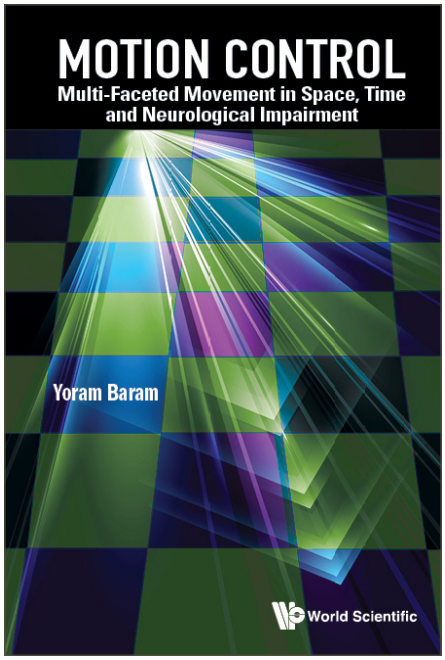
Motion Control

Multi-Faceted Movement in Space, Time and Neurological Impairment



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ABOUT THE BOOK

This book addresses the mathematical and the practical aspects of motion implied by advanced control theory. The richness and power of the theory are demonstrated by separate analyses of single-model and multi-modal repertoires, consisting of verities of estimation and control facets. Starting with purely mathematical concepts, specifically, abstract probability and information theories, model control theory is gradually revealed as a rather amazing domain. The mathematical equations, taking essentially simple forms, are exposed as powerful generators of motion. Moreover, seemingly obvious applications of the theory, such as high-performance aircraft control make room for unexpected virtual reality feedback in control of motion for the neurologically impaired.

Following the presentation of some historical milestones and mathematical preliminaries, the book is divided into four parts. The first deals with minimal-order models of state estimation and control. The second addresses multi-modal estimation and control, which facilitates the operation of high-performance aircraft in large flight envelopes. The third presents the transition from naturally nonlinear control of movement in obstacle avoidance and object targeting to virtually linear control of movement in the neurologically impaired. The fourth and final part of the book addresses the application of virtual sensory feedback in walking with specific neurological impairment. While the clinical studies reported were all based on a single-model paradigm, a later reflection reveals that, given the variety of neurological symptoms associated with the relevant disorders, a multi-modal approach, as that addressed in the control of high-performance aircraft in a large flight envelope, would be similarly applicable in the treatment of neurological disorders.

READERSHIP

Graduate students and professors of control theory, applied mathematics, electrical engineering, aeronautical engineering, mechanical engineering, medicine, computer science, physics, biology, neurology, psychology, cognition, linguistics, zoology, neurologists, doctors, physical therapists, neuroscientists, mathematicians, physicists, computer scientists. Biologists, psychologists, linguists, zoologists.

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ABOUT THE AUTHOR

Professor Yoram Baram of the Computer Science department at the Technion received his BSc degree in Aeronautical Engineering from the Technion in 1972, MSc degree in Aeronautics and Astronautics from MIT in 1974, and PhD degree in Electrical Engineering and Computer Science from MIT in 1976. Specializing in control theory, he spent the next 20 years investigating and teaching system dynamics in Israel and in the US, including two sabbatical terms as a Senior Research Associate of the National Research Council at the NASA Ames Research Center, where he also served as a consultant during 1986–2006. From 1999–2004, he developed a virtual reality apparatus for gait improvement in neurological patients, for which he was awarded a US patent.

In 2005, he received the Research Award for Best Platform Presentation at a conference on multiple sclerosis CMSC. In 2006, he was appointed the incumbent of the Technion's Roy Mattas/ Winnipeg Chair in Biomedical Engineering. The effectiveness of the sensory feedback device in the improvement of gait in adults and children with neurological disorders was clinically tested and published in leading medical journals during 2002–2016. Professor Baram has supervised about 30 graduate students. In recent years, he has been working on a mathematical theory of dynamics and information coding in neurobiological systems, and serving as head of the Technion Center for Research in Intelligent Systems. Having retired in 2015, he maintains a full research schedule at the Technion, publishing his work in leading neuroscience journals. In 2021, he published a book, *The Subcritical Brain*, suggesting the roles of mathematical structures, specifically, random graphs, nonlinear dynamics, prime numbers and quantum computation in cortical operation.

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