BIOMECHATRONICS in Medicine and Health Care

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Preface

Being multidisciplinary involving subjects such as electronics, mechanics, medicine and health care, this book provides a fundamental concept as well as a comprehensive discussion on the field of Biomechatronics. The book is the result of several years of research work by many groups on the development and application of biomechatronics on human subjects. Basic information is provided in the beginning of each chapter to facilitate clinicians, engineers and students to have background knowledge and then appreciate the application of the technical as well as clinical aspect at the latter part of the chapter. There is a growing need for biomechatronic device in medical field hence more research groups are developing different systems in this area. The new development can support the medical profession to have better health care.

The aim of the book is to present the insights of experts on emerging technology and development that are or will be applied in medical professions on a variety of clinical challenges and then demonstrate how to apply biomechatronic in providing better care and service. It also incorporates new and exciting multidisciplinary areas of research across the medical field and engineering field, such as robotic therapeutic training system for stroke rehabilitation, exoskeletons for daily activities on persons with disability, Functional Electrical Stimulation (FES) and Wireless Active Capsule Endoscopy. Each chapter provides substantial background materials relevant to the particular subject. This can be a primary reference for students and researchers in the field of Biomechatronics.

The book is enriched by the contribution of outstanding scientists and experts worldwide in different topics addressed here. This book would not have been possible without help and contributions from them and I wish to express my gratitude to all of them for their efforts.

The research group from Arizona State University (USA), consisting of Sivakumar Balasubramanian and Jiping He, have contributed to Chapter 2 with new concepts for a wearable exoskeletal system for interactive therapy on upper extremity for persons after stroke.

Olivier Lambercy and his collaborators, of the ETH Zurich (Switzerland), National University of Singapore, Simon Fraser University, McGill University and Imperial College London, have contributed to Chapter 4 with the robot-assisted rehabilita-
tion of hand function after stroke with the Haptic Knob and the HandCARE. The introduction part of neurological basic knowledge of stroke and hand function after stroke provide a good background information for stroke rehabilitation.

The book also reflects Japan’s place at the forefront of robotics research. Toru Suzuki and Eiichi Saitoh from Fujita Health University, Aichi (Japan), have provided valuable contribution to Chapter 3 about a wearable exoskeletal robot WPAL using in assisting gait for paraplegia. Research group of Kunihiro Oda, Takehito Kikuchi, Shiro Isozumi and Junji Furusho, of the Osaka Electro-Communication University (Japan) and Osaka University (Japan), introduced their isokinetic exercise machine using high performance magnetorheological (MR) fluid brake and iso-contraction exercise in Chapter 11. The third group is Jorge Solis and Atsuo Takanishi from Waseda University (Japan). They have contributed to Chapter 12 with robotic-assisted technology of dental and skin surgery simulation for medical training purposes.

A very special contribution of researchers from University of Sydney (Australia), Nur Azah Hamzaid, Che Fornusek and Glen M. Davis, provided a clear introduction of functional electrical stimulation (FES) which is a kind of technology integrated in biomechatronics in Chapter 7 for FES’s application in leg exercise of stroke therapy.

I would like to thank the contributions from research groups in Taiwan and Hong Kong. Chou-Ching K. Lin, Ming-Shaung Ju, Pin-Cheng Kung, Shu-Min Chen, of the National Cheng Kung University Hospital and National Cheng Kung University (Taiwan), contributed to Chapter 9 with robots for active rehabilitation of the upper limbs on the transverse plan for stroke patients. Xiaona Wang and Max Q.-H. Meng, of the Chinese University of Hong Kong China, contributed to Chapter 13 with wireless active capsule endoscope.

There is also a contribution from the Netherlands research group, Birgit I. Molier, Gerdienke B. Prange, Thijs Krabben, Michiel J. A. Jannink, Jaap H. Buurke, Hermie J. Hermens, of the Roessingh Research and Development (the Netherlands), University of Twente and Rehabilitation Centre ‘the Roessingh’ to Chapter 10 with upper extremity rehabilitation systems and augmented feedback.

In writing this book I have received the unstinting support of my colleagues and students in the Department of Health Technology and Informatics, the Hong Kong Polytechnic University (PolyU) (Hong Kong). The build-up of a robotic system is a team work from my graduate students, research staff, colleagues in PolyU and clinical partners. I would to thank all of them, in particular Le Li, Xiaoling Hu, and Newmen S. K. Ho for their contribution in the introduction to Biomechatronics (Chapter 1), our intention-driven rehabilitation robotic system PolyJbot (Chapter 5), hand robotic system (Chapter 6) and a robotic system combined with FES
for wrist training (Chapter 8). Persons after stroke gave us a lot of constructive comments during the experimental setup and system design. I would like to express my gratitude to their support and feedback. They are the driving force and I want to do more for them.

Most of the work presented in this book has been developed as part of the product ready for clinicians to apply on persons with disability:

- Robotic upper-extremity repetitive trainer (Arizona State University, USA)
- WPAL — Wearable Power-Assisted Locomotor, (Fujita Health University, Aichi, Japan)
- HAPTIC KNOB and HandCARE — (ETH Zurich, National University of Singapore, Simon Fraser University, McGill University and Imperial College London)
- PolyJbot — an interactive robotic system using EMG (PolyU, Hong Kong)

I am very grateful for all the contributors and their strong support.

Finally, many thanks to my wife, Wai-nga Lam, and our daughter and son, Lok-ching Tong and Lok-tin Tong, for their support, encouragement, and patience. They have been my driving source.

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