

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

*Christos P. Loizou, Department of Electrical Engineering, Cyprus University of Technology,
Limassol, Cyprus*

*Mihaela Morega, Faculty of Electrical Engineering, University "Politehnica" of Bucharest,
Bucharest, Romania*

*Efthymou C. Kyriakou, Department of Computer Science and Engineering, Frederick
University, Lemesos, Cyprus*

*Sever Pasca, Faculty of Electronics Telecommunications and Information Technology,
University "Politehnica" of Bucharest, Bucharest, Romania*

Styliani Petroudi, Department of Computer Science, University of Cyprus, Nicosia, Cyprus

*Panagiotis D. Bamidis, Lab of Medical Informatics, Medical School, Aristotle University of
Thessaloniki, Thessaloniki, Greece*

*Marios S. Pattichis, Department of Electrical and Computer Engineering, The University of
New Mexico, Albuquerque, NM, USA*

*Constantinos S. Pattichis, Department of Computer Science, University of Cyprus, Nicosia,
Cyprus*

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 (DsFIs_{mv}, DsFh_{median},

DsFkuwahara and DsF_{srad}), 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.

Christos P. Loizou
Mihaela Morega
Efthymoulos C. Kyriakou
Sever Pasca
Styliani Petroudi
Panagiotis D. Bamidis
Marios S. Pattichis
Constantinos S. Pattichis
Guest Editors
IJMSTR

Christos P. Loizou (SM'05) received the B.Sc. degree in electrical engineering and the Dipl.-Ing. (M.Sc.) degree in computer science and telecommunications from the University of Kaiserslautern, Kaiserslautern, Germany, in 1986 and 1990, respectively, and the Ph.D. degree on ultrasound image analysis of the carotid artery from the Department of Computer Science, Kingston University, London, U.K., in 2005. From 1996 to 2000, he was a Lecturer in the Department of Computer Science, Higher Technical Institute, Nicosia, Cyprus. Since 2000, he has been an Assistant Professor in the Department of Computer Science, Intercollege, Cyprus. He was a Supervisor of a number of Ph.D. and B.Sc. students in the area of computer image analysis and telemedicine. He is also an Associated Researcher at the Institute of Neurology and Genetics, Nicosia, Cyprus. He has authored or co-authored the book Despeckle Filtering Algorithms and Software for Ultrasound Imaging, fifteen chapters in books, 30 referred journals, and 55 conference papers in the fields of image and video analysis. His research interests include medical imaging and processing, motion and video analysis, signal and image processing, pattern recognition, biosignal analysis, in ultrasound, magnetic resonance, and optical coherence tomography imaging and computer applications in medicine. Dr. Loizou is a Senior Member of the Institution of Electrical Engineers, serves as a reviewer, in many IEEE Transaction journals and as a chair and co-chair, in many IEEE conferences.

Mihaela Morega (M'96) received the Dipl. Ing. and Doctoral degrees in Electrical Engineering, from the University POLITEHNICA of Bucharest in 1980 and 1988. Currently she holds a full time academic position as professor at the Faculty of Electrical Engineering from the University POLITEHNICA of Bucharest and collaborates with the Department of Biomedical Engineering and Biotechnology from the same university. She is currently engaged in promoting bioelectromagnetics as an educational and research topic in electrical engineering. Her research interests and expertise include computer aided modeling of electrophysiological phenomena, characterization of the electromagnetic environment, interactions of electromagnetic field with the living matter for applications in biomedical engineering, numerical dosimetry and the study of specific processes in the electro-thermal and electro-mechanical energy conversion. Mihaela Morega acted as section chair, member of the program committee and member of the scientific committee for several international conferences sponsored by IEEE. She is member of the IEEE EMC Society and founding member of the IEEE EMC Romanian Chapter.

Efthymoulos C. Kyriakou (StM'96, M'01) is currently an Associate Professor in the Department of Computer Science and Engineering of Frederick University, Cyprus. His research interests focus on ehealth systems, emergency telemedicine systems, medical imaging systems and intelligent systems applications in medicine. He has published 28 refereed journal, 84 conference papers, 19 invited book chapters and has one patent in these areas. He has been involved in numerous projects in these areas funded by EU, the National Research Foundation of Cyprus, the INTERREG and other bodies. He was Guest Co-Editor of 8 Special Issues including the more recent ones on Atherosclerotic Cardiovascular Health Informatics, and Citizen Centered e-Health Systems in a Global Health-care Environment, of the IEEE Trans. on Information Technology in Biomedicine. He is a co-editor of the book Ultrasound and Carotid Bifurcation Atherosclerosis, Springer, UK 2012. Moreover, he served as an Associate Editor of the IEEE Trans. on Information Technology in Biomedicine from 2007 to 2010, he serves as a reviewer in many journals related to his research fields. He was the Program Co-chair of ITAB 2009, BIBE 2012 and was in the program committee of many other scientific conferences. He is a Senior Member of the IEEE and currently is the chairman of the IEEE Cyprus Engineering in Medicine and Biology/ Signal Processing chapter.

