

GUEST EDITORIAL PREFACE

**Special Issue on Biomedical
Monitoring Technologies:
Selected Papers from the 12th IEEE
International Conference on Bioinformatics
and BioEngineering (BIBE 2012)
and the 8th International Symposium
on Advanced Topics in Electrical
Engineering (ATEE 2013), Part 2**

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INTRODUCTION

This is the second part of two special issues based on a selected number of papers presented at the 12th IEEE International Conference on BioInformatics and BioEngineering (BIBE 2012), Nov. 11-13, 2012, Cyprus (<http://bibe2012.cs.ucy.ac.cy/>) and the 8th International Symposium on Advanced Topics in Electrical Engineering (ATEE 2013), May 23-25, 2013, Romania (www.atee.upb.ro).

BIBE was organized and sponsored by IEEE, the IEEE Computer Society, the University of Cyprus and the Biological & AI Foundation (BAIF), co-organized and co-sponsored by the Frederick University, Cyprus, the Hellenic Society for Computational Biology and Bioinformatics (HSCBB), and the Technical University of Cyprus, Cyprus. BIBE 2012 was technically co-sponsored by the *IEEE Engineering in Medicine and Biology Society* (IEEE EMBS) and the International Federation for Medical and Biological Engineering (IFMBE). It was supported by the IEEE EMBS Cyprus Chapter, the IEEE CIS Cyprus Chapter, the IEEE Cyprus Section, the Cyprus Society of Medical Informatics, and the Cyprus Association of Medical Physics and Biomedical Engineering. Additional support was also given by the Cyprus Tourism Organization. The overall objective of BIBE 2012 was to cover the state of the art in Information Technology Applications in Biomedicine, under the theme. In total, 134 papers authored by 460 scientists were presented at BIBE 2012, with 31 papers on Bioinformatics, 86 on Bioengineering, and 17 on the special session on computational solutions to large-scale data management and analysis in translational and personalized medicine.

ATEE is a scientific event traditionally organized since 1996 and co-sponsored by the Faculty of Electrical Engineering, University POLITEHNICA of Bucharest, and it represents a forum for effective exchange of information between researchers in various areas of theoretical and applied electrical engineering. The 8th ATEE conference, held in 2013, was co-sponsored by several national organizations:

the Ministry of Education Youth and Sports, the ALUMNI ELTH Association, and the Association of Electrical and Electronics Engineers of Romania. ATEE 2013 was technically co-sponsored by IEEE, IEEE Romania Section, and by several IEEE Romanian Chapters: Engineering in Medicine and Biology, Electromagnetic Compatibility, Communications/Information Theory/Signal Processing, Power & Energy, Control Systems, Power Electronics, Magnetics. The conference also benefited from the technical co-sponsorship of the Romanian Academy of Technical Sciences, the University POLITEHNICA of Bucharest, and the National Society of Medical Engineering and Biological Technology. Additional support was also obtained from several companies working in the electrical engineering area: AMETEK, INSOFT, ELECTROALFA, SIMTECH, SCHRACK TECHNIK, TECHNOVOLT, EATON, and ICPE CA. From the total of 195 scientific papers presented at ATEE 2013, connected to 24 identified topics of applied research in electrical engineering, 20 papers were presented in the section of Engineering in Medicine and Biology.

The aim of this special issues of this newly launched journal is to provide a snapshot of emerging technologies in biomedical monitoring demonstrating how these can contribute to healthcare and quality of life. Authors were invited to submit papers expanding their work presented at the BIBE 2012 and ATEE 2013 conferences. Topics to be covered include: telemedicine and telemonitoring systems (5 papers in previous issue, Part 1), intelligent monitoring and decision making systems (4 papers, in this issue, Part 2), and medical image and video processing systems (2 papers in this issue, Part 2).

The structure of the preface is as follows. In the next section, a summary of the papers appearing in this special issue, IJMSTR 1(4), is given, with the papers grouped into thematic topics. The following section gives the concluding remarks.

PAPERS IN THIS SPECIAL ISSUE

Part 2: Intelligent Monitoring and Decision Making Systems

Nicolae, states that it is very important to have effective stimuli, when developing a motion synchronous Brain-Computer Interface. Her work proposes an improved brain computer interface stimulus system, based on event related spectral perturbation. In order to investigate the reaction of the motor cortex to stimuli, the influence of the human senses was investigated. Considering the limitations of human senses, the article proposes effective visual and auditory stimuli in two similar tasks, to gain accuracy and better reaction time (RT) for real movements in Brain-Computer Interface synchronous systems.

Tarata *et al.* investigate the effects of neuromuscular fatigue on work performance and safety. The paper provides a practical overview of several noninvasive methods of investigating neuromuscular fatigue (NMF), mainly via the surface electromyographic signal (SEMG), as essentially related to the muscle contraction and intimately mirroring muscle activation and contraction mechanisms. The purpose of this paper was to identify the most suitable non-invasively derived parameters for detecting and quantifying NMF, to be practically used in monitoring people exposed to high risks, such as fighter pilots. Wavelet Transform-based techniques (WT), as well as another original approach, together with the blood oxygen saturation were analyzed and discussed, based on results from preliminary experiments.

