# Sensorimotor Control And Learning An Introduction To The Behavioral Neuroscience Of Action Author James Tresilian Published On August 2012

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Humans are endowed with extraordinary sensory-motor capabilities that enable a successful interaction with and exploration of the environment, as is the case of human manipulation. Understanding and modeling these capabilities represents an important topic not only for neuroscience but also for robotics in a mutual inspiration, both to inform the design and control of artificial systems and, at the same time, to increase knowledge on the biological side. Within this context, synergies -- i.e., goal-directed actions that constrain multi DOFs of the human body and can be defined at the kinematic, muscular, neural level -- have gained increasing attention as a general simplified approach to shape the development of simple and effective artificial devices. The execution of such purposeful sensory-motor primitives on the biological side leverages on the interplay of the sensory-motor control at central and peripheral level, and the interaction of the human body with the external world. This interaction is particularly important considering the new concept of robotic soft manipulation, i.e. soft, adaptable yet robust robotic hands that can deform with the external environment to multiply their grasping and manipulation capabilities. Under this regard, a preeminent role is reserved to touch, being that skin isour primary organ to shape our knowledge of the external world and, hence, to modify it, in interaction with the efferent parts. This Research Topic reports results on the mutual inspiration between neuroscience and robotics, and on how it is possible to translate neuroscientific findings on human manipulation into engineering guidelines for simplified systems able to take full advantage from the interaction and hence exploitation of environmental constraints for task accomplishment and knowledge acquisition.

Even if you've never seen a zombie movie or television show, you could identify an undead ghoul if you saw one. With their endless wandering, lumbering gait, insatiable hunger, antisocial behavior, and apparently memory-less existence, zombies are the walking nightmares of our deepest fears. What do these characteristic behaviors reveal about the inner workings of the zombie mind? Could we diagnose zombism as a neurological condition by studying their behavior? In Do Zombies Dream of Undead Sheep?, neuroscientists and zombie enthusiasts Timothy Verstynen and Bradley Voytek apply their neuro-know-how to dissect the puzzle of what has happened to the zombie brain to make the undead act differently than their human prey. Combining tongue-in-cheek analysis with modern neuroscientific principles, Verstynen and Voytek show how zombism can be understood in terms of current knowledge regarding how the brain works. In each chapter, the authors draw on zombie popular culture and identify a characteristic zombie behavior that can be explained using neuroanatomy, neurophysiology, and brain-behavior relationships. Through this exploration they shed light on fundamental neuroscientific questions such as: How does the brain function during sleeping and waking? What neural systems control movement? What is the nature of sensory perception? Walking an ingenious line between seriousness and satire, Do Zombies Dream of Undead Sheep? leverages the popularity of zombie culture in order to give readers a solid foundation in neuroscience.

Available again, an influential book that offers a framework for understanding visual perception and considers fundamental questions about the brain and its functions. David Marr's posthumously published Vision (1982) influenced a generation of brain and cognitive scientists, inspiring many to enter the field. In Vision, Marr describes a general framework for understanding visual perception and touches on broader questions about how the brain and its functions can be studied and understood. Researchers from a range of brain and cognitive sciences have long valued Marr's creativity, intellectual power, and ability to integrate insights and data from neuroscience, psychology, and computation. This MIT Press edition makes Marr's influential work available to a new generation of students and scientists. In Marr's framework, the process of vision constructs a set of representations, starting from a description of the input image and culminating with a description of three-dimensional objects in the surrounding environment. A central theme, and one that has had far-reaching influence in both neuroscience and cognitive science, is the notion of different levels of analysis—in Marr's framework, the computational level, the algorithmic level, and the hardware implementation level. Now, thirty years later, the main problems that occupied Marr remain fundamental open problems in the study of perception. Vision provides inspiration for the continuing efforts to integrate knowledge from cognition and computation to understand vision and the brain.

The activities in this book tap into what kids love best--play. The 50 sensorimotor activities provide fun, easy, and imaginative exercises to build a child's skills that are necessary for meeting the challenges of everyday life at home, school, and out in the community.

