Processing

Assignment 2- Due: October 9

Please write a report answering the following questions. Submit the report and all the m-files you used to answer the questions on Blackboard in Module Assignments / Assignment 2.

1. Exercises with known functions: Generate a discrete-time signal  sampled from a sinusoid of frequency 1 Hz. at the rate of  and duration of  seconds. We will refer to the signal as the MATLAB variable ***x***.
   1. Using the ***subplot*** option, ***plot*** ***x*** versus *time* in seconds for seconds for . You should have one figure for each sampling rate.
      1. Are the sampling rates adequate to reconstruct the sinusoid of 1 Hz.?
      2. Are the sampling rates adequate to draw a smooth plot of the sinusoid of 1 Hz.?
      3. Explain the difference.
   2. Find ***fx***, the ***nfft*** *-point* DFT of ***x***, for , ***nfft***=512, .
      1. Using the ***subplot*** option, ***plot*** the magnitude of ***fx*** versus true frequency 0- Hz. for each value of . This exercise tests the effect of signal duration on the DFT.
      2. Comment on the results and draw a conclusion from your observation..
   3. Compute ***fx*** for , , ***nfft***,
      1. Using the ***subplot*** option, ***plot*** the magnitude of ***fx*** versus true frequency 0- Hz. for each value of ***nfft***. This exercise tests the effect of ***nfft*** on the appearance of the DFT.
      2. Comment on the results.
      3. Use ***ifft*** to find ***ix,*** theinverse DFT of each ***fx***, using the same ***nfft*** that produced ***fx***. Using the ***subplot*** option, ***plot*** ***ix*** versus *time*. Compare ***ix*** to ***x*** and draw a conclusion from your observation. This exercise shows the equivalence of the choice of ***nfft*** and zero padding.
   4. Compute ***fx*** for , , ***nfft***, using a window  {Rectangular, Hamming, Bartlett}. Compare the results in terms of main-lobe width and side-lobe height.
   5. Repeat 1.d when *x*[n] is the sum of a 1 Hz and a 3 Hz. sinusoid.
2. Exercises with EEG signals functions:

Download, read and plot the data file chb01\_01\_edfm.mat. Please indicate which one you chose to use. Observe the signals and all the channels in both the time domain and the frequency domain using the programs I provided for you. This step has no credit value but you should really do this exercise.

Save in variable x channel 7 of the data. For this exercise, you may clear the rest of the matrix.

* 1. Evaluate the ***fft*** of ***x*** for an appropriate value of ***nfft***. Check for interfering tones and use notch filters to remove them. Save the filtered signal in ***y***.
  2. Using a Hamming window, and a frame duration of 3 seconds, an overlap of 60 %, divide x and y into frames, and plot their spectrograms.
  3. You are given a crude set of 6 filters in FBMod.m
     1. Input ***y*** to each of the 6 band-pass filters. Call the output ***z***, where ***z*** is a matrix of 6 columns for each filter output***.*** Plot ***z*** using subplots.
     2. Add the 6 columns of ***z*** to obtain ***sz***. Using subplots, plot ***sz*** and ***y.*** Compare ***sz*** and ***y*** in terms of wave shape and delay. Are they nearly equal? By how many samples is ***sz*** delayed relative to ***y***? Can you account for the delay?
     3. Evaluate the DFT of ***z*** and use subplot to plot the magnitude of each column. Do they each occupy a different frequency band? State the approximate frequency range of each band in Hz.
     4. Using ***frames.m*** divide each column of ***z*** into 2 second windows overlapping by 95%. Find the energy of each frame divided by the length of the frame. Save the energy computations in a matrix ***ez*** with six columns such that each column is the energy over time of each column of ***z***. Plot columns of ***ez***.
     5. Comment on your observation relative to seizure detection.