Morega *et al.*, propose a solution for magnetic drug targeting (MDT) therapy which is usually controlled through the magnetic field produced by a permanent magnet. The solution considers a planar spiral coil (PSC) or a system of such coils, as an equally effective magnetic field source. The PSC may be designed to provide proper configurations of the magnetic field gradients, required for the generation of high magnetic body forces and to limit, in the same time, unwanted side effects affecting adjacent

tissue (heating, excitable tissue stimulation). Simplified numerical models (2D projections) and more realistic structures (3D representations) are shown and analyzed in the paper and the electromagnetic and heat transfer problems are solved for different powering schemes applied to the coils.

Dobrescu and co-workers, propose an integrated system that ensures the radiation safety and security of the patients investigated by radiological imaging methods such as radiographies, computed tomographies or scintigraphies. Imaging methods such as radiographies, computed tomographies or scintigraphies expose the patients to a cumulative effective dose of radiation that could often exceed the maximum allowed dose. A three months medical study in a Romanian hospital showed, despite the great concern of radiation exposure, the skyrocketing volume of imaging investigations with radiation risk that lack monitoring and tracking the cumulative radiation doses of the patients. The system uses state of the art technologies such as smart cards, digital signature and Public Key Infrastructure. The proposed system provides a couple of secure services like electronic patient record of radiological investigations, assistance in prescription of future radiological investigations based on the patient history, different reports and statistics and even the control access of persons to areas with risk of radiation exposure based on information stored on their smart cards.

Part 2: Medical Image & Video Processing Systems

Mylonas and Damianou propose a prototype magnetic resonance imaging (MRI)-compatible positioning device that navigates a high intensity focused ultrasound (HIFU) transducer. The intended application is to treat eventually tumors in the abdominal and thyroid. The positioning device has 3 user-controlled stages that allow access to various targets using a top to bottom coupling approach. The positioning device incorporates only MRI compatible materials such as piezoelectric motors, ABS plastic,

brass screws, and brass rack and pinion. The MRI compatibility and the accuracy of the system were successfully demonstrated in an open MRI scanner. The robot has the ability to accurately move the transducer thus creating discrete and overlapping lesions in rabbit liver in vivo. This simple, cost effective positioning device can be placed mostly on the structure of an open MRI gantry. Due to the size of this positioning device, the proposed prototype in its current form cannot be used in any closed MRI system. The novelty of this positioning device is the MRI compatible design and its intended application which is the treatment of tumors in the abdominal area using focused ultrasound. This system can be utilized in the future to treat patients with cancer in the liver, kidney, pancreas and thyroid provided that the accuracy of the positioning device is greatly improved.

Loizou *et al.*, develop a video analysis software toolbox based on MATLAB® that uses video despeckling, texture analysis and image quality evaluation techniques to automate the pre-processing and complement the disease evaluation in ultrasound CCA videos. Ultrasound medical video has the potential in differentiating between normal and abnormal tissue and structure. Ultrasound imaging is used for border identification and texture characterization of the atherosclerotic carotid plaque in the common carotid artery (CCA), the identification and measurement of the intima-media thickness (IMT) and the lumen diameter that are very important in the assessment of cardiovascular disease. However, visual perception is reduced by speckle noise affecting the quality of ultrasound B-mode imaging. Noise reduction is therefore essential for increasing the visual quality or as a pre-processing step for further automated analysis, such as the video segmentation of the IMT and the atherosclerotic carotid plaque in ultrasound video sequences. The proposed software is based on a graphical user interface (GUI), incorporates video normalisation, four different despeckle filtering techniques (DsFlsmv, DsFhmedian,

DsFkuwahara and DsFsrاد), 65 texture features, 11 quantitative video quality metrics and objective video quality evaluation. The software was validated on 10 ultrasound videos of the CCA, by comparing its results with quantitative visual analysis performed by two medical experts. It is anticipated that the system could help the physician in the assessment of cardiovascular video analysis.

CONCLUDING REMARKS

Given the rapidly growing aging population, the increased burden of chronic diseases, the offering of innovative and demanding health-care services, and the ever increasing healthcare costs, there is a strong and urgent need for the development, implementation, and deployment in everyday medical practice of intelligent biomedical monitoring systems and services in support of the citizen. Towards this direction, in the last ten years, there has been a significant effort in the development of innovative biomedical monitoring sensors, devices, algorithms, and applications. The aim of these special issues is to provide a snapshot of biomedical monitoring technologies in telemedicine and telemonitoring systems, intelligent monitoring and decision making systems, and medical image and video processing systems. It is anticipated that technological advances in the aforementioned areas will support the further development of these systems for the offering of more advanced healthcare services that would also facilitate their deployment at a world-wide scale.

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