This book is the first to view the effects of development, aging, and practice on the control of human voluntary movement from a contemporary context. Emphasis is on the links between progress in basic motor control research and applied areas such as motor disorders and motor rehabilitation. Relevant to both professionals in the areas of motor control, movement disorders, and motor rehabilitation, and to students starting their careers in one of these actively developed areas.

Sensorimotor Control and LearningAn Introduction to the Behavioral Neuroscience of ActionPalgrave Macmillan

The Superior Colliculus: New Approaches for Studying Sensorimotor Integration discusses new experimental and theoretical approaches to investigating how the brain transforms sensory signals into the motor commands that are used to shift the direction of gaze. The material includes the potential models for sensorimotor integration in the primate brain, how computational models and experimental work can be integrated to test hypotheses about sensorimotor integration, models of how multiple cortical and subcortical structures interact to generate a single behavior, and a description of new methods to correlate behavior and neural function.

Emerging and currently available technologies offer great promise for helping older adults, even those without serious disabilities, to live healthy, comfortable, and productive lives. What technologies offer the most potential benefit? What challenges must be overcome, what problems must be solved, for this promise to be fulfilled? How can federal agencies like the National Institute on Aging best use their resources to support the translation from laboratory findings to useful, marketable products and services? Technology for Adaptive Aging is the product of a workshop that brought together distinguished experts in aging research and in technology to discuss applications of technology to communication, education and learning, employment, health, living environments, and transportation for older adults. It includes all of the workshop papers and the report of the committee that organized the workshop. The committee report synthesizes and evaluates the points made in the workshop papers and recommends priorities for federal support of translational research in technology for older adults.

A comprehensive overview of an interdisciplinary approach to robotics that takes direct inspiration from the developmental and learning phenomena observed in children's cognitive development. Developmental robotics is a collaborative and interdisciplinary approach to robotics that is directly inspired by the developmental principles and mechanisms observed in children's cognitive development. It builds on the idea that the robot, using a set of intrinsic developmental principles regulating the real-time interaction of its body, brain, and environment, can autonomously acquire an increasingly complex set of sensorimotor and mental capabilities. This volume, drawing on insights from psychology, computer science, linguistics, neuroscience, and robotics, offers the first comprehensive overview of a rapidly growing field. After providing some essential background information on robotics and developmental psychology, the book looks in detail at how developmental robotics models and experiments have attempted to realize a range of behavioral and cognitive capabilities. The examples in these chapters were chosen because of their direct correspondence with specific issues in child psychology research; each chapter begins with a concise and accessible overview of relevant empirical and theoretical findings in developmental psychology. The chapters cover intrinsic motivation and curiosity; motor development, examining both manipulation and locomotion; perceptual development, including face recognition and perception of space; social learning, emphasizing such phenomena as joint attention and cooperation; language, from phonetic babbling to syntactic processing; and abstract knowledge, including models of number learning and reasoning strategies. Boxed text offers technical and methodological details for both psychology and robotics experiments.

A comprehensive look at state-of-the-art ADP theory and real-world applications This book fills a gap in the literature by providing a theoretical framework for integrating techniques from adaptive dynamic programming (ADP) and modern nonlinear control to address data-driven optimal control design challenges arising from both parametric and dynamic uncertainties. Traditional model-based approaches leave much to be desired when addressing the challenges posed by the ever-increasing complexity of real-world engineering systems. An alternative which has received much interest in recent years are biologically-inspired approaches, primarily RADP. Despite their growing popularity worldwide, until now books on ADP have focused nearly exclusively on analysis and design, with scant consideration given to how it can be applied to address robustness issues, a new challenge arising from dynamic uncertainties encountered in common engineering problems. Robust Adaptive Dynamic Programming zeros in on the practical concerns of engineers. The authors develop RADP theory from linear systems to partially-linear, large-scale, and completely nonlinear systems. They provide in-depth coverage of state-of-the-art applications in power systems, supplemented with numerous real-world examples implemented in MATLAB. They also explore fascinating reverse engineering topics, such how ADP theory can be applied to the study of the human brain and cognition. In addition, the book: Covers the latest developments in RADP theory and applications for solving a range of systems' complexity problems Explores multiple real-world implementations in power systems with illustrative examples backed up by reusable MATLAB code and Simulink block sets Provides an overview of nonlinear control, machine learning, and dynamic control Features discussions of novel applications for RADP theory, including an entire chapter on how it can be used as a computational mechanism of human movement control Robust Adaptive Dynamic Programming is both a valuable working resource and an intriguing exploration of contemporary ADP theory and applications for practicing engineers and advanced students in systems theory, control engineering, computer science, and applied mathematics.

