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Guest Editorial for Recent Advances in Medical, Biomedical, and Healthcare Measurements Special Section

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MEASUREMENT is fundamental to medical research and clinical practice. Physicians, clinicians, and medical laboratory scientists must not only be able to detect and diagnose health issues but also have confidence in the results reported by their instruments and measurement methods in order to make the correct decision for their patients. Reliability, accuracy, and efficiency of the implemented methods and devices are, therefore, the main concerns of researchers working in the field of medical measurements and applications.

Nowadays, recent advances in technology and instrumentation developments have resulted in less and less invasive approaches in clinical diagnosis as well as in the development of more and more adequate and efficient health treatments. Furthermore, the implementation of either reliable measuring and experimental approaches, as well as algorithms for signal processing and interferences removal allow significantly increasing the implementation of automatic methods for data analysis and classification.

This special section showcasing some of the most recent work in instrumentation and measurement in medicine, once again demonstrates the importance of feasible measuring setup and predictive methodologies for diagnostic applications, which allow successfully facing the challenging tasks aimed at obtaining ever greater accuracy and identifying minimal differences in the measured data. These studies can be also considered as the starting point for allowing early diagnosis, and implementing real-time tools and effective machine-learning approaches.

Outcome measures from trunk electromyography and the design and assessment of algorithms for the removal of cardiac interferences are the main topic of the study presented by Lin et al. [A1]. The new proposed algorithm whose performance has been evaluated both on synthetic data set and on real case studies, allows implementing the optimized approach in each cardiac cycle, enabling therefore possible real-time applications to be proposed such as prosthesis control.

The work carried out by Galli et al. [A2] is devoted to the characterization of a dictionary-based Gaussian approach for the decomposition of electrocardiogram traces, widely employed in medical practice. The novelty of this study is its different perspective, where metrological criteria are employed to create a common basis for the objective comparability of recorded ECG traces. Data-oriented large-scale medical analyses of ECG are made possible, allowing the investigation of elusive cardiac phenomena and personalized diagnostics. The proposed dictionary approach could be used to highlight useful evidence about the cardiac anomaly and is considered also as the starting point to implement effective machine learning approaches for ECG diagnosis.

Deep learning for the analysis and detection of epileptic seizures is the final aim of the study presented by Shankar et al. [A3]. Being a data-driven technique, deep learning requires proper input data. The paper discusses the use of the Markov transition field transformation technique for the 2-D image construction in order to provide trustable and accurate data and increase the efficiency of the automatic classification of the electroencephalogram signals. The quality of the 2-D image along with appropriate brain rhythms has been investigated together with the use of a convolution neural network (CNN) for the classification.

Cavalcanti and Santos [A4] presented a new solution for the measurement of the peak kilovoltage of X-ray tubes used for radiodiagnosis. The proposed MOSFET-based measuring method takes advantage of the buildup cap effect of the MOSFET device to obtain a signal gain and achieve lower measurement uncertainty. Peak kilovoltage can affect radiograph image quality, so developing a sensor for this parameter can reduce the radiation dose to the patient, by reducing the necessity to repeat the examination.

Eventually, Musa et al. [A5] discussed a reliable and accurate method for clinical assessment of wounds, which can help clinicians to evaluate the injury and the effectiveness of the treatments. The authors developed a software prototype able to calculate 3-D wound measurements from 3-D scans. Reducing the variability of wound measurements may improve patient outcomes, reduce the injury's prevalence, and mitigate the associated morbidity, mortality, and costs of these occurrences.

We are really honored of being invited to serve as guest editors for this special section. We are grateful to the Editorial board, all authors, and reviewers, whose work made this special section published.

Hope you will enjoy it!

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APPENDIX: RELATED ARTICLES

[A1] R. Lin, Y. Wu, Z. Du, K. Wang, Y. Yao, and L. Xu, "Toward online removal of cardiac interference from trunk electromyography by morphological modeling of the electrocardiography," *IEEE Open J. Instrum. Meas.*, vol. 1, pp. 1–9, 2022.

[A2] A. Galli, G. Giorgi, and C. Narduzzi, "Standardized Gaussian dictionary for ECG analysis a metrological approach," *IEEE Open J. Instrum. Meas.*, vol. 1, pp. 1–9, 2022.

[A3] A. Shankar, S. Dandapat, and S. Barma, "Discrimination of types of seizure using brain rhythms based on Markov transition field and deep learning," *IEEE Open J. Instrum. Meas.*, vol. 1, pp. 1–8, 2022.

[A4] F. A. Cavalcanti and L. A. P. Santos, "A MOSFET-based method for measuring peak kilovoltage (kVp) in diagnostic X-ray beams," *IEEE Open J. Instrum. Meas.*, vol. 1, pp. 1–7, 2022.

[A5] D. Musa, F. Guido-Sanz, M. Anderson, and S. Daher, "Reliability of wound measurement methods," *IEEE Open J. Instrum. Meas.*, vol. 1, pp. 1–9, 2022.

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SABRINA GRASSINI (Senior Member, IEEE) received the M.S. degree in chemistry from the University of Turin, Turin, Italy, in 1999, and the Ph.D. degree in metallurgical engineering from the Politecnico di Torino, Turin, in 2004.

She is an Associate Professor of Applied Physical Chemistry (ING-IND/23) with the Department of Applied Science and Technology, Politecnico di Torino. Her research activities, which led to the publication of more than 200 papers on national and international journals and in the proceedings of international conferences, are in the fields of chemical/physical fundamentals of plasma processes, corrosion and biomaterials, and sensors and biomedical measurements.

Dr. Grassini is an Associate Editor of the IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT. She is the Secretary of the IEEE TC-25 on Medical and Biomedical Measurements, and the Chair of the TC-17 on Materials in Measurements of the IEEE Instrumentation and Measurement Society. She is a member of the AdCOM of the IEEE Instrumentation and Measurement Society in 2020–2023, and she has been a member of the Steering Committee of the IEEE International Symposium on Medical Measurement and Applications since 2013.



MARCO PARVIS was born in Italy in 1958. He received the M.S. degree (*cum laude*) in electrical engineering and the Ph.D. (Italian Doctorate) degree in metrology from the Politecnico di Torino, Turin, Italy, in 1982 and 1987, respectively.

He is currently a Full Professor of Electronic Measurements with the Department of Electronics and Telecommunications, Politecnico di Torino, where he served also as the Deputy Head of the Electronic, Telecommunication, and Physics Council. He has been the Dean of the Second Faculty of Engineering till its deactivation due to a new Italian law. At present in cooperation with the Department of Material Science and Chemical Engineering, he is working on new sensors for mechanical and physical quantities, based on surface modification by plasma sputtering. He is the author of more than 200 publications. His main fields of interest are intelligent instrumentation, application of signal processing to measurement, biomedical, and chemical measurements.

Prof. Parvis was an IEEE Officer as the VP Member Services of the IEEE System Council from 2017 to 2019. In 2020, he became the VP on TSAC of the Instrumentation and Measurement Society. He is the Founder of Medical Measurements and Application Symposium, an IEEE annual symposium started in 2006 which now collects more than 100 papers. He has been appointed as the General Chair for the 2017 edition of the Instrumentation and Measurement Technology Conference which has been in Turin with more than 350 accepted papers. He is a Fellow Member of the IEEE Society on Instrumentation and Measurement. In the same society, he was the Chair of the TC 25 on Biological and Medical Measurement.