Guest Editorial Special Section on IEEE MeMeA 2019 Metrological Point of View in Medical Measurements

SINCE the first workshop held in Italy in 2006, the IEEE International Symposium on Medical Measurements and Application has grown constantly, year after year reaching its 14th edition, which was held in Istanbul, Turkey, on June 26–28, 2019. For the first time, researchers working in the field of medical measurements, from academia and industry, met at the interaction of the two continents, Europe and Asia, in a magnificent city so rich of historical elements. This was another excellent opportunity in the Symposium's history to spread worldwide the exchange of knowledge, experience, and advances in research on instrumentation and measurements in medicine and healthcare.

The MeMeA 2019 theme, "*Metrological point of view in medical measurements*," wanted to highlight the importance of metrology and the crucial role of proper measurements in the medical, biomedical, and healthcare fields, because they form the basis of medical diagnosis, prognosis, and evaluation in medical research and clinical practice. The importance for physicians and clinical scientists to know such aspects and to have confidence in the quantitative measurement results and in the performance of medical devices to take correct decisions for the patients was one of the main themes of discussion during the event.

The MeMeA 2019 Technical Program allocated more than 120 high-quality peer-reviewed articles presented by more than 585 authors from academia, industry, and NGO institutions, coming from 26 countries in Europe, Asia, Africa, and America. Moreover, special sessions promoting the exchange of ideas and connecting researchers with different backgrounds on a specific topic, such as metrology and medical device calibration, wearable monitoring systems, measurement systems and sensors for diagnosis and therapeutic procedures, and IoT devices in health parameters monitoring, were successfully organized. Eventually, two tutorial sessions on Ultrasensitive Memristive Biosensors and Imaging Systems and Effectiveness of Physiological Imaging Systems in Early Diagnostic Process were held attracting a wide audience of scientists, Ph.D. students, and young researchers. Dealing with as many articles would not have been possible without the help and the cooperation of authors, professional reviewers, and organizers of the local committee, who we especially would like to thank.

As announced during the Symposium, authors of the manuscripts accepted for the publication in the MeMeA 2019 Proceedings were invited to consider the possibility to extend their work and to submit their manuscript to this Special Issue, which intends to promote the best results presented at the symposium from the perspective of Instrumentation and Measurement. As a consequence, a collection of 16 manuscripts were submitted for review to the IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT.

After careful peer review, four manuscripts were eventually accepted for publication, confirming the increased attention of the I&M community toward topics, such as metrology in medical fields, monitoring systems and sensors for healthcare, and also the need for solution aimed to simplify the interaction between the measurement world and the medicine area. More submissions would be desirable for the next future, and this is still another challenge that the MeMeA Steering Committee aims to achieve, opening a new era for medical measurement.

The article "Estimation of Lung Properties from the Forced Expiration Data" Polak *et al.* studied a new approach in spirometry for lung function tests with the final goal of improving its accuracy and clinical significance. The approach is focused on the parameterization of distribution of specific airway properties along the bronchial tree and the advanced sensitivity analysis by combining an inverse neural network (InvNN) that is used as a global estimator with the local Levenberg–Marquardt estimation method. The authors improved it by considering other methods of global estimation and better tuning the inherit parameters, translating the estimation results into clinically relevant quantities. As a matter of fact, the possibility of having a noninvasive insight into the airway and lung mechanics could be a real challenge.

The article "Physiological Motion Artifacts in Capacitive ECG: Ballistocardiographic Impedance Distortions" by Uguz *et al*. presented a ballistocardiographic impedance sensor for measuring the time-variant coupling capacitance of the body–electrode interface in capacitive electrocardiogram (cECG) and investigating the effect of mechanical vibrations. In this article, the source the disturbances in the capacitive ECG has been successfully explored. The article provided a significant improvement with respect to the present state of the art in ballistocardiographic approaches. The correlation between the physiological motion artifacts and the cardiac signals and the assessment of how significant they are can lead in the next future to better unobtrusive monitoring.

The article "Unobtrusive Screening of Central Sleep Apnea from Pressure Sensors Measurements: A Patient-Specific

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Longitudinal Study" by Azimi *et al.* presented an unobstructive, patient personalized system for home monitoring that is able to detect sleep apnea events and monitoring sleep characteristics, such as bed occupancy, day clock, and night clock. The system could also allow tracking the impact of longitudinal sleep monitoring and providing information on the interaction between sleep apnea and other disease progressions. A point of strength points for the proposed solution is its capability to operate in conditions that are very close to real life and allow long-term monitoring.

Eventually, the article "High Sensitive and Selective Mini-Sensor for Acetone Monitoring" by Lombardo *et al.* presented a high-sensitive sensor to detect low concentrations of acetone in breath

Acetone is regularly produced by the human body and is present in the expired breath with the concentration below 1 ppm. In the presence of diabetes, the concentration increases to more than 1 ppm and this makes its measurement interesting as a biomarker in the medical diagnosis of diabetes. The sensors are based on a sensitive niobium-oxide nanometric thin film deposited by plasma sputtering, and it is able to detect ppm concentrations of acetone with high reproducibility, without individual sensor calibration.

We would like to thank all authors who extended and submitted their articles to this Special Section, as well as all reviewers whose time and effort made possible the publication of this Special Section. Finally, we would like to sincerely thank the IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT staff and Prof. Shervin Shirmohammadi, Editor-in-Chief, for their precious support and invaluable services for the publication of this Special Issue.

We hope that the content of this Special Issue can catch the interest of magazine readers, not only those involved in measurements and instrumentation but also scientists and physicians.

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Dr. Grassini has been a member of the IEEE Instrumentation and Measurement Society since 2013, the Steering Committee of the IEEE International Symposium on Medical Measurement and Applications (MeMeA) since 2013, and the IEEE TC-25 on Medical and Biomedical Measurements and TC-17 on Materials in Measurements. She was a Technical Program Chair of the IEEE MeMeA in 2014, and the General Chair of the IEEE MeMeA in 2015 and the International Instrumentation and Measurement Technology Conference in 2017 (I2MTC 2017). She was an Associate TPC Chair for the track "Measurement for Food Safety" of the I2MTC 2018. She was a Guest Editor of the MeMeA Special Issues of the IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT for the 2014, 2015, 2017, and 2018 symposium editions. She has been an Associate Editor of the IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT since 2018.

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