Editorial

Voicu Groza

School of Information Technology and Engineering (SITE),
University of Ottawa,
Ottawa, Ontario, Canada
E-mail: groza@site.uottawa.ca

Marco Parvis

Faculty of Engineering,
Polytechnic of Turin,
Turin, Italy
E-mail: marco.parvis@polito.it

Sergio Rapuano

Faculty of Engineering,
University of Sannio,
Benevento, Italy
E-mail: rapuano@unisannio.it

Biographical notes: Voicu Groza received his Dipl. Eng. Degree in Computer Engineering and his Dr. Eng. Degree in Electrical Engineering, both from the Polytechnic Institute of Timisoara, Romania. He was a Professor with the Polytechnic University of Timisoara, Romania and in 1997 he joined the University of Ottawa, Canada. His research interests include distributed intelligent instrumentation and reconfigurable computers; he is the author or co-author of more than 150 technical papers. He is a senior member of the *IEEE Instrumentation and Measurement Society* and he is serving as a chair of the *IEEE Working Group on Standardization of Blood Pressure Measurement*.

Marco Parvis received his MS Degree in Electrical Engineering and a PhD in Metrology both from the Politecnico di Torino, Italy. He is now Full Professor of Electronic Measurements at Politecnico di Torino, Dean of the Second Faculty of Engineering for the term 2008–2011 and fellow member of the IEEE Society on Instrumentation and Measurement where he is also chair of the TC 25 Medical Measurement. His main fields of interest are: intelligent instrumentation, application of signal processing to measurement, biomedical and chemical measurements. He is author of more than 100 publications.

Sergio Rapuano received the MS Degree with honours in Electronic Engineering and the PhD in Computer Science, Telecommunications and Applied Electromagnetism from the University of Salerno, Italy. Currently he is Assistant Professor of Electric and Electronic Measurement at the Faculty of Engineering of the University of Sannio. He is member of the IEEE Instrumentation and Measurement Society TC-10, TC-23 and TC-25.

His research interests include digital signal processing for measurement in telecommunications, ADC and DAC characterisation, distributed measurement systems, virtual laboratories, and medical measurement. In 2008 he received the Outstanding Young Engineer Award from the IEEE Instrumentation and Measurement Society.

This is the first volume of two for the special issue devoted to different aspects of the interaction between electronic measurement instrumentation and human healthcare. They contain 16 selected papers from the *3rd IEEE International Workshop on Medical Measurements and Applications*, which took place in May 2008 in Ottawa, Canada. The papers presented here are significantly extended beyond the scope of their MeMeA 2008 version, in terms of the overall technical content and research results.

The MeMeA workshops started in May 2006 in Benevento, Italy as a parallel event of the IEEE Instrumentation and Measurement Technical Conference. The second MeMeA workshop was held in Warsaw, Poland, in May 2007. The workshops deal with all aspects of interactions between the instrumentation and measurement field and the medical field. Measurement complexity in medical applications is continuously increasing and thesis that is supported by several examples that derive specific knowledge about the patient status from their vital parameters by processing measurement data acquired from various instruments.

The main themes of MeMeA 2008 included:

- 3D reconstruction of parts of human body models
- pattern recognition
- smart sensor systems for medical purposes
- automatic measurement systems for monitoring the training of impaired subjects
- calibration of automatic blood pressure measurement systems.

The first group that addresses human body modelling included three papers. In particular, the paper ‘Rapid impingement detection and surface distance measurement system for real-time ball-and-socket joint motion simulation’, by D. Cai, W-S. Lee, C. Joslin and P.E. Beaulé, focuses on 3D modelling of parts of human body for surgical aims. In particular, starting from computerised tomography data, the authors propose a computer-based system that is able to

- model the hip joint in real time
- measure the femur-acetabulum distance
- detect possible impingements by means of movement simulations.

The paper ‘MRI image enhancement by PROPELLER data fusion’, by K. Malczewski, presents a method for reconstructing a high-resolution Magnetic Resonance Image with a reduced amount of artefacts from several low resolution conventional ones by using Periodically Rotated Overlapping Parallel Lines with Enhanced Reconstruction (PROPELLER) sequences and a frequency domain high-resolution

reconstruction algorithm. The paper 'A 3D scanning system for biomedical purposes', by B.D. Bradley, A.D.C. Chan and M.J.D. Hayes, describes a method for the realisation of 3D models from anatomical parts by means of a simpler, more cost-effective scanning system.

