FACULTY OF ENGINEERING AND ARCHITECTURE

DEPARTMENT OF INFORMATION TECHNOLOGY
RESEARCH GROUP WAVES

Prof. Dr. Verhulst
s.verhulst@ugent.be
waves.intec.ugent.be/hearing-technology

Lab Exercise 2: Auditory EEG – preparation of the recordings

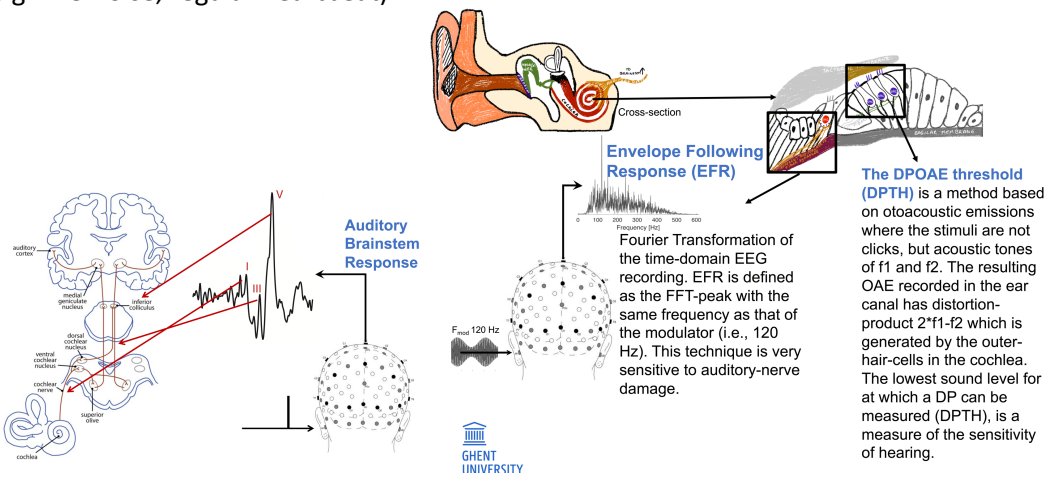
This lab practicum and lab exercise consists of three parts:

- Generating the auditory stimuli that you will present to a test subject during the EEG recording. Bring these stimuli with you on the day of the lab recording (on usb). These stimuli will be checked by the supervisor and calibrated before the actual experiment will commence.
- Perform an auditory EEG recording (on 9 March 9:00, Meeting place: Lobby of the iGent building (Technologiepark 126, tall building with solar panels).
- Analyse and visualize your measured auditory evoked potentials. (on 16 March after lecture on auditory EEG)

The stimuli and recordings you will focus on for the purpose of this practicum serve to study the subcortical EEG response to sound (e.g. for hearing diagnostics) or make a first attempt to track the F0 of a speech stimulus from an EEG recording.

1. Generate your stimuli

The first two recordings will focus on auditory EEG in response to a click (ABR) and in response to an amplitude-modulated pure tone (i.e., the envelope following response). The 3rd stimulus will be a speech recording of the word "David" and this condition will already be implemented. Your task is to generate **in Matlab** an array that contains the stimulation, and an array (of the same duration) that contains the trigger events (i.e. the start of individual trials). The array contains a number of repetitions (i) of the same stimulus such that we can improve the signal-to-noise ratio of the recording in the analysis, (ii) and introduces some jitter/randomness between the repetition of trials to minimize the effect of phase-locked noise on the recording (e.g. line-noise, regular heartbeat)



1.1 Click ABR

Generate a single stimulation array (Ch1) that contains 3000 repetitions of a click trial. The first epoch should have a positive polarity click, the second a negative, etc. such that in the end there are 1500 interleaved positive and negative polarity clicks.

The click epoch itself has a duration of 0.09 s and has a 80-µs click with amplitude 1 at the start of it, followed by zeros. Multiply by -1 to get the negative polarity click. The sampling frequency should be 48 kHz.

Before you concatenate the individual click epochs together to get your Ch1 array, you should introduce jitter, i.e. zeropadding each individual epoch with a random duration that can be up to 10% of the epoch window of 0.09 s. You can use a random generator for this purpose (perhaps with a fixed seed if you always want to generate the same jitter sequence).

Because there is some randomness introduced as to when a following click will start, you need to generate a trigger array (Trigger) that has zeros everywhere except for 3-samples-long trigger events (ones) at samples that coincide with click onsets in your Ch1. This Trigger signal should have the same number

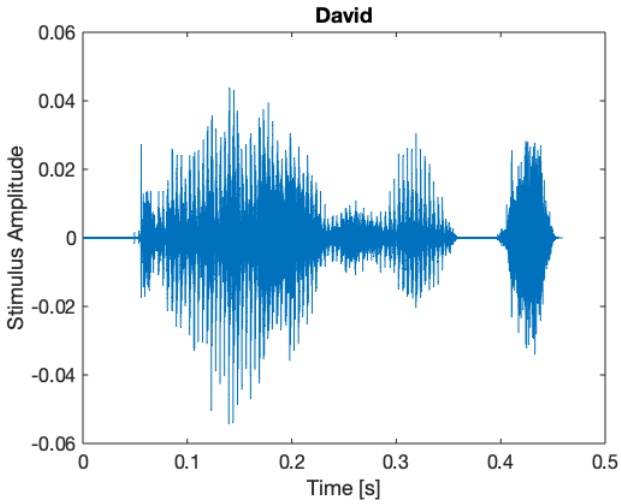
Lastly, zeropad both Ch1 and Trigger arrays with 0.1 s silence at the start and end of the recording, to ensure that the stimulus stream does not start too abruptly. Plot the time domain traces of the stimulus and trigger signal to ensure that your stimulation is correct.

1.2 Envelope following response

The procedure is very similar to that of the ABR, only here your stimulus epochs will contain a 0.5-ms-long amplitude-modulated pure-tone. Fs=48 kHz, the carrier frequency is 4 kHz, the modulation frequency 120 Hz (start with 0 phase modulation at epoch onset), and the modulation depth is 100%. Look up the formula for amplitude modulation on Wikipedia if necessary. Here we will use a total of 1000 epochs with interleaved positive and negative polarities of the stimulus epoch (500 each), and again introduce a jitter of 10%, and a 0.1 s silence interval at the start and end of the stimulation array (Ch1). Generate a trigger signal for this condition as well (Trigger) and visualize the time-domain waveforms of both trigger and stimulus to make sure your stimulus has the characteristics as outlined.

1.3 Speech EEG

You do not need to implement this stimulus, but for your information, the time-domain waveform of the word “david” is given here. Note that this stimulus has been high-pass filtered and that the fluctuations in its F0 have been straightened.



2. Corona safety measures during the practicum
   - Wear a mouth mask in the lab (poorly ventilated space).
   - Let fresh air into the room by opening the door of the lab frequently.