



Development of a Data Analysis Tool for Mentalab ExG Device

Project Management and Software Development
for Medical Applications

General Info

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Project Abstract

The objective of the project is to develop a Python-based tool for offline EEG, ECG, and EMG (ExG) data processing, analysis, and visualization, specifically for data collected from Mentalab ExG amplifiers and building upon Mentalab's existing software. The tool will focus on data processing and visualizing, including functions for signal filtering, artifact removal/rejection, and feature extraction, epoching, and averaging. In the development process, large parts will be using functions of MNE¹, and the project will result in a direct integration of Mentalab data into the MNE toolbox. The tool will empower researchers to conduct advanced offline analyses of bio-signals.

Background and Motivation

Mentalab² devices record ExG data that are crucial for studying the brain, as well as heart and muscle activity. While Mentalab provides open-source Python-based software solutions³ for real-time data streaming, there is currently a need for offline data processing tools that allow researchers to work with saved data files. This project aims to create an intuitive Python tool to load, visualize and process ExG data from Mentalab recordings, providing an efficient workflow for offline analysis. While CSV files are the primary focus, extending the other relevant data formats, such as EDF(BDF+) can be added if time permits.

Student's Tasks Description

Goal 1: Data Loading and Preprocessing

- Implement basic functionality for loading ExG data from CSV/BDF files into relevant MNE-compatible format.

Goal 2: Signal Processing & Feature Extraction

- Apply basic processing steps, such as filtering, averaging, epoching, re-referencing⁴.
- Extract relevant features, like e.g. power spectral density or heart rate variability.
- Implement existing artefact handling (removal / rejection) algorithms

Goal 3: Visualization Using VisPy⁵

- Build interactive visualizations for EEG/ECG signals using VisPy.
- Built time-series plots, spectral plots of data that allows users to explore recordings

Goal 4: Export and Extensions (Optional)

- Provide an option to export processed data.
- If time permits, extend support for handling EDF(BDF+) files.



Technical Prerequisites

- Strong proficiency in Python and data manipulation libraries like pandas, scipy and numpy
- Signal processing knowledge on filters, noise and data preprocessing
- Ideally, familiarity with GPU-based visualizer programming

Recommended Libraries

- VisPy for visualization.
- Pandas and NumPy for data manipulation.

References

1. <https://mne.tools/dev/index.html>
2. <https://mentalab.com/>
3. <https://mentalab.com/eeg-software/>
4. https://mne.tools/dev/auto_tutorials/pre_processing/index.html
5. https://vispy.org/getting_started/index.html