
Feature engineering methods for Brain Computer Interfaces

1 Description

Brain computer interfaces (BCIs) [1, 2] are used to translate electrical signals into commands without the need for motor intervention. They are particularly useful for implementing assistive technologies providing communication and control to people with severe muscular or neural handicaps [3]. More recently BCIs have also found application in other different domains such as gaming [4], virtual reality environments [5], and space applications [6].

BCIs require a decoding component in which brain signals are translated into commands. Usually, classification algorithms are applied to predict the human intention from the analysis of the signals. Several classification algorithms have been used to analyze brain data in the context of BCI applications [7]. They include linear discriminant classifiers (LDA) [8], support vector machines (SVMs) [9], neural networks (NNs) [10], and other classification methods [7].

A key ingredient of successful applications of classification methods to BCIs is feature engineering, i.e., ways to create, by transformations and combinations of the original features, new, more informative, features that can help the classifiers to produce accurate predictions.

2 Objectives

The goal of the project is apply feature engineering techniques to classify BCI data. A set of datasets of an open BCI challenge will be available¹. The student can select any of the 8 datasets for testing the feature engineering method.

The student should: 1) Preprocess the dataset as required. 2) Implement the feature engineering method. 3) Apply three or more classifiers using the new features and compute the accuracy of the classifiers.

As in other projects, a report should describe the characteristics of the design, implementation, and results. A Jupyter notebook should include calls to the implemented function that illustrate the way it works.

3 Suggestions

- Read Lotte's paper on classification methods for BCIs <https://hal.inria.fr/inria-00134950/document>.
- See description of the BCI Challenge and datasets [11].
- Implementations can use any Python library.

¹This dataset, which is described in [11], can be downloaded from http://www.bbci.de/competition/iii/#data_set_i

References

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