

Neurophysiological signal processing and network analysis: Practical: EEG processing pipeline

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AI-SUPPORTED MODELLING
IN CLINICAL SCIENCES
RESEARCH GROUP

Practical sessions

➤ Three practical sessions at VUB:

- 01/April/2024 - Jette – H043D (the whole session)
- 29/April/2024 - Jette – H043D (shared with prof. Van Schependom)
- 13/May/2024 - Jette – H043D (shared with prof. Nagels)

➤ **Deadline** to submit the project: June 2nd



1. First year master (MA1) or Second year master (MA2)?
2. From which program? Biomedical engineering or computer science or ...?

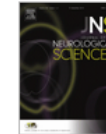
Goal

- Reproduce the work by Dr. Jorne Laton from our research group.
- Build a pipeline going from raw EEG data to scientific results
<https://www.sciencedirect.com/science/article/pii/S0022510X14006686?via%3Dihub>












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Single-subject classification of schizophrenia patients based on a combination of oddball and mismatch evoked potential paradigms

Jorne Laton^a  , Jeroen Van Schependom^{a b} , Jeroen Gielen^a , Jeroen Decoster^c ,
Tim Moons^c , Jacques De Keyser^a , Marc De Hert^c , Guy Nagels^{a b c d} 

Goal

To build a full **data analysis pipeline** for **EEG** to discriminate between **Schizophrenia and healthy subjects** based on the **auditory P300**.

Table 1

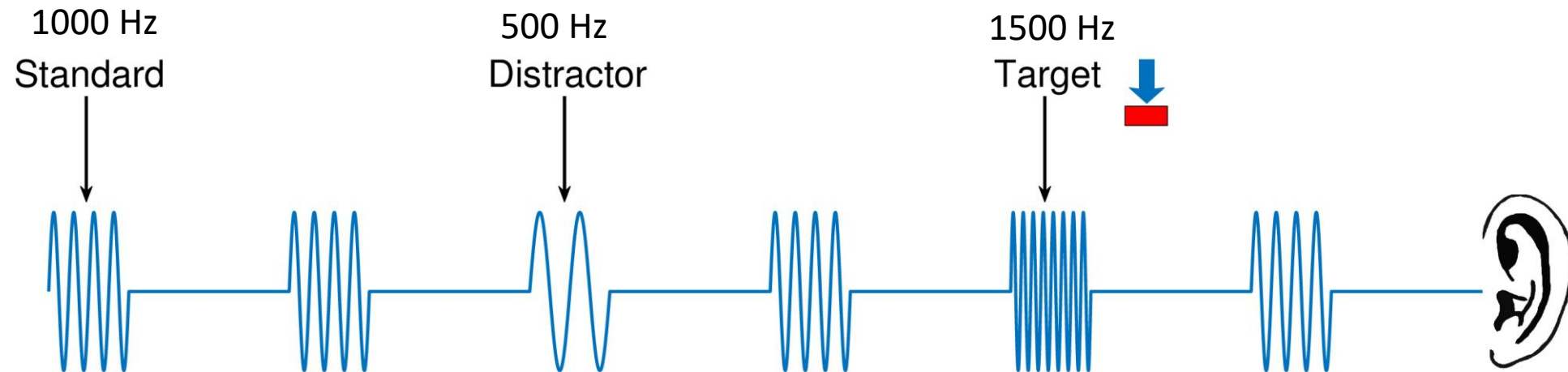
Demographic data.

	Patients	Controls	P
Amount of participants	54	54	
Male	36	36	
Age (years): mean \pm std	40.5 \pm 10.1	37.6 \pm 14.1	0.22
Age (years): range	[22.4, 60.5]	[15.1, 64.4]	
Education (years): mean \pm std	12.6 \pm 1.80	14.8 \pm 2.11	4.84×10^{-5}
Disease duration (years): mean \pm std	14.8 \pm 9.04	–	
Disease duration (years): range	[1, 40]	–	

Data

Auditory P300 task

EEG data of 54 schizophrenia patients and 54 healthy controls, matched for age and gender



Let's start!

Python

MNE package



Open-source Python package for exploring, visualizing, and analyzing human neurophysiological data: MEG, EEG, sEEG, ECoG, NIRS, and more.

<https://mne.tools/stable/index.html#>

- Format of data: .set file
- Jupyter Notebook or JupyterLab

No report but comment your code!

