SFN'2004 abstract (Society for NeuroScience meeting, San Diego, USA, 23-27Oct2004)

Common independent components for motion-based brain-computer-interfaces

Hovagim Bakardjian, LABSP, BSI, RIKEN

During smooth motion (SM) perception the brain performs visual processing of natural, gradually-moving objects, while apparent motion (AM) corresponds to a series of occluded or discrete images shown in rapid sequence, for example on a cinema screen. The present study attempted to employ the fast pathways of the motion-response system for creating a Brain-Computer-Interface (BCI) with dual command sequences flowing from a human to a machine. To collect the cortical responses and to identify correctly cortical activation areas, we employed a high-density electroencephalographic (EEG) system with 256 sponge-type electrodes. The data was pre-processed using the wavelet-packet transform and independent components (ICA) were extracted using the ThinICA algorithm (2nd– and 4th–order statistics). Single-trial component selection was performed by template matching using fourth-order cross-cumulant and 2nd-order cross-correlation measures. We observed two main results. First, we discovered a weak, but persistent early motion component appearing before or around 100ms after visual motion stimulus onset, through which it was possible to distinguish the AM from SM responses even in single-trials. Source analysis of this early component showed that the response is localized in a few electrodes from our high-density electrode array, located over the inferior parieto-occipital cortex. Second, attempting to imagine smooth motion (IMS) while viewing an AM stimulus resulted in a response biased towards SM in the same motion-processing locations. The imagined-smooth cortical responses were extracted with a maximal rate of success of 85%, which was strongly dependent on experimental subject, attention and motivation. These results showed, for the first time, that a human BCI operator may be able to modulate very quickly his visual-motion brain responses in order to communicate a simple command to a remote machine.