Title: A Systematic Literature Review on Classification Algorithms for EEG-based Brain Computer Interfaces (BCI)

Level: Bachelor/Master

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Brain-Computer Interface (BCI): devices that enable its users to interact with computers by mean of brain-activity only, this activity being generally measured by ElectroEncephaloGraphy (EEG).

Electroencephalography (EEG): physiological method of choice to record the electrical activity generated by the brain via electrodes placed on the scalp surface.

In Science and Technology Development BCI plays a vital role in the field of Research. Classification is a data mining technique used to predict group membership for data instances. Analyses of BCI data are challenging because feature extraction and classification of these data are more difficult as compared with those applied to raw data.

Most current electroencephalography (EEG)-based brain-computer interfaces (BCIs) are based on machine learning algorithms. There is a large diversity of classifier types that are used in this field. Many new algorithms have been developed and tested to classify EEG signals in BCIs. The time is therefore ripe for an updated review of EEG classification algorithms for BCIs.

In this study you will survey the BCI and machine learning literature from 2015 up-to-now to identify the new classification approaches that have been investigated to design BCIs. To synthesize these studies in order to present such algorithms, to report how they were used for BCIs, what were the outcomes, and to identify their pros and cons.

The result of study will provide a comprehensive overview of the modern classification algorithms used in EEG-based BCIs, presents the principles of these methods and guidelines on when and how to use them. It also identifies a number of challenges to further advance EEG classification in BCI.

Some relevant literature:

[1] Lotte F, Bougrain L, Cichocki A, Clerc M, Congedo M, Rakotomamonjy A, Yger F., A review of classification algorithms for EEG-based brain-computer interfaces: a 10 year update, J Neural Eng, June 2018

[2] Geeta Sharma, Neha Sharma, Tanya Singh, Rashmi Agrawal, A Detailed Study of EEG based Brain Computer Interface, Proceedings of the First International Conference on Information Technology and Knowledge Management pp. 137–143, 2017

[3] CarmenVidaurre, ClaudiaSannelli, WojciechSamek, SvenDähne, Klaus-RobertMüller, Machine Learning Methods of the Berlin Brain-Computer Interface, IFAC-PapersOnLine, Volume 48, Issue 20, 2015, Pages 447-452

[4] Ewan S. Nurse, Philippa J. Karoly, David B. Grayden and Dean R. Freestone, A Generalizable Brain-Computer Interface (BCI) Using Machine Learning for Feature Discovery, PLoS One. 2015

[5] Natasha Padfield, Jaime Zabalza, Huimin Zhao, Valentin Masero, and Jinchang Ren, EEG-Based Brain-Computer Interfaces Using Motor-Imagery: Techniques and Challenges, MDPI, Sensors (Basel). 2019 Mar; 19(6): 1423.

[6] Benjamin Blankertz, Guido Dornhege, Steven Lemm, Matthias Krauledat, Gabriel Curio, Klaus-Robert Müller, The Berlin Brain-Computer Interface: Machine Learning Based Detection of User Specific Brain States