Sever Viorel Paşca (M'02) was born in Baia Mare, Romania, on November 27, 1955. He received the Engineering degree and the Ph.D. degree in electronics and telecommunication from the "Politehnica" University of Bucharest (PUB), Bucharest, Romania, in 1980 and 1994, respectively. In 1982, he joined the Department of Medical Electronics and Informatics, Faculty of Electronics and Telecommunication, PUB, where he was an Assistant Professor, became an Associate Professor in 1997, and a Professor in 2004. He is currently a Professor and the Head of the Department of Applied Electronics and Information Technology, Faculty of Electronics and Telecommunication, PUB. He has published more than 100 scientific papers, and more than 25 books in the field of medical electronics and informatics. His current research interests include medical imaging, electrical stimulation, virtual instrumentation, data acquisition, ambient intelligence, and embedded systems. Prof. Paşca is Vice-Chair of the IEEE EMBS Romanian Chapter.

Styliani Petroudi received her B.Sc. in Electrical Engineering in 1998 with a Fulbright Scholarship from the University of Michigan, Ann Arbor, where she also received her M.Sc. in Electrical Engineering with a focus in Signals and Systems in 2000. Styliani continued her Ph.D. studies at the University of Oxford, with a Cancer Research U.K. fellowship, where she received the D. Phil. Degree in 2005. From 2005 to 2007 she was a Postdoctoral Research Associate at the Wolfson Medical Vision Lab, Department of Engineering, Oxford University, working on oncological image analysis. From 2007 she has been working at the University of Cyprus, as a Visiting Lecturer at the Department of Electrical and Computer Engineering, and then as a Research Fellow at the Department of Computer Science. Styliani's research interests lie in the areas of signal processing, medical image analysis with applications in oncological imaging, computer assisted minimally invasive surgery and artificial intelligence for the advancement of detection and diagnosis schemes that improve clinical outcomes.

Panagiotis Bamidis, Assist. Prof. of Medical Education Informatics, at the Dept. of Medicine, of the Aristotle University of Thessaloniki, Greece. Formerly, he has been the Senior Research Officer at the South East-European Research Centre. He has conducted research in the Weizmann Institute of Science (Israel), Research Centre Juelich (Germany), the University of Newcastle and the Open University (UK). He has chaired the organising or programme committees of 7 conferences, and organised more than 13 workshops within international conferences. He is a member of the Editorial Board of 2 journals, Guest Editor in 12 Special Issues, & reviewer in more than 15 Journals. Research interests are: technology enhanced learning in medical education, Affective Computing & HCI, Applied Neuroscience, Health Information Management; he has published over 150 papers in journals & proceedings. He has recently coordinated 2 large EC funded projects (mEducator/eContentPlus, LLM/CIP-PSP), and has been the Scientific coordinator for another 20 national and international grants. In 2009, he was awarded the Prize of the AUTH Research Committee for the Best Track Record in funded research projects among AUTH young academic staff. He has been the Chairman/Organiser of six international conferences (iSHIMR2001, iSHIMR2005, MEDICON2010, GASMA2010, SAN2011, MEI2012) and the Conference Producer of the Medical Education Informatics Conference and Spring School Series.

Marios S. Pattichis (M'99–SM'06) received the B.Sc. (high honors and special honors) degree in computer sciences and the B.A. (high honors) degree in mathematics, in 1991, the M.S. degree in electrical engineering, in 1993, and the Ph.D. in computer engineering, in 1998, all from the University of Texas at Austin, Austin. He is currently an Associate Professor in the Department of Electrical and Computer Engineering at the University of New Mexico (UNM). His research interests include digital image, and video processing and communications, dynamically reconfigurable computer architectures, and biomedical and space image processing applications. Dr. Pattichis is an Associate Editor of the IEEE Transactions on Image Processing and has served as an Associate Editor for the IEEE Transactions on Industrial Informatics, and a Guest Associate Editor for the IEEE Transactions on Information Technology in Biomedicine. He was the General Chair of the 2008 IEEE Southwest Symposium on image analysis and interpretation. He was a recipient of the 2004 Electrical and Computer Engineering Distinguished Teaching Award and the 2006 School of Engineering Harrison Faculty Recognition Award at UNM.

Constantinos S. Pattichis He is currently Professor with the Department of Computer Science of the University of Cyprus. His research interests include ehealth and mhealth, medical imaging, biosignal analysis, life sciences informatics, and intelligent systems. He has published 78 refereed journal and 186 conference papers, and 27 chapters in books in these areas. He is Co-Editor of the books M-Health: Emerging Mobile Health Systems, and of the Ultrasound and Carotid Bifurcation Atherosclerosis, published by Springer in 2006, and 2012 respectively. He was Guest Co-Editor of 11 journal Special Issues including the more recent ones on Atherosclerotic Cardiovascular Health Informatics, and Citizen Centered e-Health Systems in a Global Health-care Environment,, of the IEEE Trans. on Information Technology in Biomedicine. He was General Co-Chairman of the IEEE 12th International Conference on BioInformatics and BioEngineering (BIBE2012), and the IEEE Information Technology in Biomedicine (ITAB09). Moreover, he serves as Distinguished Lecturer of the IEEE EMBS, an Associate Editor of the IEEE Journal of Biomedical and Health Informatics, and on the Editorial Board of the Journal of Biomedical Signal Processing and Control. He is a Fellow of IET, and Senior Member of IEEE.