Preface

The present book includes extended and revised versions of a set of selected papers from the 9th International Joint Conference on Biomedical Engineering Systems and Technologies (BIOSTEC 2016), held in Rome, Italy, February 21–23, 2016.

BIOSTEC 2016 received 321 paper submissions from 54 countries, of which 7% are included in this book.

The papers were selected by the event chairs and their selection is based on a number of criteria that include the evaluations and comments provided by the Program Committee members, the session chairs' assessment, and also the program chairs' global view of all papers included in the technical program. The authors of selected papers were then invited to submit a revised and extended version of their papers having at least 30% innovative material.

The purpose of the International Joint Conference on Biomedical Engineering Systems and Technologies is to bring together researchers and practitioners interested in both theoretical advances and applications of information systems, artificial intelligence, signal processing, electronics, and other engineering tools in knowledge areas related to biology, medicine, and health care.

BIOSTEC is composed of five complementary and co-located conferences, each specialized in at least one of the aforementioned main knowledge areas:

- International Conference on Biomedical Electronics and Devices — BIODEVICES
- International Conference on Bioimaging — BIOIMAGING
- International Conference on Bioinformatics Models, Methods and Algorithms — BIOINFORMATICS
- International Conference on Bio-inspired Systems and Signal Processing — BIOSIGNALS
- International Conference on Health Informatics — HEALTHINF

The papers selected to be included in this book contribute to the understanding of relevant trends of current research on biomedical engineering systems and technologies.

In the biomedical electronics and devices area we have included a set of three papers focusing on aspects related to arterial pulse measurement, radiation exposure monitoring, and speech rehabilitation. Although these address diverse domains, they share two common features: The developments reported are aimed at increasing the usability of the devices, as a way of making them more acceptable to patients and allowing use by non-trained individuals. They also demonstrate the importance of integrated novel sensing devices with sophisticated signal processing techniques — which illustrates the value of BIOSTEC in bringing together researchers in complementary fields.

The area of bioimaging is approached also in a set of three papers. Complying with the well-known phrase, "A picture is worth a thousand words," the world of medical imaging has been playing a very crucial role in the modern clinic. It encompasses many

fields starting from diagnosis through functional assessment to image-guided therapy. It is almost impossible to imagine any field in medicine today that does not utilize some form of imaging. Attesting to this fact are the three manuscripts chosen for publication in this volume. The first work suggests an image-based tool for quantitative assessment of synaptic densities. The second offers modeling strategies for the design of orthodontic aligners. And the third utilizes dynamic computed tomography (CT) imaging for assessment of ventilation distribution reproducibility. These works are taken from three seemingly unrelated fields, but they all share the same basis, which is the reliance on images and image processing tools. I hope you will find them interesting and stimulating, conveying the message that, "medical imaging has no boundaries."

The papers selected from the Bioinformatics conference reflect the recent direction in bioinformatics research defined by a particular focus on using advanced computational methodologies to maximize the ability to extract useful information from the available raw biological data. It can be argued that bioinformatics research is entering a second phase in its development, with the initial phase primarily focusing on the use of simple algorithmic techniques to analyze the unexpected large amount of biological data. Recently, with the increasing volume, variability, and complexity of the available data, algorithmic approaches with a higher degree of sophistication are needed to extract much-needed knowledge from the 'big' biological data. The selected papers employ advanced statistical approaches, complex graph theoretic models, and various machine-learning techniques to handle the difficult task of analyzing bioinformatics data. The papers also reflect the unique nature of BIOSTEC conferences; they cover various aspects of biomedical informatics in a harmonious and complementary way. It is becoming increasingly difficult to draw hard or clear lines between the different types of advances in technology or informatics that support biomedical research. As a result, there are references and connections in the selected papers to the other four BIOSTEC conferences, particularly the conferences in health informatics and biomedical imaging. Taking full advantage of the available data sources, whether they contain omics data, imaging data, clinical/patient data or ontology data, is critical in advancing biomedical informatics and positively impacting health-care practices. We hope that reading the selected papers will inspire the readers to further explore the exciting discipline of bioinformatics and find ways to contribute to its emerging subdisciplines.

From the conference's track on bio-inspiring systems and signal processing, seven papers were chosen, which illustrate its current trends. Their main application domains address issues in monitoring, well-being, and rehabilitation. Common methodological solutions include various forms of machine-learning algorithms, as well as experimental set-ups based on brain–computer interfaces. Three papers focus on monitoring physiological features: Hörmann et al. study the relation between modern working environment demands and the concomitant increase in cognitive workload; Boutaayamou et al. introduce a new signal-processing algorithm for gait analysis; and Uchida et al. present a real-time remote monitoring approach, aimed at estimating the heart rate of a subject from various types of images of his face. Two papers address a clustering or classification task: Arini and Torkar compare various machine-learning classifiers in their ability to discriminate ventricular premature beats in rabbits; Wang et al. introduce

a new approach for the problem of dynamic time warping, and illustrate its improved efficiency in the context of human sleep stage clustering. Bustamante et al. present a robot-based strategy for rehabilitation of lower limb movements, using electromyographic control signals. Their methodology appears to be extendable to other joints, as well as commanding signals. Finally, aiming also at recovering lost physical abilities, Gonzalez et al. describe a new system, based on permanent magnetic articulography, which enables patients having undergone laryngectomy to communicate verbally.

Health informatics encompasses a wide spectrum of health-related topics including among others: health-care IT; decision support systems; clinical data mining and machine learning; physiological and behavioral modeling; software systems in medicine and public health; and mobile, wearable, and assistive technologies in health care. This book includes a selected set of five papers that address the design, implementation, and evaluation of a variety of health informatics systems and frameworks: e-health and m-health systems that encourage well-being and disease control by leveraging social community support (Elloumi et al. for physical activity and exercise, and Smedberg et al. for stress management); an evaluation framework for connected health systems to holistically assess their value and potential impact (Carroll et al.); a continuous, real-time, and non-invasive system for monitoring and calibrating patient post operatory breathing (Seppänen et al.); and a system for formally representing computer-interpretable guidelines, detecting potential interactions in multimorbidity cases, and coping with possibly conflicting pieces of evidence in clinical studies (Zamborlini et al.).

We would like to thank all the authors for their contributions, and express also our gratitude to the reviewers who have helped ensure the quality of this publication.

February 2016

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http://www.springer.com/978-3-319-54716-9

Biomedical Engineering Systems and Technologies
9th International Joint Conference, BIOSTEC 2016, Rome, Italy, February 21–23, 2016, Revised Selected Papers
Fred, A.; Gamboa, H. (Eds.)
2017, XXV, 428 p. 174 illus., Softcover
ISBN: 978-3-319-54716-9