

Brain Computer Interfaces Principles And Practice

This book is dedicated to wearable and autonomous systems, including devices, offers to variety of users, namely, master degree students, researchers and practitioners, An opportunity of a dedicated and a deep approach in order to improve their knowledge in this specific field. The book draws the attention about interesting aspects, as for instance, advanced wearable sensors for enabling applications, solutions for arthritic patients in their limited and conditioned movements, wearable gate analysis, energy harvesting, physiological parameter monitoring, communication, pathology detection, etc..

The introduction is designed as a textbook for upper level undergraduate and first-year graduate courses in neural engineering or brain-computer interfacing for students from a wide range of disciplines. It can also be used for self-study and as a reference by neuroscience, computer scientists, engineers, and medical practitioners. Key features include questions and exercises in each chapter and a supporting website.

In a distant-future which humanity has spread to every system within five hundred light-years, the inhabitants of an ancient starship enter orbit around a promising Earth-like planet after a four-hundred-year journey, but detect curious electromagnetic emissions that reveal the existence of intelligent life. By the author of Newton's Wake.

A recognizable surge in the field of Brain Computer Interface (BCI) research and development has emerged in the past two decades. This book is intended to provide an introduction to and summary of essentially all major aspects of BCI research and development. Its goal is to be a comprehensive, balanced, and coordinated presentation of the field's key principles, current practice, and future prospects.

The Annual BCI Research Awards are international prizes that recognize the top new projects in brain-computer interface (BCI) research. This book contains concise descriptions of projects nominated for the 2020 BCI Research Award and interviews with nominees. Each article is authored by the researchers who developed the project, and articles have been updated with new progress achieved since their nomination. These chapters are complemented by an introduction by the editors together with a concluding chapter that reviews the annual Awards Ceremony, announces the winners, and ends with a brief discussion. One of the prominent trends in recent years has been the development of BCIs for restoring limb use and for aiding optical and auditory sensory perception. Many chapters in this book present emerging and novel research directions likely to become more prevalent in the near future. This year's book includes chapters based on interviews with BCI experts who were nominated for an award, including this year's first, second, and third place winners. These interview chapters are generally less technical than project descriptions, and provide individual perspectives from people actively working on new methods and systems.

Karawirra Parr

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Smart Wheelchairs and Brain-Computer Interfaces

The idea of interfacing minds with machines has long captured the human imagination. Recent advances in neuroscience and engineering are making this a reality, opening the door to restoration and augmentation of human physical and mental capabilities. Medical applications such as cochlear implants for the deaf and neurally controlled prosthetic limbs for the paralyzed are becoming almost commonplace. Brain-computer interfaces (BCIs) are also increasingly being used in security, lie detection, alertness monitoring and in the study of the mind.

For generations, humans have fantasized about the ability to create devices that can see into a person's mind and thoughts, or to communicate and interact with machines through thought alone. Such ideas have long captured the imagination of humankind in the form of ancient myths and modern science fiction stories. Recent advances in cognitive neuroscience and brain imaging technologies have started to turn these myths into a reality, and are providing us with the ability to interface directly with the human brain. Physical processes within the brain which correspond with certain forms of thought. Brain-Computer Interfaces: Applying our Minds to Human-Computer Interaction broadly surveys research in the Brain-Computer Interface domain. More specifically, each chapter articulates some of the challenges and opportunities for using brain sensing in Human-Computer Interaction work, as well as applying Human-Computer Interaction solutions to brain sensing work. For researchers with little or no expertise in neuroscience or equip them to not only appreciate the state-of-the-art, but also ideally to engage in novel research. For expert Brain-Computer Interface researchers, the book introduces ideas that can help in the quest to interpret intentional brain control and develop the ultimate input device. It challenges researchers to further explore passive brain sensing to evaluate interfaces and feed into adaptive computing systems. Most importantly, the book will connect multiple communities allowing research to leverage their work and expertise.