Have over a hundred years of brain research revealed all its secrets? This book is motivated by a realization that cortical structure and behavior can be explained by a synergy of seemingly different mathematical notions: global attractors, which define non-invertible neural firing rate dynamics, random graphs, which define connectivity of neural circuit, and prime numbers, which define the dimension and category of cortical operation. Quantum computation is shown to ratify the main conclusion of the book: loosely connected small neural circuits facilitate higher information storage and processing capacities than highly connected large circuits. While these essentially separate mathematical notions have not been commonly involved in the evolution of neuroscience, they are shown in this book to be strongly inter-related in the cortical arena. Furthermore, neurophysiological experiments, as well as observations of natural behavior and evidence found in medical testing of neurologically impaired patients, are shown to support, and to be supported by the mathematical findings.

The report is the first of a two-part presentation which deals with certain computer controlled manipulator problems. This first part discusses a model which is designed to address problems of motor control, motor learning, adaptation, and sensorimotor integration. The problems are outlined and a solution is given which makes use of a state space memory and a piece-wise linearization of the equations of motion. A forthcoming companion article will present the results of tests performed on an implementation of the model.

This volume evolved from a workshop which addressed the general area of motor control, and the broader problems of serial organisation and sensory-motor integration of human skills. A number of specific issues are highlighted, including the neural mechanisms and disabilities of sensory-motor integration, planning and programming of action, the dynamics of interlimb coordination, amendment and updating mechanisms, and in particular, perception-action coupling and the representation of action. Underlying much of the volume are the major theoretical issues which include the debate between computational and prescriptive approaches versus the emergent properties and system dynamics approaches. The book represents a diverse approach from such disciplines as psychology, electrical and mechanical engineering, human movement studies, physiotherapy, neurology, and kinesiology.

Neural Networks for Control brings together examples of all the most important paradigms for the application of neural networks to robotics and control. Primarily concerned with engineering problems and approaches to their solution through neurocomputing systems, the book is divided into three sections: general principles, motion control, and applications domains (with evaluations of the possible applications by experts in the applications areas.) Special emphasis is placed on designs based on optimization or reinforcement, which will become increasingly important as researchers address more complex engineering challenges or real biological-control problems.A Bradford Book. Neural Network Modeling and Connectionism series

We experience and understand the world, including music, through body movement–when we hear something, we are able to make sense of it by relating it to our body movements, or form an image in our minds of body movements. Musical Gestures is a collection of essays that explore the relationship between sound and movement. It takes an interdisciplinary approach to the fundamental issues of this subject, drawing on ideas, theories and methods from disciplines such as musicology, music perception, human movement science, cognitive psychology, and computer science.

This book constitutes the refereed proceedings of the 13th International Symposium on Visual Computing, ISVC 2018, held in Las Vegas, NV, USA in November 2018. The total of 66 papers presented in this volume was carefully reviewed and selected from 91 submissions. The papers are organized in topical sections named: ST: computational bioimaging; computer graphics; visual surveillance; pattern recognition; vitrual reality; deep learning; motion and tracking; visualization; object detection and recognition; applications; segmentation; and ST: intelligent transportation systems.

Sensorimotor Control and Learning is a groundbreaking text that provides a uniquely integrated treatment of sensory and motor processes, reflecting the latest research trends in both neuromotor control and the perceptual sciences. Richly illustrated and written in a clear and concise manner, the book emphasizes the intimate links between sensory and motor processes, providing an integrated view of perception and action. Features of the book: • Emphasis on the multidisciplinary nature of the subject, which makes the text useful for a wide variety of readers • A rigorous and thorough account of how motor behaviors are controlled, coordinated, and changed • Numerous real-world examples relating to everyday experience • The latest research in the field, including a unique introductory treatment of control theory • Boxes highlighting and explaining more than 100 key terms, definitions and concepts throughout the text • Essential background material on neuroscience, biomechanics and engineering, making it a self-contained book for students • Over 600 high-quality illustrations by the author Sensorimotor Control and Learning is an indispensable resource for students of kinesiology and psychology, as well as students of other disciplines such as human factors, biomedical engineering, physiotherapy, and the neurosciences.

