

A subject personalized frequency domain features selection approach using genetic algorithm to improve SVM classification in EEG N400 paradigm

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Context

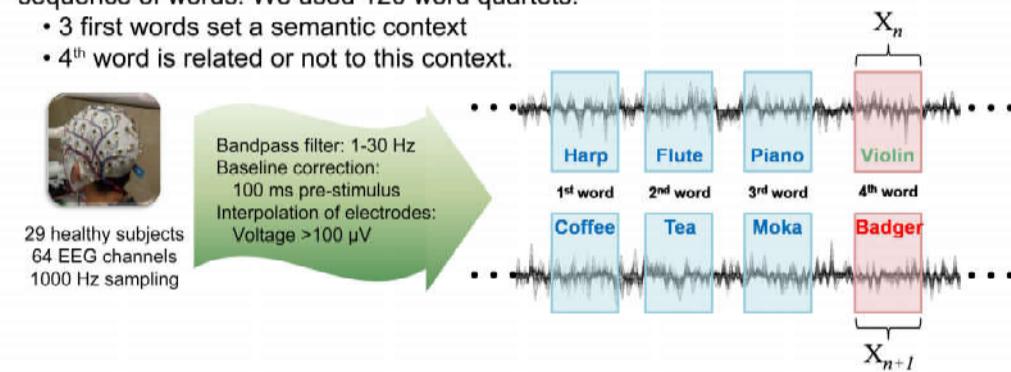
In recent years, progress in medicine allowed to keep alive an increasing number of patients with disorders of consciousness. The neuroimaging technique of electroencephalography (EEG) is widely exploited to investigate brain mechanisms involved in cognitive processes and *in extenso* to monitor consciousness activity.

These data are used for the supervised training and testing of a Support Vector Machine (SVM), but recent studies have evidenced serious difficulties in achieving good performances both in unresponsive patients and healthy control subjects.

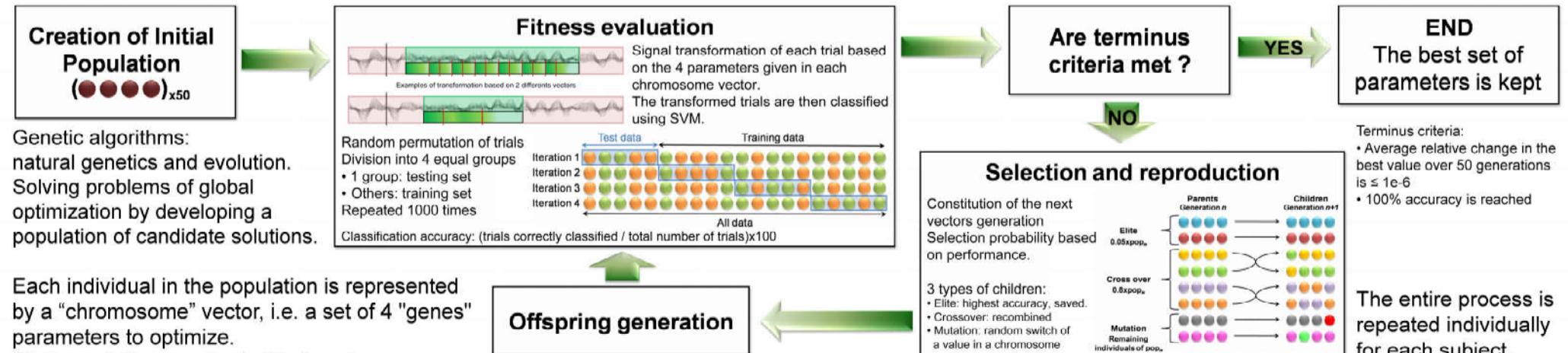
In this study, we test a features extraction optimization method, assuming that only a method that shows a good accuracy in fully aware subjects is likely to perform well in the detection of covert awareness.

