PREFACE

Each of us is intrigued by some aspect of human walking. Yet while many different disciplines study normal human locomotion, we rarely approach this study from a transdisciplinary perspective. One of the reasons for such a parochial approach to the study of human locomotion is our different conceptual frameworks and the vocabulary we use to describe walking. Although we are interested in understanding how the human system produces the elegant behavior of walking and the factors that lead to decline in performance, each discipline has adopted a unique set of terms to define the theory and measurement of human walking. We designed this book to cut across disciplinary boundaries in order to stimulate and facilitate discussion.

The content provides a comprehensive review of current understanding of gait analysis. The book has been developed to teach the reader about the theories upon which gait measurements are based, basic characteristics of human walking, and technologies available to measure gait performance. Application of this knowledge is demonstrated through examples that involve the evaluation of both nondisabled and disabled walking performance.

The text is divided into four parts. Part I illustrates how different disciplines approach a walking disorder using different conceptual frameworks. Part II provides a detailed review of several theories developed to explain how walking is produced. A mathematical model, a neural control model, a motor learning model, and a dynamical systems model are each presented. Part III addresses the variables used to measure walking performance. The theoretical basis from which the variables were derived is presented, the technology available to perform the measurement is reviewed, and operational definitions and normative data are provided for many of the variables used to describe gait. Chapters address measurement theory, footfall measures, joint kinematics, kinetics, and EMG. Part IV applies gait analysis methods and theory to human examples of locomotion. Goals of assessment are reviewed, and each subsequent chapter is an example of the analyses applied to meet a particular goal.

The book is intended for use as a textbook for students learning about movement analysis, biomechanics, or clinical assessment. The book has been designed so that a variety of different disciplines can use selected chapters to teach discipline-specific information. The other chapters can then serve as examples of application. The chapters are written so that even the reader who lacks a sophisticated mathematics background can pass over the equations and glean the essential issues and problems central to each theory.

The book should be useful for entry-level clinicians interested in gait analysis. Engineering students interested in biomechanics, measurement theory, and gait analysis technology can use this book as an entry-level text. Movement science students can use all aspects of the book for entry-level teaching. The content should also be interesting to experienced scientists who wish to approach the analysis of movement from a global perspective. Neuroscientists may wish to use this book to learn about measures of functional performance and to integrate this information with knowledge of the nervous system. Biomechanists may use this book to learn about other disciplines, motor control models, and the clinical needs for movement analysis.

It is our hope that we will help the reader integrate current knowledge about human walking performance with measurement theory, gait analysis technology, and clinical application. We have come away from this task with an enriched perspective about human locomotion. It is obvious that no discipline has figured out how human locomotion occurs or identified the sensitive and specific variables that should be used to describe the behavior. Maybe it is time for a collective effort.

Rebecca L. Craik, PhD, PT
Carol A. Oatis, PT, PhD