What Is BCI2000? BCI2000 is a general-purpose software platform for brain-computer interface (BCI) research. It can also be used for a wide variety of data acquisition, stimulus p- sentation, and brain monitoring applications. BCI2000 has been in development since 2000 in a project led by the Brain-Computer Interface R&D Program at the Wadsworth Center of the New York State Department of Health in Albany, New York, USA, with substantial contributions by the Institute of Medical Psychology and Behavioral Neuroscience laboratories around the world, most notably the BrainLab at Georgia State University in Atlanta, Georgia, and Fondazione Santa Lucia in Rome, Italy. have also played an important role in the project's development. Mission The mission of the BCI2000 project is to facilitate research and the development of applications in all areas that depend on real-time acquisition, processing, and feedback of biosignals. Vision Our vision is that BCI2000 will become a widely used software tool for diverse areas of research and education.

Contemporary research in the field of robotics attempts to harness the versatility and sustainability of living organisms. By exploiting those natural principles, scientists hope to render a renewable, adaptable, and robust class of technology that can facilitate self-repairing, social, and moral—even conscious—machines. This is the realm of robotics that scientists call “the living machine.” Living Machines can be divided into two entities-biomimetic systems, those that harness the principles discovered in nature and embodied in biological entities with synthetic ones. Living Machines: A handbook of research in biomimetic and biohybrid systems surveys this flourishing area of research. It captures the current state of play and points to the opportunities ahead, addressing such fields as self-organization and co-operativity, biologically-inspired active materials, self-assembly and self-repair, learning, memory, control architectures and self-regulation, locomotion in air, on land or in water, perception, cognition, control, and communication. In all of construction of a wide range of different biomimetic devices and animal-like robots. Biohybrid systems is a relatively new field, with exciting and largely unknown potential, but one that is likely to shape the future of humanity. Chapters outline current research in areas including brain-machine interfaces-where neurons are connected to microscopic sensors and actuators-and various forms of intelligent prostheses from sensory devices like artificial retinas, to life-like artificial limbs, brain implants, and virtual reality life. The impact living machine technology will have on both society and the individual, by forcing human beings to question how we see and understand ourselves. With contributions from leading researchers drawing on ideas from science, engineering, and the humanities, this handbook will appeal to both undergraduate and postgraduate students of biomimetic and biohybrid technologies. Researchers in the areas of computational modeling and engineering, including artificial intelligence, machine learning, artificial life, biorobotics, and robotics will find it an invaluable resource.

Living Machines

Revolutionizing Human-Computer Interaction

A Practical Guide to Brain-Computer Interfacing with BCI2000

Brain Computer Interfaces for the Control of Robotic Swarms

Brain-Computer Interface Research

A Scientific Romance

Brain-computer interfaces (BCI) are devices which measure brain activity and translate it into messages or commands, thereby opening up many investigation and application possibilities. This book provides keys for understanding and designing these multi-disciplinary interfaces, which require many fields of expertise such as neuroscience, statistics, informatics and psychology. This first volume, Methods and Perspectives, presents all the basic knowledge underlying the working principles of BCI. It opens with the anatomical and physiological organization of the brain, followed by the brain activity involved in BCI, and following with information extraction, which involves signal processing and machine learning methods. BCI usage is then described, from the angle of human learning and human-machine interfaces. The basic notions developed in this reference book are intended to be accessible to all readers interested in BCI, whatever their background. More advanced material is also offered, for readers who want to expand their knowledge in disciplinary fields underlying BCI. This first volume will be followed by a second volume, entitled Technology and Applications

