

Foreword

Interest in Brain-Computer Interfacing (BCI) is growing. This can be concluded from the number of BCI papers appearing in neuro-engineering and neuroscience journals and that are being presented at BCI conferences and workshops. More importantly, it can also be concluded from the growing number of BCI publications that appear in journals and in conference and workshop proceedings that consider brain activity as one of the many modalities that provide a system or a device with knowledge of its human interaction partners, including the situation where a human interaction partner directly addresses the system or device, using BCI. That is, currently, we are seeing brain computer interaction becoming integrated with other interaction possibilities and other interaction devices. This is an extremely important development. Integration means that information coming from other modalities such as speech, eye gaze, gestures, facial expressions, body postures, and various physiological modalities (heart rate, blood pressure, and skin conductivity) can be fused with detected brain signals to make it more easily possible to give a context-aware and context-dependent interpretation of these signals. It means that BCI technology needs to be integrated with, for example, wearable sensors, speech processing and computer vision technology. However, it also means new challenges for (computational) neuroscience researchers and that brain signals need to be processed in non-clinical situations.

Presently we see a lot of application-oriented research that aims at providing users, not only disabled users, with the capability to control devices or sensors and actuators in their environment, where these environments and devices can range from wheelchairs and artificially controlled hands for grasping, to entertainment applications including artful visualization and musification, digital painting, game control, interaction with social robots or virtual humans, and domestic applications. With these applications for the general audience we cannot be surprised to see the appearance of companies focusing on commercial BCI devices and applications. A possible mass market for BCI technology will help to forward BCI research in general and it will certainly help to increase awareness of BCI technology and its possibilities. No wonder that in recent years science policy makers and funding agencies have decided that it is time to have new and original views on possible

short-term and long-term developments in this research field and possible ways to steer these developments. Hence, there has been a veritable avalanche of state-of-the-art reports of BCI research, assessments of BCI research and roadmaps for BCI research. Apart from many scientific challenges, one of the (European Union) roadmaps mentioned the following four challenges: (1) the growing need for standards is still unmet, (2) there is inadequate interaction within the BCI community, (3) there is inadequate dissemination outside of the BCI community, and (4) there is little agreement on the most promising future directions.

Of course, such issues have become prominent now that different research groups, user groups, companies, and decision makers without the traditional clinical BCI background have entered the field. It has also led to discussions about the ‘definition’ of a BCI, maybe comparable with a less than fruitful discussion about a definition of ‘artificial intelligence’ in the 1950s of the previous century. In the traditional definitions intentional control of a device by modulating brain signals and explicit feedback to the user was emphasized. Now we see descriptions that include multiple users, multiple BCI paradigms used in parallel or sequentially, fusion of features or decisions that involve both BCI information and information obtained from other modalities and, exploiting brain signals in interaction situations where they are not necessarily intentionally modulated by the user and where no immediate explicit feedback is given. BCI research is supposed to lead to technology in which brain signals are used to support people in their interaction activities.

It has been a long road from the early BCI investigations to the current day’s investigations and applications. There can be applications that do not require or aim at using perfect detection or perfect interpretation of brain signals in order to be successful. But, of course, possible improvements that can be obtained from fundamental research in BCI and underlying research areas are necessary to improve and to extend the current limited range of real-world BCI applications. In this book Prof. Aboul Ella Hassanien and Dr. Ahmad Taher Azar have collected and edited contributions of well-known researchers in the BCI field in order to provide a representative view, also from the observations presented above, of current trends and applications in BCI research. Their efforts have been successful. Therefore, it has been a pleasure to write a Foreword for this book.

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