EE434 Biomedical Signal Processing Course
Homework # 2

Deadline: November 14th, 2021, 23:59

Download ecg_1.mat , ecg_2.mat and ecg_3.mat. The signals were sampled at 1000 Hz.

Question #1: About sampling rate, signal plotting, FFT, plotting the magnitude and phase spectrums of a signal, and the noise types.

a) Calculate how many samples are there for 1 second for the ECG data you downloaded?
b) Calculate the total recording times in seconds for each ECG data you downloaded?
c) For each ECG data you downloaded, plot a total of 3 seconds of ECG data based on time, starting from the beginning of the 2nd second to the end of the 4th second. How many samples do we have for these 3-second fractions?
d) Now plot the magnitude and phase spectrums separately by calculating the FFT for each of these parts you have plotted.
    i. Can you tell what kind of noise each data has by looking at the magnitude spectrums? (Low? High? Band-limited? etc.)
    ii. Can you tell what kind of phase each data has by looking at the phase spectrums? (Zero phase?, Linear phase? Non-linear phase?)
e) Now, repeat parts (c) and (d), but this time starting from the beginning of the 5th second to the end of the 7th second.
f) Compare the magnitude and phase spectrums for these two different cases? Are they exactly same? If there is any difference what can be the reason?

Question #2: About time-and-frequency analysis, Short-time Fourier Transform (STFT) and plotting the spectrogram.

Again we will use the same signals we downloaded above to make time and frequency analysis using STFT.

To calculate STFT and plot the spectrogram, we will use Matlab's stft.m or spectrogram.m functions. Some versions have stft.m, some have spectrogram.m. But they perform almost the same thing. Check which one you have! You may use whatever you want!

These pages may help you:

https://www.mathworks.com/help/signal/ref/stft.html

https://www.mathworks.com/help/signal/ref/spectrogram.html

a) Using a rectangular window with a length of 256 samples and length of overlap as 128 samples: Plot the STFT (spectrogram).
b) Using a hamming window with a length of 256 samples and length of overlap as 128 samples: Plot the STFT (spectrogram).
c) Compare the spectrograms you obtained in parts (a) and (b).
d) If you make a comparison between the spectrograms you obtained in Question#2 and the spectrums in Question#1, what are advantages of spectrograms and disadvantages of spectrums?

Note: When you make the plots please label all the axes, write their units, and give an explanatory title for each plot.

Load your homework as a pdf file using the name template:

HW-02-Your_School_ID.pdf