Approved for Release by NSA on 05-08-2013 pursuant to E.O. 13526 *Law Gehrig's disease is a fatal, mostly non-familial disease that affects the nervous system of humans by causing the degeneration of nerve cells in the brain and spinal cord. The degeneration hampers communication between the nervous system and voluntary muscles in the body. This leads to muscle paralysis and eventually the muscles that control breathing are affected, causing respiration to fail. The disease, which affects 20,000-30,000 men and women in the United States at any given time, has no effective treatment; most people with ALS die from respiratory failure within 5 years of the onset of symptoms. Recent epidemiologic studies report an association between the development of ALS and prior service in the U.S. military. The studies evaluated either veterans of the 1991 Persian Gulf War or veterans who served in the military in the period 1910-1982. Due to those findings, the Department of Veterans Affairs (VA) asked the National Academies to conduct an assessment of the potential relationship between military service and the later development of ALS. The project was assigned to the Institute of Medicine (IOM), which appointed a committee and gave it the task of evaluating the scientific literature on ALS in veterans. The committee began its work by identifying medical and scientific literature on ALS. PubMed, a database created and managed by the National Library of Medicine. Amyotrophic Lateral Sclerosis in Veterans: Review of the Scientific Literature presents the findings of this committee. The committee reviewed, evaluated, and summarized the scientific literature on ALS in veterans, composed primarily of peer-reviewed, published literature. This report includes the recommendations of the committee.*

Writing a comprehensive scientific book about the cerebral palsy is a great challenge. Many different interventions are available for persons with CP. Increasingly, it is recognized that intervention needs to be evidence-based and family-centered. Related therapies can offer improvement in some cases but do not offer a cure. Lifelong rehabilitation (habilitation and rehabilitation) in person with cerebral palsy is the first part of this book which has four chapters about management in children and adults with cerebral palsy through the life span, providing support and services. Three chapters of the second part are exploring the new therapy options which could improve the family quality of life. Third part has two chapters about complementary therapies with new possibilities for the future.

User experience doesn't happen on a screen; it happens in the mind, and the experience is multidimensional and multisensory. This practical book will help you uncover critical insights about how your customers think so you can create products or services with an exceptional experience. Corporate leaders, marketers, product owners, and designers will learn how cognitive processes from different brain regions form what we perceive as a singular experience. Author John Whalen shows you how anyone on your team can conduct "contextual interviews" to unlock insights. You'll then learn how to apply that knowledge to design brilliant experiences for your customers. Learn about the "six minds" of user experience and how each contributes to the perception of a singular experience. Find out how your team—without any specialized training in psychology—can uncover critical insights about your customers' conscious and unconscious processes. Learn how to immediately apply what you've learned to improve your products and services. Explore practical examples of how the Fortune 100 used this system to build highly successful experiences.

The Wise Advocate

Engaging Brain State Dynamics

Brain-Computer Interfaces 1

Learning the World

Principles and Practice

General-Purpose Software for Brain-Computer Interface Research, Data Acquisition, Stimulus Presentation, and Brain Monitoring

Leadership is the habit of making good choices. Even in difficult and uncertain circumstances, the most effective leaders focus their attention and overcome entrenched patterns of behavior to push an organization to new heights of success. This capability is no fluke: the latest research on the brain shows that we can pinpoint the mental activity associated with it—and cultivate it for our benefit. In this book, Art Kleiner, a strategy expert; Jeffrey Schwartz, a research psychiatrist; and Josie Thomson, an executive coach, give a transformative explanation of how cutting-edge neuroscience can help business leaders set a course toward better management. Mapping the functions of a manager onto established patterns of mental activity, they identify crucial brain circuits and their parallels in organizational culture. Strategic leaders, they show, play the role of wise advocates: to go beyond day-to-day transactional behavior to a longer-term, broader perspective that articulates their organization's deeper purpose. True leaders can play this influencer role in an organization because they have cultivated similar self-reflective habits in their own minds. Providing a powerful guide to decision strategies and their consequences, The Wise Advocate helps managers find their own inner voice and then make that voice ring out loud and clear, with a four-step program for practice and catalytic implications for management strategy, executive education, and business results.