Despite the intensive experimental and theoretical studies for over a century, the general processes involved in neural control of pasture and movement, in learning of motor behaviour in healthy subjects and in adaptation in pathology were and remain a challenging problems for the scientists in the field of sensorimotor control. The book is the outcome of the Advanced Research Workshop Sensorimotor Control, where the focus was on the state and the perspectives of the study in the field.

A novel theoretical framework that describes a possible rationale for the regularity in how we move, how we learn, and how our brain predicts events. In Biological Learning and Control, Reza Shadmehr and Sandro Mussa-Ivaldi present a theoretical framework for understanding the regularity of the brain's perceptions, its reactions to sensory stimuli, and its control of movements. They offer an account of perception as the combination of prediction and observation: the brain builds internal models that describe what should happen and then combines this prediction with reports from the sensory system to form a belief. Considering the brain's control of movements, and variations despite biomechanical similarities among old and young, healthy and unhealthy, and humans and other animals, Shadmehr and Mussa-Ivaldi review evidence suggesting that motor commands reflect an economic decision made by our brain weighing reward and effort. This evidence also suggests that the brain prefers to receive a reward sooner than later, devaluing or discounting reward with the passage of time; then as the value of the expected reward changes in the brain with the passing of time (because of development, disease, or evolution), the shape of our movements will also change. The internal models formed by the brain provide the brain with an essential survival skill: the ability to predict based on past observations. The formal concepts presented by Shadmehr and Mussa-Ivaldi offer a way to describe how representations are formed, what structure they have, and how the theoretical concepts can be tested.

This book looks at the common problems both human and robotic hands encounter when controlling the large number of joints, actuators and sensors required to efficiently perform motor tasks such as object exploration, manipulation and grasping. The authors adopt an integrated approach to explore the control of the hand based on sensorimotor synergies that can be applied in both neuroscience and robotics. Hand synergies are based on goal-directed, combined muscle and kinematic activation leading to a reduction of the dimensionality of the motor and sensory space, presenting a highly effective solution for the fast and simplified design of artificial systems. Presented in two parts, the first part, Neuroscience, provides the theoretical and experimental foundations to describe the synergistic organization of the human hand. The second part, Robotics, Models and Sensing Tools, exploits the framework of hand synergies to better control and design robotic hands and haptic/sensing systems/tools, using a reduced number of control inputs/sensors, with the goal of pushing their effectiveness close to the natural one. Human and Robot Hands provides a valuable reference for students, researchers and designers who are interested in the study and design of the artificial hand.

Information Processing in Motor Control and Learning provides the theoretical ideas and experimental findings in the field of motor behavior research. The text presents a balanced combination of theory and empirical data. Chapters discuss several theoretical issues surrounding skill acquisition; motor programming; and the nature and significance of preparation, rapid movement sequences, attentional demands, and sensorimotor integration in voluntary movements. The book will be interesting to psychologists, neurophysiologists, and graduate students in related fields.

Taken together, the findings from these studies provide novel insights into the sensorimotor integration impairments underlying stuttering. The sensorimotor learning studies demonstrated that sensory prediction errors may not be correctly integrated for subsequent movement planning in both CWS and AWS, and that this limitation reflects less than optimal implicit learning processes. The sensorimotor control study confirmed that AWS are indeed more dependent on online feedback for immediate within-movement corrections. This necessary but inefficient control strategy may ultimately lead to the repetitive corrections or postural fixations that are perceived as stuttering moments during speech production (Max et al., 2004; Max & Daliri, 2019).