➤ Example from last year

In **ENGLISH**

➤ Project defense on the same day of your exam → about 30 minutes

```
Read in all the files, make sure the Notebook is in the same directory as the folder containing the data

[3]: DATA_DIR_norm = './Data_fdt_set/Norm/'
     set_files_norm = sorted(glob.glob(DATA_DIR_norm + '*.set'))

     DATA_DIR_schiz = './Data_fdt_set/Schizo/'
     set_files_schiz = sorted(glob.glob(DATA_DIR_schiz + '*.set'))

The following function extract_waveforms applies most of the processing steps (from raw data to averaged waveforms) per subject in the following order:

1. Filter the raw data
2. Extract all events in the data recording (80% / 10% / 10% trials)
3. Remove bad/unnecessary channels (because those could cause problems with the artifact rejection algorithm)
4. Epoching with [200 ms, 800 ms] relative to stimulus onset + baseline correction
5. Re-referencing to linked ears
6. Artifact rejection (peak-to-peak + flat segment rejection)
7. Rejection criterion (absolute maximum)
8. Average over all epochs

[4]: def extract_waveforms(file):
     raw = mne.io.read_raw_eeglab(file, preload=True)

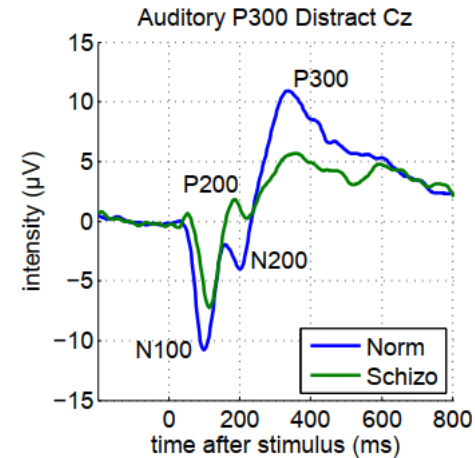
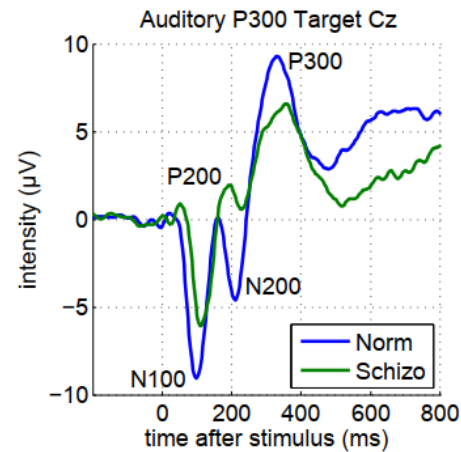
     ## 1. Filtering the raw data
     eegfilt = raw.copy().filter(0.1, 30, verbose=False).notch_filter(50, notch_widths=4, verbose=False)
     #band-pass between 0.1-30 Hz
     #band-stop between 48-52 Hz (centered at 50 Hz, with a width of 4)

     ## 2. Extract all events in the data recording (80% / 10% / 10% trials)
     #Event-ids corresponding to 3 event groups in Auditory P300
     # P300std = 30 standard
     # P300tar = 31 target
     # P300dis = 32 distractor

     #Knowing the event_ids, using this manual dict lets us extract the 80% / 10% / 10% trials
     #for both Norm and Schizo data successfully
     annotation_2_event_id = {'30': 30,
                              '31': 31,
```


Pipeline

- Follow the steps in the methods section of Jorne's paper



- Classification section -->

https://colab.research.google.com/drive/1Vq77vojGDOOgaSapmuQZ_E0FqNT5SlBd

Non-disclosure agreement

Step 1: You need to sign the NDA document and send via email

Step 2: I will share the datasets (OneDrive folder)

WAIVER OF RIGHTS

BETWEEN

VRIJE UNIVERSITEIT BRUSSEL, with registered offices at Pleinlaan 2, 1050 Brussels, represented by
Prof. dr. ir. Guy Nagels

AND

_____, with student ID _____,

EEG data + EEG-set up + Paper



HC



schiz



Laton et al_2014



Legende stimulatie



Legende stimulatie.docx

THANK YOU

A solid orange horizontal bar spanning the width of the slide at the bottom.