Brain-Computer Interfaces Handbook: Technological and Theoretical Advances provides a tutorial and an overview of the rich and multi-faceted world of Brain-Computer Interfaces (BCIs). The authors supply readers with a contemporary presentation of fundamentals, theories, and diverse applications of BCI, creating a valuable resource for anyone involved with the improvement of people's lives by replacing, restoring, improving, supplementing or enhancing natural output from the central nervous system. It is a useful guide for readers interested in understanding how neural bases for cognitive and sensory functions, such as seeing, hearing, and remembering, relate to real-world technologies. More precisely, this handbook details clinical, therapeutic and human-computer interfaces applications of BCI and various aspects of human cognition and behavior such as perception, affect, and action. It overviews the different methods and techniques used in acquiring and pre-processing brain signals, extracting features, and classifying users' mental states and intentions. Various theories, models, and empirical findings regarding the ways in which the human brain interfaces with external systems and environments using BCI are also explored. The handbook concludes by engaging ethical considerations, open questions, and challenges that continue to face brain-computer interface research. Features an in-depth look at the different methods and techniques used in acquiring and pre-processing brain signals, extracting features, and classifying the user's intention Covers various theories, models, and empirical findings regarding ways in which the human brain can interface with the systems or external environments Presents applications of BCI technology to understand various aspects of human cognition and behavior such as perception, affect, action, and more Includes clinical trials and individual case studies of the experimental therapeutic applications of BCI Provides human factors and human-computer interface concerns in the design, development, and evaluation of BCIs Overall, this handbook provides a synopsis of key technological and theoretical advances that are directly applicable to brain-computer interfacing technologies and can be readily understood and applied by individuals with no formal training in BCI research and development.

Brain-Computer Interfaces: Lab Experiments to Real-World Applications, the latest volume in the Progress in Brain Research series, focuses on new trends and developments. This established international series examines major areas of basic and clinical research within the field of neuroscience by further expanding this established, ongoing international series. Examines major areas of basic and clinical research within the field

Brain-Computer Interface (BCI) sounds comparable to plugging a USB cable into a human brain with a laptop and accessing brain information. However, it is not as simple as it sounds. BCI is a multidisciplinary discipline with an exponential progress parallel to and with Artificial Intelligence for the past decades. Initially started with the Electroencephalography (EEG) analysis, BCI offers practical applications for cortical physiology today. Although BCI outcomes are more perceptible in medicine such as cognitive assessment, neurofeedback, and neuroprosthetic implants, it opens up amazing avenues for the business community through machine learning and robotics. Thought-to-text is one example of a hot topic in BCI. So, it is quite predictable to see BCI for individual usage given the current affordability of platforms for less technologically savvy users as well as BCI integrated within office automation productivity tools. The current trend is towards vulgarization for businesses benefits, by extension to the society at large. Thus, the interest in preparing a book on BCI. This book aims to compile and disseminate the latest research findings and best practices on how BCI is expanding the frontiers of knowledge in clinical practices, on the brain itself, and the underlying technologies.

Wearable and Autonomous Biomedical Devices and Systems for Smart Environment

Computer Interfaces

A Guide for Clinicians and End Users

Brain-Computer Interfacing

Neural Engineering

Brain-Computer Interfaces

Topic Editor Christoph Guger is the CEO of Guger Technologies. All other topic editors declare no competing interests with regards to the Research Topic subject.

Smart Wheelchairs and Brain-Computer Interfaces: Mobile Assistive Technologies combines the fields of neuroscience, rehabilitation and robotics via contributions from experts in their field to help readers develop new mobile assistive technologies. It provides information on robotics, control algorithm design for mobile robotics systems, ultrasonic and laser sensors for measurement and trajectory planning, and is ideal for researchers in BCI. A full view of this new field is presented, giving readers the current research in the field of smart wheelchairs, potential control mechanisms and human interfaces that covers mobility, particularly powered mobility, smart wheelchairs, particularly sensors, control mechanisms, and human interfaces. Presents the first book that combines BCI and mobile robotics Focuses on fundamentals and developments in assistive robotic devices which are commanded by alternative ways, such as the brain Provides an overview of the technologies that are already available to support research and the development of new products

The latest research in the development of technologies that will allow humans to communicate, using brain signals only, with computers, wheelchairs, prostheses, and other devices.

