Bachelor thesis

# Usage of Matching Pursuit algorithm in single Evoked Response Potential calculations from obtained Steady-State Visual Evoked Potential Signal

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## 1. Introduction

The work aimed at checking the possibility of using the Matching Pursuit algorithm for the detection of evoked potentials during a study based on brain-computer communication (BCI).

Based on a set of basic signals of finite length, the MP algorithm iteratively explains the complex signal obtained from the EEG test with its help. To do this, the degree of correlation with subsequent signal segments was checked and after specifying the closest one, saved, subtracted from the original and the algorithm was repeated until a sufficiently large part of the signal was clarified. In addition, the problem of P300 potential was discussed, usually appearing under the influence of noticing the stimulus expected by the examined, as well as the phenomenon of SSVEP consisting in synchronization of one of the components of the recorded signal along with the frequency of the stimulus appearing on which the tester's attention is focused.

## 2. Conducted study

To obtain the relevant data, tests were carried out in which the volunteer, after putting on the measuring apparatus, underwent calibration, consisting in focusing attention on the field with the answer to the question appearing on the screen. At this stage, the program analysed the quality of the received responses obtained from the signal for different frequencies in order to determine two of them giving their best value. After calibration, the subject underwent a test trial with a procedure almost identical to calibration, however, the response fields had a fixed frequency of flashes, and the response was solely selected based on the recorded signal.

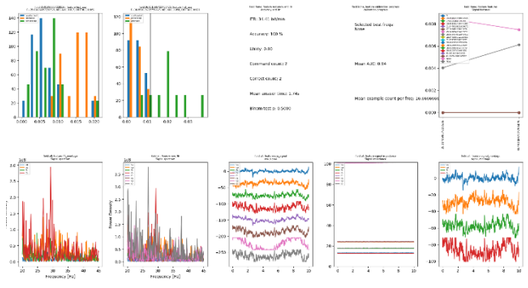

**Figure:** Study parameters acquired during test

## 3. Data processing

Recorded signal has been treated with a number of filters having, among others its task was to remove a constant component from it, disturbances appearing from the electrical network present in the room and narrow the frequency range to the area of interest to us, as well as a program that, using default criteria, searched in the signal for randomly appearing artefacts that were marked.

Obtained data were processed by the aforementioned Matching Pursuit algorithm, giving relatively easy to analyse results in which the appearing signal components around the frequencies determined during calibration were visible. In addition, appearance of a signal about 0.3s after the start of each question could be noticed, very similar to the P300 response, which was clearly highlighted after averaging individual attempts.

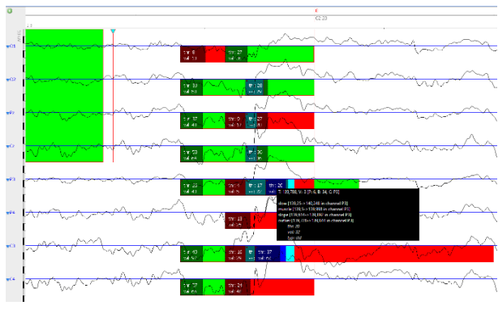

**Figure:** Artifacts detected in obtained signal

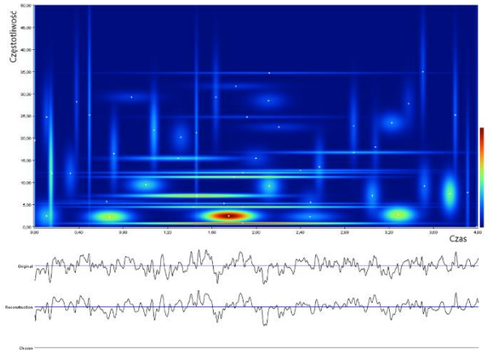


**Figure:** Signal decomposition presented on the time-frequency plane, and it's reconstruction

## 4. Conclusions

Detection of single potentials evoked by the SSVEP phenomenon and random potentials during single tests is possible.

Precise determination of the moment of stimulus appearance and the moment at which the response is selected using the P300 potential is possible.

Creating individual models of the reaction and behavior of the tested object allows you to optimize the practical interaction of BCI interfaces and monitor changes in these reactions over time.

Data from decomposition can be used for other tests (e.g. comparative) without the need to re-distribute them, and with appropriate experience in data interpretation, the possibility of precise elimination of artifacts appearing in the signal.

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