BIOMECHANICS AND MOTOR CONTROL OF HUMAN MOVEMENT

Fourth Edition

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To my wife and children, and to my colleagues, graduate and undergraduate students, all of whom have encouraged, challenged, and influenced me over the years.

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PREFACE TO THE FOURTH EDITION

This text is a revision of the third edition with the goal of adding two additional chapters reflecting additional directions in the biomechanics literature. The original text, *Biomechanics of Human Movement*, published in 1979, had its title changed, when the second edition was published in 1990, to *Biomechanics and Motor Control of Human Movement* to acknowledge the new directions of the 1980s. In that second edition, five of eight chapters addressed various aspects of muscles and motor systems. The third edition, published in 2004, with its major new addition of three-dimensional (3D) kinematics and kinetics, reflects the continued emphasis on the motor control area.

As in the first three editions, the goal of the text is to fill the gap in the human movement science area where modern science and technology are integrated with anatomy, muscle physiology, and electromyography to assess and understand human movement. The emphasis is on dynamic movements and on live data. A wide spectrum of measurement and analysis techniques is presented and is aimed at those interested in higher-level quantitative assessments. The text is intended to appeal to the practitioner as well as the researcher and to those concerned with the physically handicapped, the elite athlete, and the person in the workplace.

This edition has two new chapters, Chapter 2, "Signal Processing," and Chapter 11, "Biomechanical Movement Synergies." In the previous editions, there was some material on frequency analysis and digital filtering in the chapter on kinematics; most of this information has been removed and is now more formalized along with other valuable signal processing techniques not available in previous additions: auto- and cross correlation and ensemble averaging techniques. The previous Chapter 2, "Kinematics," has become Chapter 3 but retains the special digital filtering techniques necessary to filter kinematic data with no phase shift. All subsequent chapters have been shifted ahead with the exception of the two chapters "Three Dimensional Analysis"

and "Synthesis of Human Movement," which were interchanged because it was felt that the rigor of 3D analysis should be covered before the additional complexities of movement synthesis were introduced. In Chapter 6, "Work, Energy, and Power," much of the material was rearranged so that the many new terms and mechanisms were defined and explained before more advanced energy and power concepts and equations were introduced. Finally, a new Chapter 11, "Movement Synergies," was introduced and recognizes the unique position that biomechanics has with its hardware and software to analyze total body movements in 3D. The appendices, which underwent major additions in the second edition, remain intact. In response to many requests, the extensive numerical tables contained in Appendix A: "Kinematic, Kinetic, and Energy Data" can also be found at the following website: http://www.wiley.com/go/biomechanics.

As was stated in the original editions, it is expected that the student has had basic courses in anatomy, mechanics, calculus, and electrical science. The major disciplines to which the book is directed are: kinesiology, bioengineering (rehabilitation engineering), physical education, and ergonomics, physical, and occupational therapy; the text should also prove valuable to researchers in orthopedics, muscle physiology, and rehabilitation medicine.

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