In the second group of four papers, 'A Master-Slave Neural Network for precise recognition of the complicated hand operations based on EEG', by X.D. Zhang and H.R. Choi, proposes an innovative pattern recognition method, based on artificial neural networks, for the classification of complex hand operations starting from electroencephalography. In the paper 'Reduction of doubtful detection of micro-nucleus in human lymphocyte', D. Grimaldi and F. Lamonaca exploit several image processing and pattern recognition techniques to allow automatic detection of abnormal presence of multiple nuclei in human lymphocytes by means of a flow cytometer equipped with a camera. The paper 'Human–Computer interaction for smart environment applications using hand gestures and facial expressions', by Q. Chen, M.D. Cordea, E.M. Petriu, A.R. Varkonyi-Koczy and T.E. Whalen, presents a method for computer-based recognition of facial expressions and hand gestures, to enable non-verbal human–computer interaction for healthcare and smart environment applications. Finally, the paper, 'Beamformer-aided processing of EEG signals for analysing epileptic seizures', by A. Lay-Ekuakille, G. Vendramin and A. Trotta, proposed a very low noise analogue preprocessing of electroencephalographic signals for automatic detection of seizure signatures in epileptic subjects.

The four papers of the third theme present smart sensor systems for medical applications. The paper, 'Designing a wireless sensor system for continuous monitoring of the cervical dilation of a pregnant woman', by P. Verma, A.K. Ghosh, R.C. Huck, S. Cheng, S. Chen, M. Martens and A. Kaul, describes a novel electronic sensor system designed to continuously monitor the dilation of the cervix of a pregnant female. The system is capable of wirelessly transmitting the progress of dilation to a central monitoring agency using wireless telephony. In 'Health status and air quality parameters monitoring based on mobile technology and WPAN', O.A. Postolache, P.M.B. Silva Girão, P. Sinha, A. Anand and G. Postolache present a wireless personal area network including two measuring nodes that delivers information on physiological parameters of the patients under analysis, and provides information of indoor air temperature and relative humidity. Such data can be received by a smart phone device, thus enabling an easy continuous monitoring and fast intervention by physicians. E. Ghafar-Zadeh and M. Sawan, propose a CMOS-based platform for Lab-on-Chip (LoC) in their paper 'Towards fully integrated Lab-on-Chip: design, assembly and experimental results'. In particular, the authors present a low-complexity platform consisting of capacitive biosensor and microfluidic channel and valve for further integration in a complete LoC. Finally, in the paper 'New piezoelectric sensors with Gall Bladder stone material', by V.R. Singh and K. Singh, gall bladder stones are studied as base materials for piezoelectric sensors. The resistivity, the dielectric constant, the dissipation factor as well as charge and voltage constants of solid gall bladder stones are determined and discussed. Three types of sensors based on gall bladder stone material are presented as well.

Two papers in the fourth group deal with haptic motor rehabilitation. In particular, the paper 'A benchmarked automated progress measurement system for haptic motor rehabilitation', by R. Kayyali and S. Shirmohammadi, describes a haptic-based virtual rehabilitation system for motor rehabilitation of stroke patients suffering, especially after

surgery, from residual hand impairments. The authors present several exercises and a trial on several patients that show how the force and tactile feedback achieved by the proposed system can be effective for the upper extremity rehabilitation. The paper 'Haptic rehabilitation exercises performance evaluation using automated inference systems', by A. Barghout, A. Alamri, M. Eid and A. El Saddik, is focused on the same research topic proposing an automated inference system that is able to utilise haptic data to quantise the patient's performance, thus enabling a quantitative monitoring of the rehabilitation progress. The last paper of the group, 'Comparative analysis of tactile sensitivity between blind, deaf and unimpaired people', by I.L. Barbacena, A.C.O. Lima, A.T. Barros, R.C.S. Freire and J.R. Pereira, presents the methodological procedures and the results of an analysis of tactile sensitivity to vibrotactile stimuli, by using a self-developed stimulating system on normal and visually or hearing impaired people.

The last two papers deal with the problem of reproducibility and traceability of blood pressure measurement. In particular, the paper 'The possibility of standardising blood pressure measurement', by R. Leca and V. Groza, clearly presents the lack of the well-known and widely used Korotkoff method in measuring blood pressure in terms of reproducibility and traceability. As the Korotkoff method is considered the gold standard for calibrating automatic blood pressure measurement systems, the above-quoted limitations reflect the impossibility of comparing measures obtained by means of different instruments. Unfortunately, such scenario is confirmed from the current state of the art of the international standards in such field, as depicted in the paper 'Standard calibration procedures for automated non-invasive measurement of blood pressure', by E. Balestrieri and S. Rapuano.

Our hope is that papers aggregated in this special issue will provide the reader with a broad sampling of the engineers' most recent answers to the questions posed by the healthcare practice. We appreciate that the higher level of this journal owes in the first place to the authors' talent and their assiduous work. From the perspective of most of the authors, this volume represents a milestone in their research activity.

Finally, we express our special thanks and gratitude to all submitters and anonymous reviewers for their hard work leading to this special issue.