In this book Dr. Amit Ray describes the principles, algorithms and frameworks for incorporating compassion, kindness and empathy in machine. This is a milestone book on Artificial Intelligence. Compassionate AI address the issues for creating solutions for some of the challenges the humanity is facing today, like the need for compassionate care-giving, helping physically and mentally challenged people, reducing human pain and diseases, stopping nuclear warfare, preventing mass destruction weapons, tackling terrorism and stopping the exploitation of innocent citizens by monster governments through digital surveillance. The book also talks about compassionate AI for precision medicine, new drug discovery, education, and legal system. Dr. Ray explained the DeepCompassion algorithms, five design principles and eleven key behavioral principle of compassionate AI systems. The book also explained several compassionate AI projects. Compassionate AI is the best practical guide for AI students, researchers, entrepreneurs, business leaders looking to get true value from the adoption of compassion in machine learning technology.

Recent Progress and Future Prospects

Brain-Computer-Interfaces in their ethical, social and cultural contexts

Amyotrophic Lateral Sclerosis in Veterans

Toward Brain-computer Interfacing

Technology and Applications

Research on Brain-computer Interface Principles

In the last ten years neural ensemble recording grew into a well-respected and highly data-lucrative science. New experimental paradigms, including the fabrication of high-density microelectrodes, new surgical implantation techniques, multi-channel signal processing, and the establishment of direct real-time brain-machine interfaces, hold promise not just for neurophysiology research, but also for new-generation prosthetic devices aimed at restoring mobility and communication skills in severely disabled patients. Extensively updated and expanded, Methods for Neural Ensemble Recording, Second Edition distills the current state-of-the-science and provides the nuts and bolts foundation from which to advance the field for the next ten years. With contributions from pioneering researchers, this second edition begins with an overview of microarray design for chronic neural recordings. Demonstrating the diversity now enjoyed in the field, the book reviews new surgical techniques for chronic implantation of microwire arrays in not just rodents, but primates as well. It explores microelectrode microstimulation of brain tissue, discusses multi-electrode recordings in the somatosensory system and during learning, and analyzes neural ensemble recordings from the central gustatory-reward pathways in awake and behaving animals. An exploration of new strategies for neural ensemble data analysis for Brain-Machine Interface (BMI) applications foreshadows an investigation into employing BMI to restore neurological function. Using multi-electrode field potential recordings, contributions define global brain states and propose conceptual and technical approaches to human neural ensemble recordings in the future.

As a strategic response to cognitive and CNS impairments, BCI is a theoretical outgrowth of several generations of endogenous devices for peripheral nerves, which have as a prime goal the direct replacement of lost neural function. In these earlier applications therapeutic intervention has been premised only on the restoration of signal generating capacity where nerve transmission is largely unidirectional and temporally sequenced. It is increasingly apparent, however, that the brain not only employs a very different type of syntax from that of peripheral nerves but also structures the semantic content of motor activity, fundamentally altering the conception of BCI as a therapeutic medium. The book presented here documents this change, proposing a multi-faceted strategy in which BCI therapy can restore the loss of multi-tiered, brain based motor function.

In 2007, Mike Jensen and I wrote the book Walking the Torrens from Source to Sea, taking notes as he went. First appearing as a popular series of articles in the Adelaide Review with photographs by Cathy Brooks, Karawirra Parr is a beguiling social and natural history of the river, and a delightful meditation on literature and walking.

Brain-computer interfaces (BCI) are devices which measure brain activity and translate it into messages or commands, thereby opening up many possibilities for investigation and application. This book provides keys for understanding and designing these multi-disciplinary interfaces, which require many fields of expertise such as neuroscience, statistics, informatics and psychology. This second volume, Technology and Applications, is focused on the field of BCI from the perspective of its end users, such as those with disabilities to practitioners. Covering clinical applications and the field of video games, the book then goes on to explore user needs which drive the design and development of BCI. The software used for their design, primarily OpenVIBE, is explained step by step, before a discussion on the use of BCI from ethical, philosophical and social perspectives. The basic notions developed in this reference book are intended to be accessible to all readers interested in BCI, whatever their background. More advanced material is also offered, for readers who want to expand their knowledge in disciplinary fields underlying BCI.

