BBT.HTI.501: Processing of Biosignals

Assignment 2: Spectral analysis of EEG

Return your answers to Moodle in PDF format. Check the correct deadline from course instructions! Attach your Matlab codes to the report as an appendix or return them as separate m-files. Remember to check the assessment criteria and general instructions for reporting.

NOTE: If you have measured EEG signal yourself, read the data according to the instructions provided in the measurement instruction document. Remember to check your sampling frequency, it might be different than in the physionet dataset given in the instructions below!

If you haven't measured EEG at the lab, download the data according to these instructions.

At the PhysioNet web page (http://www.physionet.org/), find the polysomnography recordings (http://physionet.org/physiobank/database/sleep-edf/). Download the .rec file of the first recording. In PhysioNet, you can view data with 'PhysioBank ATM' (PhysioNet > PhysioBank > PhysioBank ATM).

Use the Matlab function readedf_EX1.m to read data into Matlab. For example, put the data files and readedf_EX1.m into the same directory, and in Matlab, go to that directory.

Table 1. The channels in the file sc4002e0.rec. You can see these using Polyman.

Channel	Measurement	Sampling freq. (Hz)	Unit	Transducer type
1	EEG, Fpz-Cz	100	μV	AgAgCl electrodes
2	EEG, Pz-Oz	100	μV	AgAgCl electrodes
3	EOG, horizontal	100	μV	AgAgCl electrodes
4	Respiration, oro-nasal	1		Thermistor
5	EMG, submental	1	μV-mrs	AgAgCl electrode
6	Temperature, body	1	Degrees C	Rectal thermistor
7	Event marker	1		Marker button

Load to Matlab 360 s from the beginning of the EEG measurement Fpz-Cz, using the command

```
[x,Fs,Start_date,Start_time,Label,Dimension,Coef,Nmb_chans,N] =
readedf_EX1('sc4002e0.rec',0,0,360);
```

Calculate the power spectrum estimates of this signal using the Welch's method with 2 different sets of parameters, one yielding a spectral estimate of relatively high variance (looking noisy) and another yielding a considerably smoother spectral estimate. You may use the Matlab function `pwelch`, e.g., `pwelch(x,128,64,128,fs)`.

In the report present:
1. Two figures corresponding to the two sets of parameters. In the figure captions, list the parameters used.
2. A discussion on how the different parameters (window length, overlap, and number of DFT points) affect the spectra.

Thereafter, perform time-frequency analysis on the EEG signal that you loaded to Matlab previously. Again, perform analyzes with two different sets of parameters. You may use the Matlab function `spectrogram`, e.g, `spectrogram(x,128,64,128,fs)`. Spectrogram color scale manipulation: `set(gca, 'Clim', [-100 45]);`

In the report, present:
3. Figures of the two spectrograms.
4. A discussion on what you see in the spectrograms. How do the parameters affect the results?

Looking at both the spectrograms, in the report, present:
5. A discussion on does the signal look stationary during the period considered or not, and how you see that in the figures.