Biological and Medical Physics, Biomedical Engineering

Towards Practical Brain-Computer Interfaces

Bridging the Gap from Research to Real-World Applications

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1. Auflage 2012. Buch. xxiv, 412 S. Hardcover
ISBN 978 3 642 29745 8
Format (B x L): 15,5 x 23,5 cm
Gewicht: 812 g

Preface

Brain–computer interface (BCI) research is advancing rapidly. The last few years have seen a dramatic rise in journal publications, academic workshops and conferences, books, new products aimed at both healthy and disabled users, research funding from different sources, and media attention. This media attention has included both BCI fi (BCI-based science fiction) and stories in mainstream magazines and television news programs.

Despite this progress and attention, most people still do not use BCIs, or even know what they are. While the authors of this book generally have access to the best BCI equipment, and they know how to use it, the chapters are written in the old-fashioned way, with keyboards and mice instead of BCIs. This may be surprising because BCIs are generally presented inaccurately in the popular media, where undeserved hype and sloppy reporting often create a gap between expectations and reality.

This book aims to bridge that gap by educating readers about BCIs, with emphasis on making BCIs practical in real-world settings. Experts in BCI research widely agree that one of the major challenges in the field is moving BCIs from laboratory gadgets that work with some healthy users to tools that are reliable, straightforward, and useful in field settings for whoever needs them. Many of these experts discuss the state of the art and major challenges across four sections. Three of the sections address the three main components of BCIs: sensors, signals, and signal processing; devices and applications; and interfaces and environments. The last section summarizes other challenges that relate to complete BCI systems instead of one component.

BCI research is inherently interdisciplinary, requiring contributions from neuroscience, psychology, medicine, human–computer interaction (HCI), many facets of engineering, and other disciplines. Similarly, many sectors are involved in BCI research, including academia, small and large businesses, government, medicine, and different types of nonprofit institutions. The authors who contributed to this book represent an eclectic mix of these disciplines and sectors. This breadth of contributors provides different perspectives and should make this book relevant to a wide variety of readers.

However, while this book could be useful for different specialists in the BCI community, we also made a strong effort to keep the chapters practical and readable for people who do not have a background in BCI research or any related discipline. Chapters are written in plain English, without unnecessary technical detail, and acronyms and special terms are defined within chapters and in our glossary. Ample references are provided in case readers want more information. Hence, many readers outside of the conventional BCI community may enjoy this book for different reasons. Nurses, doctors, therapists, caretakers, and assistive technology practitioners may want to learn more about what real-world BCIs can (and cannot) do, which may help them decide whether a BCI is viable as an assistive technology. Other readers may instead be curious about BCIs for other user groups, including healthy users. Students might use this book to learn about BCIs, and teachers might assign chapters in relevant classes. Business experts and policy makers may want to learn more about whether BCIs are promising enough to merit additional funding through commercial investment or grants. Journalists, writers, or other people interested in developing articles, documentaries, or other shows might find helpful background information or inspiration here. Finally, we hope our book appeals to people who are just curious about a technology that has long captured the human imagination and could revolutionize how people interact with each other and their environments.

Acknowledgements: The editors gratefully acknowledge the help of the following chapter reviewers: Tom Carlson, Günter Edlinger, Jan van Erp, Shangkai Gao, Gary Garcia Molina, Gangadhar Garipelli, Cuntai Guan, David Ibañez, Andrea Kübler, Bram Van de Laar, Fabien Lotte, Massimiliano Malavasi, Behnam Molaee, Roderick Murray-Smith, Tim Mullen, Femke Nijboer, Dani Perez Marcos, Mannes Poel, Aureli Soria-Frisch, Olga Sourina, Michael Tangermann, Aleksander Väljamäe, Yijun Wang, Tomas Ward, and Thorsten Zander. Their often extensive and always careful comments certainly helped the authors in improving the chapters. The editors also want to express their gratitude to their "technical editor," Hendri Hondorp from the HMI group of the University of Twente, for improving uniformity, consistency, and completeness of the book. Finally, preparation of many chapters in this book has benefited from funding from the *European Union Seventh Framework Programme (FP7/2007-2013)*. In particular the editors gratefully acknowledge the support of the *Future BNCI project (Project number ICT-248320)*.

Enschede
November 2011

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