

Brain-Computer Interfaces That Use Electroencephalography

Authors : Arda Ozkurt, Ozlem Bozkurt

Abstract : Brain-computer interfaces (BCIs) are devices that output commands by interpreting the data collected from the brain. Electroencephalography (EEG) is a non-invasive method to measure the brain's electrical activity. Since it was invented by Hans Berger in 1929, it has led to many neurological discoveries and has become one of the essential components of non-invasive measuring methods. Despite the fact that it has a low spatial resolution -meaning it is able to detect when a group of neurons fires at the same time-, it is a non-invasive method, making it easy to use without possessing any risks. In EEG, electrodes are placed on the scalp, and the voltage difference between a minimum of two electrodes is recorded, which is then used to accomplish the intended task. The recordings of EEGs include, but are not limited to, the currents along dendrites from synapses to the soma, the action potentials along the axons connecting neurons, and the currents through the synaptic clefts connecting axons with dendrites. However, there are some sources of noise that may affect the reliability of the EEG signals as it is a non-invasive method. For instance, the noise from the EEG equipment, the leads, and the signals coming from the subject -such as the activity of the heart or muscle movements- affect the signals detected by the electrodes of the EEG. However, new techniques have been developed to differentiate between those signals and the intended ones. Furthermore, an EEG device is not enough to analyze the data from the brain to be used by the BCI implication. Because the EEG signal is very complex, to analyze it, artificial intelligence algorithms are required. These algorithms convert complex data into meaningful and useful information for neuroscientists to use the data to design BCI devices. Even though for neurological diseases which require highly precise data, invasive BCIs are needed; non-invasive BCIs - such as EEGs - are used in many cases to help disabled people's lives or even to ease people's lives by helping them with basic tasks. For example, EEG is used to detect before a seizure occurs in epilepsy patients, which can then prevent the seizure with the help of a BCI device. Overall, EEG is a commonly used non-invasive BCI technique that has helped develop BCIs and will continue to be used to detect data to ease people's lives as more BCI techniques will be developed in the future.

Keywords : BCI, EEG, non-invasive, spatial resolution

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