Methods and Perspectives

Brain-Computer Interface Systems - Recent Progress and Future Prospects

New Frontiers in Brain

Walking the Torrens from Source to Sea

Electrocorticographic Brain-Computer Interfaces

Frameworks and Algorithms

Brain-Computer Interface (BCI) systems allow communication based on a direct electronic interface which conveys messages and commands directly from the human brain to a computer. In the recent years, attention to this new area of research and the number of publications discussing different paradigms, methods, signal processing algorithms, and applications have been increased dramatically. The objective of this book is to discuss recent progress and future prospects of BCI systems. The topics discussed in this book are: important issues concerning end-users; approaches to interconnect a BCI system with one or more applications; several advanced signal processing methods (i.e., adaptive neural fuzzy inference systems, Bayesian sequential learning, fractal features and neural networks, autoregressive models of wavelet bases, hidden Markov models, equivalent current dipole source localization, and independent component analysis); review of hybrid and wireless techniques used in BCI systems; and applications of BCI systems in epilepsy treatment and emotion detections.

Neural Engineering, 2nd Edition, contains reviews and discussions of contemporary and relevant topics by leading investigators in the field. It is intended to serve as a textbook at the graduate and advanced undergraduate level in a bioengineering curriculum. This principles and applications approach to neural engineering is essential reading for all academics, biomedical engineers, neuroscientists, neurophysiologists, and industry professionals wishing to take advantage of the latest and greatest in this emerging field.

This book provides a comprehensive overview of the current state of the art of practical applications of neuroprosthesis based on functional electrical stimulation for restoration of motor functions lost by spinal cord injury and discusses the use of brain-computer interfaces for their control. The book covers numerous topics starting with basics about spinal cord injury, electrical stimulation, electrical brain signals and brain-computer interfaces. It continues with an overview of neuroprosthetic solutions for different purposes and non-invasive and invasive brain-computer interface implementations and presents clinical use cases and practical applications of BCIs. Finally, the authors give an outlook on cutting edge research with a high potential for clinical translation in the near future. All authors committed themselves to use easy-to-understand language and to avoid very specific information, focusing instead on the essential aspects. This makes this book an ideal choice not only for researchers and clinicians at all stages of their education interested in the topic of brain-computer interface-controlled neuroprostheses, but also for end users and their caregivers who want to inform themselves about the current technological possibilities to improve paralyzed motor functions.

Brain-Computer Interfacing, Volume 168, not only gives readers a clear understanding of what BCI science is currently offering, but also describes future expectations for restoring lost brain function in patients. In-depth technological chapters are aimed at those interested in BCI technologies and the nature of brain signals, while more comprehensive summaries are provided in the more applied chapters. Readers will be able to grasp BCI concepts, understand what needs the technologies can meet, and provide an informed opinion on BCI science. Explores how many different causes of disability have similar functional consequences (loss of mobility, communication etc.) Addresses how BCI can be of use Presents a multidisciplinary review of BCI technologies and the opportunities they provide for people in need of a new kind of prosthetic Offers a comprehensive, multidisciplinary review of BCI for researchers in neuroscience and traumatic brain injury that is also ideal for clinicians in neurology and neurosurgery

A Handbook of Research in Biomimetics and Biohybrid Systems

Mobile Assistive Technologies

Using Brain Science to Build Better Products

Evolving BCI Therapy

Design for How People Think

Neuroprosthetics and Brain-Computer Interfaces in Spinal Cord Injury

Brain-Computer Interface (BCI) technology provides a direct electronic interface and can convey messages and commands directly from the human brain to a computer. BCI technology involves monitoring conscious brain electrical activity via electroencephalogram (EEG) signals and detecting characteristics of EEG patterns via digital signal processing algorithms that the user generates to communicate. It has the potential to enable the physically disabled to perform many activities, thus improving their quality of life and productivity, allowing them more independence and reducing social costs. The challenge with BCI, however, is to extract the relevant patterns from the EEG signals produced by the brain each second. Recently, there has been a great progress in the development of novel paradigms for EEG signal recording, advanced methods for processing them, new applications for BCI systems and complete software and hardware packages used for BCI applications. In this book a few recent advances in these areas are discussed.