Part 1 : N400 paradigm and features extraction by Fourier transform

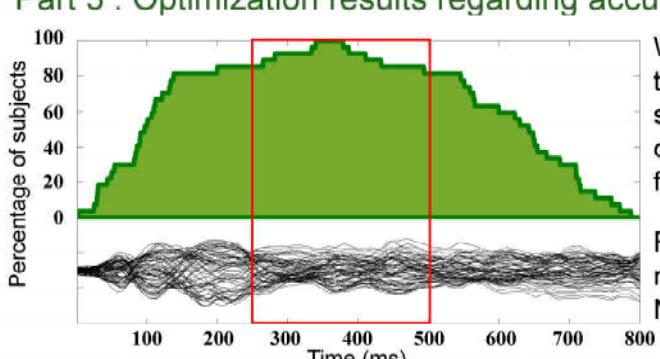
N400 is an event-related potential that allows to appraise the semantic processing ability of the subject. It appears when a word of different meaning occurs in a sequence of words. We used 120 word quartets:



Part 2 : Optimization of features extraction subject by subject



Part 3 : Optimization results regarding accuracy and pValue



N400 window is relevant, since all subjects presented relevant features at that time.

We clearly see that inter-subject deviation makes the relevant features exceed N400 window, and should therefore be taken in account.

Future directions

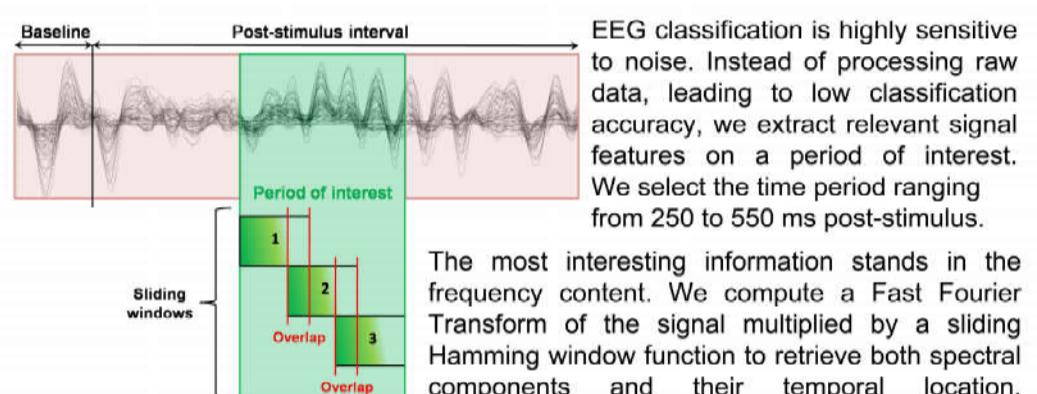
The dramatic performances contrast obtained with the two features extraction methods illustrates the difficulty of dealing with brain responses variations across healthy subjects.

The development of new optimization processes turns to be a promising lead to detect neuromarkers for instance in disorders of consciousness assessment and pronostic.

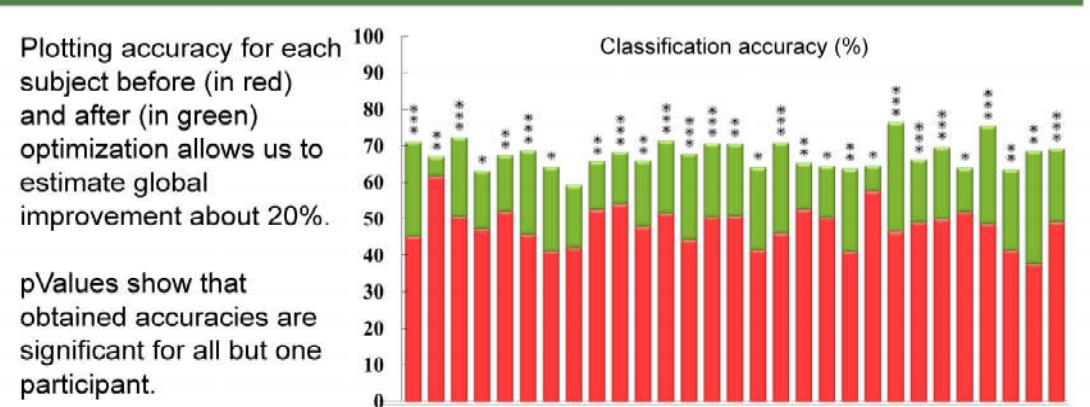
Purpose

The object of the present study is to address the following questions:

- 1- How to extract relevant features after EEG recording of brain mechanisms during N400 stimuli ?
- 2- How to manage inter-subjects variability and optimize features extraction for each one of them ?
- 3- What improvements of classification accuracy and pValue can be expected using this method ?



Considering the wide inter-subjects variations, we considered necessary to customize the period of interest, the sliding window width and the overlap length.



These results confirm that features extraction optimization permits classification improvement which allows for better brain activity discrimination in semantic cognitive processes.

References

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