Chapter 56

Multi-Brain Computing: BCI Monitoring and Real-Time Decision Making

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In this chapter, we survey recent research on multibrain applications. That is, applications in which synchronized brain activity of multiple users is measured and integrated to use their joint brain activity to make real-time decisions about communication with and control of devices in smart environments.[1] Interestingly, we can go back to early brain–computer interface research of the 1970s to see many ideas and sometimes implementations of synchronized multibrain "computing." Usually they can be found in the artistic domain. In this decade (2010–20), we see growing attention in this research area, partly because of the availability of affordable electroencephalographic (EEG) devices and partly because of the interest of human–computer interaction researchers in affective computing.[2]

This additional interest is now responsible for a focus on brain–computer interface (BCI) research that has changed from clinical applications to applications that are of interest to industry, specific groups of professionals, or to the general population.[3] Traditional BCI researchers are not always open to these developments,[3,4] in which, rather than focusing on Amyotrophic Lateral Sclerosis (ALS) patients, this new research focuses on entertainment, games, art, and playful applications in the domestic and public domains.

Among the many applications of multibrain computing as adapted and extended from Stoica (2012)[5] are: (1) Joint decision-making in environments requiring high accuracy, and/or rapid reactions, or feedback; (2) joint/shared control and movement planning of vehicles or robots; (3) assessment of team performance, stress-aware task allocation, and rearrangement of tasks; (4) characterization of group emotions, preferences, and appreciations; (5) social interaction research (two or more people); (6) arts, entertainment, and games.

We discuss some examples from multibrain computing and focus on possible ways of joint decision making (or otherwise using the measured brain activity of multiple users). We will also emphasize the possibilities that are offered by the multimodal context, that is, considering brain–computer interfacing as one of the many possible modalities to obtain information about a user's or a group of users' affective states, preferences, and decisions. How to fuse information coming from different modalities and from different users needs to be discussed.[2] For that, we can learn from multimodal interaction research in human–computer interaction, including observations on sequential and parallel multimodality.

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