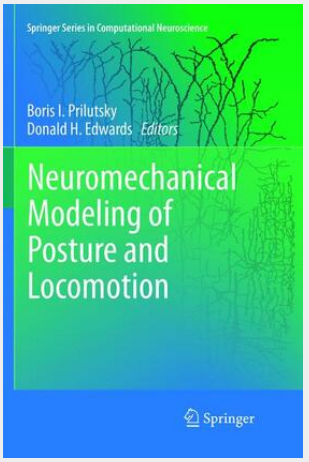
Edwards / Prilutsky

Neuromechanical Modeling of Posture and Locomotion



Neuromechanics is a new, quickly growing field of neuroscience research that merges neurophysiology, biomechanics and motor control and aims at understanding living systems and their elements through interactions between their neural and mechanical dynamic properties. Although research in Neuromechanics is not limited by computational approaches, neuromechanical modeling is a powerful tool that allows for integration of massive knowledge gained in the past several decades in organization of motion related brain and spinal cord activity, various body sensors and reflex pathways, muscle mechanical and physiological properties and detailed quantitative morphology of musculoskeletal systems. Recent work in neuromechanical modeling has demonstrated advantages of such an integrative approach and led to discoveries of new emergent properties of neuromechanical systems. Neuromechanical Modeling of Posture and Locomotion will cover a wide range of topics from theoretical studies linking the organization of reflex pathways and central pattern generating circuits with morphology and mechanics of the musculoskeletal system (Burkholder; Nichols; Shevtsova et al.) to detailed neuromechanical models of postural and locomotor control (Bunderson; Edwards, Marking et al., Ting). Furthermore, uniquely diverse modeling approaches will be presented in the book including a theoretical dynamic analysis of locomotor phase transitions (Spardy and Rubin), a hybrid computational modeling that allows for in vivo interactions between parts of a living organism and a computer model (Edwards et al.), a physical neuromechanical model of the human locomotor system (Lewis), and others.

For over a century, research has yielded enormous amounts of quantitative information about animal motor systems. Yet our understanding of neural control mechanisms of animal balance and locomotion remains cursory and fragmented. This book aims to change that. This is the first book on neuromechanical modeling, a tool that integrates the massive body of knowledge in computational models and complex motor behaviors to reveal the mechanisms by which these behaviors emerge. The majority of research groups working in this area have contributed chapters to this book. The book covers a wide range of topics from theoretical studies linking the organization of spinal reflex pathways and central pattern generating circuits with morphology and mechanics of the musculoskeletal system, to detailed neuromechanical models of balance and locomotor control, to analyses of nonlinear transformations of neural signals by the musculoskeletal system. This book can be used as an introductory guideto this new and exciting area of computational neuroscience research.

160,49 €
149,99 € (zzgl. MwSt.)

Lieferfrist: bis zu 10 Tage

Artikelnummer: 9781493980086
Medium: Buch
ISBN: 978-1-4939-8008-6
Verlag: Springer
Erscheinungstermin: 29.03.2019
Sprache(n): Englisch
Auflage: Softcover Nachdruck of the original 1. Auflage 2016
Serie: Springer Series in Computational Neuroscience
Produktform: Kartoniert
Gewicht: 575 g
Seiten: 368
Format (B x H): 155 x 235 mm

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