Review and Evaluation of Trending Canonical Correlation Analyses-Based Brain Computer Interface Methods

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Abstract : The fast development of technology that has advanced neuroscience and human interaction with computers has enabled solutions to various problems, and issues of this new era have been found and are being found like no other time in history. Brain-computer interface so-called BCI has opened the door to several new research areas and have been able to provide solutions to critical and important issues such as supporting a paralyzed patient to interact with the outside world, controlling a robot arm, playing games in VR with the brain, driving a wheelchair or even a car and neurotechnology enabled the rehabilitation of the lost memory, etc. This review work presents state-of-the-art methods and improvements of canonical correlation analyses (CCA), which is an SSVEP-based BCI method. These are the methods used to extract EEG signal features or, to be said in a different way, the features of interest that we are looking for in the EEG analyses. Each of the methods from oldest to newest has been discussed while comparing their advantages and disadvantages. This would create a great context and help researchers to understand the most state-of-the-art methods available in this field with their pros and cons, along with their mathematical representations and usage. This work makes a vital contribution to the existing field of study. It differs from other similar recently published works by providing the following: (1) stating most of the prominent methods used in this field in a hierarchical way (2) explaining pros and cons of each method and their performance (3) presenting the gaps that exist at the end of each method that can open the understanding and doors to new research and/or improvements.