Sensorimotor Control and Learning is a groundbreaking text that provides a uniquely integrated treatment of sensory and motor processes, reflecting the latest research trends in both neuromotor control and the perceptual sciences. Richly illustrated and written in a clear and concise manner, the book emphasizes the intimate links between sensory and motor processes, providing an integrated view of perception and action. Features of the book: Emphasis on the multidisciplinary nature of the subject, which makes the text useful for a wide variety of readers A rigorous and thorough account of how motor behaviors are controlled, coordinated, and changed Numerous real-world examples relating to everyday experience The latest research in the field, including a unique introductory treatment of control theory Boxes highlighting and explaining more than 100 key terms, definitions and concepts throughout the text Essential background material on neuroscience, biomechanics and engineering, making it a self-contained book for students Over 600 high-quality illustrations by the author Sensorimotor Control and Learning is an indispensable resource for students of kinesiology and psychology, as well as students of other disciplines such as human factors, biomedical engineering, physiotherapy, and the neurosciences."

We introduce a biomimetic simulation framework for investigating human perception and sensorimotor control. Our framework is unique in that it features a biomechanically simulated musculoskeletal human model actuated by 823 muscles. The anthropomorphic model has two human-like eyes whose retinas contain spatially nonuniform arrangements of photoreceptors. The sensorimotor control system of our human model comprises a set of 15 automatically-trained, fully-connected deep neural networks. Two networks control the saccadic eye movement functionality of its binocular, foveated perception system. The remaining networks achieve neuromuscular control of the skeletal muscles. One network controls the 216 neck muscles that actuate the neck-head biomechanical complex, producing controlled head movements. In our prototype model, 3 networks control each limb; in particular, the 29 muscles in each of the two arms and the 39 muscles in each of the two legs. Thus, the virtual human demonstrates eective sensorimotor control of its eyes, head, and four limbs driven exclusively by visual perception to achieve a nontrivial motor task. We also demonstrate that its foveated perceptual system is capable of appearance-based recognition.

Although somatosensory system works in tandem with the motor system in biology, the majority of the prosthetics research and commercial efforts had focused on accommodating movement deficits. With the development of neuroprostheses in the last 15 years, it has become evident that somatosensory input (mainly as touch and proprioception) is essential for motor control, manipulating objects, and embodiment, in addition to its primary role for sensory perception. Somatosensory Feedback for Neuroprosthetics covers all relevant aspects to facilitate learning and doing research and development in the field. To understand the properties of the body to create viable solutions, this book starts with chapters reviewing the basic anatomy, physiology, and psychophysics of the somatosensory system, sensorimotor control, and instrumentation. Some sections are dedicated to invasive (peripheral and central, mainly cortical) and noninvasive (vibrotactile, electrotactile, etc.) approaches. Final chapters cover future technologies such as novel sensors and electrodes, safety, and clinical testing, and help to make up future prospects for this field with an emphasis on development and end use. With contributions from renowned experts, the contents include their recent findings and technical details necessary to understand those findings. Provides a concise review of the somatosensory system and latest advances in the use of somatosensory feedback for neuroprosthetics Analyzes many approaches to somatosensory feedback Provides the most detailed work on somatosensory neuroprostheses, their development, and applications in real life work.

The human hand can take on a huge variety of shapes and functions, providing its owner with a powerful hammer at one time or a delicate pair of forceps at another. The universal utility of the hand is even more enhanced by the ability to amplify the function of the hand by using tools. To understand and appreciate how the human brain controls movements of the hand, it is important to investigate both the healthy motor behaviour and dysfunction during everyday manipulative tasks. This book provides a contemporary summary of the physiology and pathophysiology of the manipulative and exploratory functions of the human hand. With contributions from scientists and clinical researchers of biomechanics, kinesiology, neurophysiology, psychology, physical medicine and rehabilitation, it covers the development of healthy human grasping over the lifespan, the wide spectrum of disability in the pathological state and links basic motor research with modern brain sciences.

