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Brain-Computer Interfaces

Revolutionizing Human-Computer Interaction

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Preface

It’s an exciting time to work in Brain–Computer Interface (BCI) research. A few years ago, BCIs were just laboratory gadgets that only worked with a few test subjects in highly controlled laboratory settings. Since then, many different types of BCIs have succeeded in providing real-world communication solutions for several severely disabled users. Contributions have emerged from a myriad of research disciplines across academic, medical, industrial, and nonprofit sectors. New systems, components, ideas, papers, research groups, and success stories are becoming more common. Many scientific conferences now include BCI related special sessions, symposia, talks, posters, demonstrations, discussions, and workshops. The popular media and general public have also paid more attention to BCI research.

However, the field remains in its infancy, with many fundamental challenges remaining. BCI success stories are still expensive, time consuming, and excruciatingly infrequent. We still cannot measure nor understand the substantial majority of brain activity, which limits any BCI’s speed, usability, and reliability. Communication and collaboration across disciplines and sectors must improve. Despite increased efforts from many groups, you still can’t really do very much with a BCI. The increased publicity has also brought some stories that are biased, misleading, confusing, or inaccurate.

All of the above reasons inspired a book about BCIs intended for non-expert readers. There is a growing need for a straightforward overview of the field for educated readers who do not have a background in BCI research nor some of its disciplines. This book was written by authors from different backgrounds working on a variety of BCIs. Authors include experts in psychology, neuroscience, electrical engineering, signal processing, software development, and medicine. The chapters describe different systems as well as common principles and issues. Many chapters present emerging ideas, research, or analysis spanning different disciplines and BCI approaches. The style and content provide a readable and informative overview aimed toward non-specialists.

The first chapter gives a particularly easy introduction to BCIs. The next three chapters cover the foundations of BCIs in more detail. Chapters 4 through 8 describe the four most cited non-invasive BCI systems, and chapters 9 and 10 cover neurorehabilitation. Chapter 11 focuses on BCIs for locked-in patients and presents a unique
interview with a locked-in patient. Invasive approaches are addressed in chapters 12 to 14. Chapters 15 and 16 present a freely available BCI framework (BCI 2000) and one of the first commercial BCI systems. Chapters 17 and 18 deal with signal processing. The last chapter gives a look into the future of BCIs.

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