The success of a BCI system depends as much on the system itself as on the user's ability to produce distinctive EEG activity. BCI systems can be divided into two groups according to the placement of the electrodes used to detect and measure neurons firing in the brain. These groups are: invasive systems, electrodes are inserted directly into the cortex are used for single cell or multi unit recording, and electrocorticography (ECoG), electrodes are placed on the surface of the cortex (or dura); noninvasive systems, they are placed on the scalp and use electroencephalography (EEG) or magnetoencephalography (MEG) to detect neuron activity. The book is basically divided into three parts. The first part of the book covers the basic concepts and overviews of Brain Computer Interface. The second part describes new theoretical developments of BCI systems. The third part covers views on real applications of BCI systems.

This handbook is a valuable resource to anyone involved with improvement of people's lives by replacing, restoring, supplementing and improving motor action, and understanding the neural bases of such functions. While there are several other resources available, there is no handbook such as this one. This handbook addresses the recent and rapid changes in the field of braincomputer interfaces (BCIs). Due to these changes interest in BCI has grown enormously, including interest from computer science researchers with a background in computational intelligence, human-computer interaction, and researchers in entertainment technology.

The field of Brain-Computer Interfaces (BCIs) has grown rapidly in the last few decades, allowing the development of faster and more reliable assistive technologies based on direct links between the brain and an external device. Novel applications of BCIs have also been proposed, especially in the area of human augmentation, i.e., enabling people to go beyond human limitations in sensory, cognitive and motor tasks. Brain-imaging techniques, such as electroencephalography, have been used to extract neural correlates of various brain processes and transform them, via machine learning, into commands for external devices. Brain stimulation technology has allowed to trigger the activation of specific brain areas to enhance the cognitive processes associated to the task at hand, hence improving performance. BCIs have therefore extended their scope from assistive technologies for people with disabilities to neuro-tools for human enhancement. This Special Issue aims at showing the recent advances in BCIs for human augmentation, highlighting new results on both traditional and novel applications. These include, but are not limited to, control of external devices, communication, cognitive enhancement, decision making and entertainment.

Applying our Minds to Human-Computer Interaction

Brain-Computer Interfaces Handbook

Methods for Neural Ensemble Recordings, Second Edition

Challenges for the Future

Neurobiology.

Issues and Characterization

In the last 15 years, a recognizable surge in the field of Brain Computer Interface (BCI) research and development has emerged. This emergence has sprung from a variety of factors. For one, inexpensive computer hardware and software is now available and can support the complex high-speed analyses of brain activity that is essential is BCI. Another factor is the greater understanding of the central nervous system including the abundance of new information on the nature and functional correlates of brain signals and improved methods for recording these signals in both the short-term and long-term. And the third, and perhaps most significant factor, is the new recognition of the needs and abilities of people disabled by disorders such as cerebral palsy, spinal cord injury, stroke, amyotrophic lateral sclerosis (ALS), multiple sclerosis, and muscular dystrophies. The severely disabled are now able to live for many years and even those with severely limited voluntary muscle control can now be given the most basic means of communication and control because of the recent advances in the technology, research, and applications of BCI. This book is intended to provide an introduction to and summary of essentially all major aspects of BCI research and development. Its goal is to be a comprehensive, balanced, and coordinated presentation of the field's key principles, current practice, and future prospects.