The human visual system is amazing in its ability to guide us in a diverse range of everyday tasks - driving, preparing food, reading - in addition to leisurely pursuits such as ball games, or reading music. Somehow, without conscious effort, our eyes find the information we need to negotiate the world around us. Only recently, however, has it become possible to explore just how it is that our eyes can supply the brain systems controling our limbs with the information they need to carry out these tasks. Thanks to the development of head-mounted eye trackers, we can now explore the strategies that the eye movement system uses in the the initation and guidance of action. Looking and Acting explores a wide variety of visually guided activities - from sedentary activities such as reading music, or drawing, to dynamic behaviours such as driving or playing cricket. It proposes that the eye movement system has its own store of knowledge about where to find the most appropriate information for guiding action - information not often available to conscious scrutiny. Thus, every action has its own specific repertoire of linked eye movements. The book starts with a brief background of eye movement studies. Part two reviews observations and analyses of different activities. Finally, the book looks at visual representations, the neurophysiology of the brain systems involved, and the roles of attention and learning. Opening up a whole new field in eye movement research, the fascinating new book will be of great interest to all vision scientists, (psychologists, physiologists, ophthalmologists) whether at professional, graduate, or advanced undergraduate levels.

Close your eyes and ask yourself, 'what do I feel?' You might feel thirsty or tired. You might feel healthy and well or perhaps a little under the weather. Maybe you can feel that you are standing or that you are leaning over. You may also feel the world around you - the shape and texture of an apple in your hand, the feel of a chair you're sitting on. All these feelings have something in common, say psychologists and neuroscientists. They are all mental events, things that happen in the mind. But what if this is all wrong? What if it's not just the mind, but also the body itself that feels? And not merely physical sensations, but other feelings that seem to have nothing to do with bodies. Things like 'emotions' and 'intuitions' - joy or rage, anxiety or optimism, or the feeling of being hard done by or misunderstood? Drawing on the latest research and a range of classic and contemporary thought, How You Feel shows you that your brain and your body are two parts of a single system that creates your mind and mental life. You will discover that you don't have feelings, thoughts and emotions inside your body, you have them with your body. There can be no mind without the body. Psychology is no longer about the brain, or about 'mind and body', it is about the whole that is you.

This book is concerned with sensory cue integration both within and between sensory modalities, and focuses on the emerging way of thinking about cue combination in terms of uncertainty. These probabilistic approaches derive from the realization that our sensors are noisy and moreover are often affected by ambiguity. For example, mechanoreceptor outputs are variable and they cannot distinguish if a perceived force is caused by the weight of an object or by force we are producing ourselves. The probabilistic approaches elaborated in this book aim at formalizing the uncertainty of cues. They describe cue combination as the nervous system's attempt to minimize uncertainty in its estimates and to choose successful actions. Some computational approaches described in the chapters of this book are concerned with the application of such statistical ideas to real-world cue-combination problems. Others ask how uncertainty may be represented in the nervous system and used for cue combination. Importantly, across behavioral, electrophysiological and theoretical approaches, Bayesian statistics is emerging as a common language in which cue-combination problems can be expressed.

"In the present work, we seek to build on previous studies of speech motor control and learning responses to perturbed auditory feedback by demonstrating associations between sensorimotor speech processes and patterns of brain activity. In particular, we wish to draw attention to speech motor learning in comparison to speech motor control. Contemporary models of speech motor control have been constructed on the basis of feedback perturbation studies, but generally do not include mechanisms for motor learning or the associated neural substrates. In a series of three studies, we investigated the modulation of cortical beta oscillations during unperturbed speech planning and production; in response to perturbed auditory feedback; and as a measure to compare resting brain connectivity before and after a speech motor learning and speech motor control task. The first study revealed a broad role for beta desychronization during speech planning, beginning in different regions of the left and right hemisphere and then spreading across much of the left hemisphere and a more restricted area of the right. During overt speech production, beta desynchronization was focused around pericentral regions, with additional modulations in auditory and inferior frontal regions at certain points during the utterance, corresponding in time to sensorimotor feedback processing. The patterns of beta oscillations throughout both phases partly corresponded with pathways proposed by a "dual-stream" model of auditory processing. The second study found significant associations between cortical beta power and behavioural compensation to perturbed auditory feedback. The particular regions depended on the learning phase (early/late) and also the utterance phase (planning/production). A number of brain regions outside of those proposed in speech motor control models showed this relationship with behavioural compensation, particularly in prefrontal and inferior parietal regions, including bilateral supramarginal gyrus, a region proposed to play a variety of different sensorimotor functions during speech. The final study found a broad network of brain regions with significant increases in beta band connectivity after a speech motor learning task, particularly including anterior prefrontal and right temporal regions. In comparison, a speech motor control task evoked only two significant increases in connectivity. Connectivity changes across the two tasks showed some potential functional overlap, but also point to a network for feedback processing outside of core speech motor control regions. This network would include a module for phonological working memory, as well as a link between speech motor learning and lexical-semantic processes. Our results suggest the need for expanded models of speech production. These expanded models could then serve as a basis for examining the interactions between lower-level sensorimotor control and learning processes and behavioural processes such as second-language learning and recovery of speech capacities after injury." --

