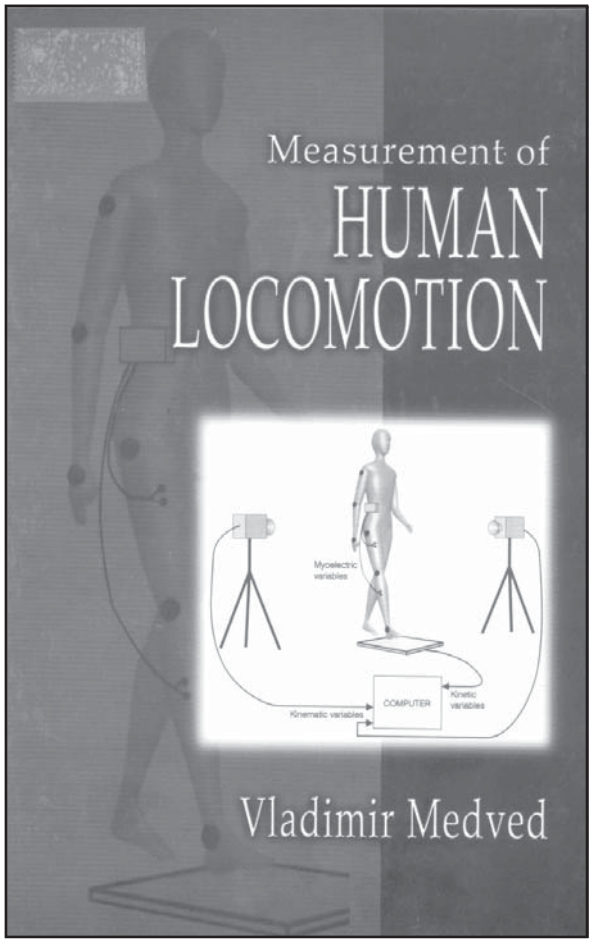
MEASUREMENT OF HUMAN LOCOMOTION

Vladimir Medved, CRC Press, Boca Raton FL, 2001
255 pp. (hb) ISBN 0-8493-7675-0



Many books exist in the field of biomechanics. In this field, the importance of measurement is well recognised. If someone is interested in entering this field, this text is worthwhile reading. Interdisciplinarily oriented in character, this volume addresses a large scale of engineers, researchers, physicians, kinesiologists, students, etc. The book describes the methods, technical devices, and procedures used when measuring both pathological and/or healthy human locomotion. Engineering solutions, systems, and procedures facilitate a more objective evaluation and a better understanding of the locomotor function, which is yet to be fully understood. One may acquire a new and better insight into the mechanism of action and the function of the neuro-musculo-skeletal system being, from an engineering point of view, one of the most complex automatic control systems in the natural world. This current book is based on the author's experience of working and teaching in the mentioned field and it is a good introduction to this advanced field.

The book has seven chapters. Chapter 1 (Introduction) is a review of major historical landmarks in the development of locomotion measurement methods. Special attention is paid, primarily, to kinematic variables. Historical insights into certain, more recent, measurement methods of kinetic, and, particularly, myoelectric variables, are given in more detail in chapters 5 and 6, respectively.

Chapter 2 (Methodological Background) is the basis for providing an answer to the question: Which variables have to be measured, and why? The methodology of studying human movement is presented, which is the source of the required measurement methods. On the one hand, they are determined by the biomechanical modelling of the human body, thereby enabling quantitative characterisation of locomotion by treating the body as a complex multi-segmental mechanical system. On the other hand, basic neurophysiological mechanisms of the locomotor apparatus are briefly drafted, giving an insight into the biocommunication and bioenergetic processes vital for the realisation of movement structures. A summary of skeletal muscle biomechanics is to be found at the end of this chapter.

Chapter 3 (General Properties of Locomotion Measurement Systems), focusing on what is common to all measurement methods, begins with a presentation of the global structure of the measurement system. The analog-to-digital conversion procedure, enabling the interface of the analog measurement data to the digital computer, is also described. Overall requirements on locomotion measurement systems from the users' standpoint are summarised at the end of this chapter.

Measurement methods and procedures fall into three categories, sorted respectively in Chapter 4 (Measurement of Locomotion Kinematics), Chapter 5 (Measurement of Kinetic Variables) and Chapter 6 (Measurement of Myoelectric Variables). While kinematic and kinetic locomotion variables are mechanical entities, myoelectric signals are physiological variables, originating in the human body. Therefore, in chapter 6, a description of the

myoelectric signal genesis is also given. Each particular measurement method, i.e. system, is described through the basic physical and/or engineering working principle. The essential parts of the engineering realisation of systems are explained at the level of block schematics or, when necessary, electronic circuit or mathematical algorithm. Attention is paid to the evaluation of measurement errors, from those caused by sensor features (accuracy, linearity, frequency characteristics, possible hysteresis, durability, etc.), to those appearing in the information processing chain, before the final result is presented to the user. Consequently, the reader will gain an insight into working principles, typical uses, and comparative advantages of a number of instruments, from simple electrogoniometers to the sophisticated stereometric instruments, wireless electromyographs, etc. Particular methods (or groups of methods, providing they measure the same variables using physically or technically different procedures) are illustrated by typical results with an interpretation, including the author's own results where appropriate.

Chapter 7 (Comprehensive Locomotion Diagnostic Systems and Future Prospects) lists several examples of how modern comprehensive systems are applied to measuring, analysing and diagnosing locomotion, which integrate kinematic, kinetic and EMG measurements, and are supported by specific data processing and interpretation facilities. The emphasis is on practical clinical applications and standardisation of methods. A non-invasive, automated kinematic measurement method, currently under development, is presented.

It is considerable to underline an extensive list of references, as well as an excellent historical overview.

In general, the author has written a very good basic textbook describing the fundamentals of biomechanical and bioelectrical aspects of measurement of human locomotion. Since interdisciplinary in character, the book addresses biomedical engineers, active in industry or the clinical environment, physicians, kinesiologists, physical therapists, and students and R&D workers of human locomotion.

Stanko Tonković