

Brain-computer interfaces: principles and common applications

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Abstract

Brain-Computer interfaces (BCI) interpret brain activity to produce commands on a computer or other devices like robotic arms. A BCI therefore allows its user, and especially a severely impaired person, to interact with their environment only using their brain activity. The main applications of BCIs are the assistance to people with motor disabilities (especially those completely paralyzed suffering from locked-in syndrome), multimedia (e.g. video games), and more generally the interaction with any automated system (robotics, home automation, etc.). A BCI can be described as a closed loop system consisting of six main steps:

1. recording of brain activity (electroencephalography in particular);
2. signal processing (to remove artefacts, apply a band-pass filter);
3. feature extraction (to amplify and recover useful information); 4. classification (to identify the order);
4. translation of the order into a command; 6. feedback (to provide information on the outcome of the order and/or brain activity).

The presentation will introduce brain imaging techniques (mainly electroencephalography), physiological phenomena generated by brain activities (such as brain rhythms, evoked potentials...), classical processings (signal processing, feature extraction and machine learning), many common applications and future challenges.