

## GUEST EDITORIAL PREFACE

# Special Issue on the 13th Mediterranean Conference on Medical and Biological Engineering and Computing

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Biomedical integrative research is being fostered by the use of emergent technologies and the generation of knowledge at different scales of living systems. These advances are producing a tremendous impact on medicine and biology promoting the shift from a reactive medicine to a preventive medicine through novel concepts and practices. In this scientific and technical context, computational modeling is regarded as a key field to generate personalized knowledge for a better prevention and control of most common but also the rarest diseases, chronic and curable conditions. In addition, novel biomedical applications applied to rehabilitation engineering are providing promising approaches to the solution of important biomedical problems.

This special issue contains extended versions of articles that were presented at the 13th Mediterranean Conference on Medical and Biological Engineering and Computing (MEDICON 2013) in the tracks of “*Biomechanics, Robotics and Minimal Invasive Surgery*”, “*Cardiovascular, Respiratory and Endocrine Systems Engineering*” and “*Neural and Rehabilitation Engineering*”. This regional conference of the *International Federation of Medical and Biological Engineering* (IFMBE) was held in Seville, Spain, during the dates of September 25th to 28th, 2013, under the general theme “*Research and development of technology for sustainable healthcare*”, focusing on the public concern on the appearance and use of emergent technologies and biomedical applications.

The special issue contains six contributions addressing advances on research topics ranging from neural engineering, brain physiology and modeling, and hemodynamic modeling, to neurorehabilitation control, posture control, or the measurement of exercise performance.

The first article by Wada et al. focuses on the relationship between body mass index and the autonomic nervous activity, through the introduction of a pressure sensor array that detects a pressure wave referred to as “motion body wave” during sleep. This wave is used to classify breathing patterns and sleeping postures, which are correlated with body mass index. Through an experimental study it is concluded that the body mass index has a relevance to respiration rate, breathing pattern and unconscious behavior.

The second article by Hosseini et al. evaluates the robustness of a dynamic causal modeling toolbox to investigate brain connectivity in response to different tasks as well as auditory, visual, and somatosensory stimulation. The toolbox under analysis is the Statistical Parametric Mapping toolbox under the Matlab® framework, and includes functionality for use on EEG and fMRI. The authors compare analysis results of identical sets of EEG data in different versions of the toolbox, different versions of Matlab® and different operating systems, and carrying out a reproducibility study using various model structures.

The third article by Talaminos et al. designs and develops a computational model of the human cardiovascular system, aimed at the prediction, heartbeat by heartbeat, of some hemodynamic variables in different pathophysiological cardiac situations. The proposed structure is a pressure-volume model designed as a lumped-parameter fluid circuit with four compartments, and its parameters are personalized to simulate some surgical interventions such as the bidirectional Glenn shut, the systemic-to-pulmonary shunt and the Fontan procedure. The model is validated by comparing simulation results with hemodynamic data available in the literature, and places the approach as a complement and alternative to animal experimentation.

The next article by Vijaykumar et al. proposes novel strategies for the control of assistive exoskeleton in the context of six-degree of freedom (Dof) planar lower limb exoskeleton. The approach is aimed at the reduction of the effects of disturbances on the trajectories of planned rehabilitation exercises, including Cartesian position control and variable execution speed. The proposed methods are tested by using a realistic simulation model of the exoskeleton consisting of three revolute actuators, one Dof for each joint. The effect of disturbances on the particular joints are evaluated by comparing the resulting trajectories with respect to those planned, showing the differences between the proposed models.

The fifth article by Martins et al. presents the design and development of an intelligent system to detect sitting posture and provide its correction. The system is based on air bladders that can be conformed by inflation/ deflation. Both the seat pad and backrest are divided into a matrix of 2-by-2 pressures bladders, so that the solution is low-cost and commercially viable. In addition, up to eleven standardized postures can be detected. A neural network is designed to automatically detect user's posture. The proposed system includes two correction algorithms using a mobile application that executes the postural classification and correction in real-time.

Finally, the last article by Ödman et al. presents an experimental setup for the measurement of exercise performance in mammals. The authors review related works and focus their contribution in exercise wheels for mice and time markers for run exercise in humans. Both systems rely on wireless communications and share a common architecture based on a PC, a broadcast unit that controls the timing signals, and one or more measurement units. The proposed exercise wheel is validated against the ADEA system as a reference, and the activity measured by both systems in mice with different hormone dopamine levels is compared, showing a good correlation. In the validation with humans, runners are clocked by the system and manually, showing again a

good correlation with conventional methods. The proposed system is positively compared with other measurement setups in terms of cost-efficiency.

As guest editors we hope that given the heterogeneity of biomedical applications covered in this special issue, it will be of value for all readers. At the same time, we are grateful to the authors for their contributions to this issue and the reviewers for their help to improve the quality of the manuscripts. Special thanks are given to the Editor-in-Chief of the International Journal on Systems Dynamics Applications, Dr. Ahmad Taher Azar, Benha University, Egypt, for all his help and support to this special issue.

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