The Routledge Handbook of Motor Control and Motor Learning is the first book to offer a comprehensive survey of neurophysiological, behavioural and biomechanical aspects of motor function. Adopting an integrative approach, it examines the full range of key topics in contemporary human movement studies, explaining motor behaviour in depth from the molecular level to behavioural consequences. The book contains contributions from many of the world´s leading experts in motor control and motor learning, and is composed of five thematic parts: Theories and models Basic aspects of motor control and learning Motor control and learning in locomotion and posture Motor control and learning in voluntary actions Challenges in motor control and learning Mastering and improving motor control may be important in sports, but it becomes even more relevant in rehabilitation and clinical settings, where the prime aim is to regain motor function. Therefore the book addresses not only basic and theoretical aspects of motor control and learning but also applied areas like robotics, modelling and complex human movements. This book is both a definitive subject guide and an important contribution to the contemporary research agenda. It is therefore important reading for students, scholars and researchers working in sports and exercise science, kinesiology, physical therapy, medicine and neuroscience.

Provides a contemporary summary of the physiology and pathophysiology of the manipulative and exploratory functions of the human hand.

This collection of contributions on the subject of the neural mechanisms of sensorimotor control resulted from a conference held in Cairns, Australia, September 3-6, 2001. While the three of us were attending the International Union of Physiological Sciences (IUPS) Congress in St Petersburg, Russia, in 1997, we discussed the implications of the next Congress being awarded to New Zealand. We agreed to organise a satellite to this congress in an area of mutual interest -the neuroscience of movement and sensation. Australia has a long-standing and enviable reputation in the field of neural mechanisms of sensorimotor control. Arguably this reached its peak with the award of a Nobel Prize to Sir John Eccles in 1963 for his work on synaptic transmission in the central nervous system. Since that time, the subject of neuroscience has progressed considerably. One advance is the exploitation of knowledge acquired from animal experiments to studies on conscious human subjects. In this development, Australians have achieved international prominence, particularly in the areas of kinaesthesia and movement control. This bias is evident in the choice of subject matter for the conference and, subsequently, this book. It was also decided to assign a whole section to muscle mechanics, a subject that is often left out altogether from conferences on motor control. Cairns is a lovely city and September is a good time to visit it.

A synthesis of biomechanics and neural control that draws on recent advances in robotics to address control problems solved by the human sensorimotor system. This book proposes a transdisciplinary approach to investigating human motor control that synthesizes musculoskeletal biomechanics and neural control. The authors argue that this integrated approach—which uses the framework of robotics to understand sensorimotor control problems—offers a more complete and accurate description than either a purely neural computational approach or a purely biomechanical one. The authors offer an account of motor control in which explanatory models are based on experimental evidence using mathematical approaches reminiscent of physics. These computational models yield algorithms for motor control that may be used as tools to investigate or treat diseases of the sensorimotor system and to guide the development of algorithms and hardware that can be incorporated into products designed to assist with the tasks of daily living. The authors focus on the insights their approach offers in understanding how movement of the arm is controlled and how the control adapts to changing environments. The book begins with muscle mechanics and control, progresses in a logical manner to planning and behavior, and describes applications in neurorehabilitation and robotics. The material is self-contained, and accessible to researchers and professionals in a range of fields, including psychology, kinesiology, neurology, computer science, and robotics.