Technological advances have greatly increased the potential for, and practicality of, using medical neurotechnologies to revolutionize how a wide array of neurological and nervous system diseases and dysfunctions are treated. These technologies have the potential to help reduce the impact of symptoms in neurological disorders such as Parkinson's Disease and depression as well as help regain lost function caused by spinal cord damage or nerve damage. Medical Neurobinomics is a concise overview of the biological underpinnings of neurotechnologies, the development process for these technologies, and the practical application of these advances in clinical settings. Medical Neurobinomics is divided into three sections. The first section focuses specifically on providing a sound foundational understanding of the biological mechanisms that support the development of neurotechnologies. The second section looks at the efforts being carried out to develop new and exciting bioengineering advances. The book then closes with chapters that discuss practical clinical application and explore the ethical questions that surround neurobinomics. A timely work that provides readers with a useful introduction to the field, Medical Neurobinomics will be an essential book for neuroscientists, neuroengineers, biomedical researchers, and industry personnel.

A big swarm robot can be defined as a large group of interchangeable robots with limited sensing and/or actuating capabilities that cooperate (explicitly or implicitly) based on local communications and sensing in order to complete a mission. Its inherent redundancy provides flexibility and robustness to failures and environmental disturbances which guarantee the proper completion of the required task. At the same time, human intuition and cognition can prove very useful in extreme situations where a fast and reliable solution is needed. This idea led to the creation of the field of Human-Swarm Interfaces (HSI) which attempts to incorporate the human element into the control of robotic swarms for increased robustness and reliability. The aim of the present work is to extend the current state-of-the-art in HSI by applying ideas and principles from the field of Brain-Computer Interfaces (BCI), which has proven to be very useful for people with motor disabilities. At first, a preliminary investigation about the connection of brain activity and the observation of swarm collective behaviors is conducted. After showing that such a connection may exist, a hybrid BCI system is presented for the control of a swarm of quadrators. The system is based on the combination of motor imagery and the input from a game controller, while its feasibility is proven through an extensive experimental process. Finally, speech imagery is proposed as an alternative mental task for BCI applications. This is done through a series of rigorous experiments and appropriate data analysis. This work suggests that the integration of BCI principles in HSI applications can be successful and it can potentially lead to systems that are more intuitive for the users than the current state-of-the-art. At the same time, it motivates further research in the area and sets the stepping stones for the potential development of the field of Brain-Swarm Interfaces (BSI).

A brain-computer interface (BCI) establishes a direct output channel between the human brain and external devices. BCIs infer user intent via direct measures of brain activity and thus enable communication and control without movement. This book, authored by experts in the field, provides an accessible introduction to the neurophysiological and signal-processing background required for BCI, presents state-of-the-art non-invasive and invasive approaches, gives an overview of current hardware and software solutions, and reviews the most interesting as well as new, emerging BCI applications. The book is intended not only for students and young researchers, but also for newcomers and other readers from diverse backgrounds keen to learn about this vital scientific endeavor.

Brain-Computer Interfaces for Human Augmentation

Cerebral Palsy

Brain-Computer Interfaces 2

Review of the Scientific Literature

Brain-Computer Interfaces: Lab Experiments to Real-World Applications

The Biomedical Engineering of Neural Protheses

This volume summarizes the ethical, social and cultural contexts of interfacing brains and computers. It is intended for the interdisciplinary community of BCI stakeholders. Insofar, engineers, neuroscientists, psychologists, physicians, care-givers and also users and their relatives are concerned. For about the last twenty years brain-computer-interfaces (BCIs) have been investigated with increasing intensity and have in principle shown their potential to be useful tools in diagnostics, rehabilitation and assistive technology. The central promise of BCI technology is enabling severely impaired people in mobility, grasping, communication, and entertainment. Successful applications are for instance communication devices enabling locked-in patients in staying in contact with their environment, or prostheses enabling paralysed people in reaching and grasping. In addition to this, it serves as an introduction to the whole field of BCI for any interested reader.

Compassionate Artificial Intelligence

Brain-Computer Interface Systems

Recent Advances in Brain-Computer Interface Systems