



# Introductory notes for the Acta IMEKO Special Issue on the “23<sup>rd</sup> Symposium on Measurement of Electrical Quantities” and “International Workshop on Metrology for Agriculture and Forestry - 2019”

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## 1. INTRODUCTORY NOTES ON THE “23<sup>RD</sup> SYMPOSIUM ON MEASUREMENT OF ELECTRICAL QUANTITIES”

Distinguished Readers, this current number of Acta IMEKO is mainly connected with the 23<sup>rd</sup> Symposium on Measurement of Electrical Quantities which has been held in the city of Xi’an, People’s Republic of China on September 2019. One of the IMEKO most active technical committee (TC) is the no. 4, established since 1984, being mainly dedicated to the measurement of electrical quantities. The central objective of this scientific event was to present the latest achievements in the field of electrical measurements and to stimulate information exchanges on current researches. At the end after the review process the target of 17 papers with valuable content and elegant form imposed by our magazine have been successfully reached. Of these papers, 8 have been selected for this issue of Acta IMEKO, while the other 9 will be included in our very next release. We hope that each reader of this issue will find interesting and useful information, with a high degree of applicability.

In the paper submitted by Pavol Dolinský et al, “The ECG signal model based on the parametric description of the characteristic waves” there is developed a research focused on new ECG signal modelling based on geometrical properties of the signal. Instead of artificial functions used in common ECG models, the proposed model is based on the modelling of real ECG signal divided into time segments, each segment being modelled by simple geometrical forms. The final ECG signal model is represented by the sequence of parameters of the base

functions. Parameter variation allows generation of different waveforms for each subsequent heartbeat without mixing PQRST waves order that allows representing the irregularities of the consecutive heartbeats.

The paper presented by Andrea Mariscotti et al “Experimental Characterization of Pantograph Arcs and Transient Conducted Phenomena in DC Railways” is centred on the depiction of this transient event quite common in electrified transportation systems. It is discussed the wide range of responses related to the substation and on-board filters and line resonances and antiresonances. There are analyses of the electrical characteristics of these transients and of the excited responses to define their typical spectral signatures in DC railways.

In the assessment performed by Oleh Velychko et al, “Evaluation of results of RMO comparisons and inter-laboratory comparisons for electrical quantities” there are approached elements of the global metrological traceability from the perspective of the implementation of international mutual recognition agreements in the field of metrology. The linked results of international comparisons of national standards for the AC/DC voltage transfer difference measurements and electric power measurements and national inter-laboratory comparison AC/DC voltage transfer difference and electric power measurements at industrial frequency have been detailed and evaluated.

“Uncertainty of the Energy Measurement Function deriving from Distortion Power Terms for a 16.7 Hz Railway” is a different but even complementary paper also presented by Andrea Mariscotti. The paper is an implementation of the EN

50463-2 Energy Measurement Function, including the criteria for the significance of the measured and calculated terms and carries out a Monte Carlo analysis to assess the impact of harmonic power terms on the measured energy and its uncertainty.

The following submission, "A Data-Based Approach for Smart Meter Online Calibration", by Fangxing Liu et al. starts from the assertion that the smart meter should be considered as the key element of the smart grid. Current smart meter verification method mainly focuses on in situ and laboratory detection and fails to test all the setup meters. The authors insist on the advantages of the "online calibration" as a novel approach which calculates meter errors by analysing meter reading data. By presenting a comprehensive survey and basic model of smart meter online calibration, this paper proposes a recursive algorithm for estimating the meter accuracy.

An Internet of Things (IoT) prototype which consists of a data acquisition device wirelessly connected to Internet via Wi-Fi is detailed in the paper "A Wi-Fi IoT prototype for ECG monitoring exploiting a novel Compressed Sensing method" developed by Eulalia Balestrieri et al. The proposed system performs a novel Compressed Sensing (CS) based method on ECG signal with the aim of reducing the amount of transmitted data, thus realizing an efficient way to increase the battery life of such devices. The evaluation of the reconstruction quality of the ECG signal in terms of Percentage of Root-mean-squared Difference (*PRD*) is reported for several Compression Ratios (*CRs*).

An overview of the recent research work dealing with the DAC testing is been detailed in the paper "Research trends and challenges on DAC testing" submitted by Eulalia Balestrieri et al. There are highlighted the trends and issues, also being provided useful information for the revision of the standard IEEE Std. 1658. Main testing challenges the DACs include the reduction of the test time and cost, the measurement uncertainty computation and facing with the emerging Built-In Self-Test (BIST) solutions.

"A review of accurate phase measurement methods and instruments for sinewave signals" is performed for us by Eulalia Balestrieri et al. The phase measurement of sine-wave signals is important for several applications such as electric and electronic instrumentations, telecommunications and optical interferometry. The paper presents an overview of some high accurate phase measurement methods and instruments to highlight the characteristics in terms of measurement uncertainty of the main used ones, by taking into account a varying operative frequency range.

It was a great honour for me to act as Guest Editor for this issue of ACTA IMEKO. I would like to express a special appreciation for our current Editor in Chief Dušan Agrež, who continues to the same high standards of competence and exigency, the tradition with which we have been already accustomed by his predecessors, Paul Regtien and Paolo Carbone.

Alexandru Salceanu  
Guest Editor

## 2. INTRODUCTORY NOTES ON THE INTERNATIONAL WORKSHOP ON 'METROLOGY FOR AGRICULTURE AND FORESTRY' 2019

Distinguished Readers, the here finalized issue of Acta IMEKO includes a first selection of scientific contributions that have been presented at the IEEE International Workshop on Metrology for Agriculture and Forestry held in Portici, Naples on October 2019. As for the previous edition, the Workshop was organized with the intent of creating an active and stimulating forum where academics, researchers and industry experts in the field of measurement and data processing techniques for Agriculture, Forestry and Food could meet and share new advances and research results. As guest editors of this issue, we selected out of the 69 presented papers from several countries, the papers that appeared most suitable with the profile of Acta IMEKO journal. A couple of papers has been considered to be included in this Acta IMEKO issue. We would like to highlight, anyhow, that other contributions presented to the Workshop and elected for technically extended versions are still under review for the future issues.

The first paper included in the Special Section presents machine learning techniques aimed at measuring the soil moisture. The methodological approach exploits the meteorological data as inputs and compares the performance granted by three different machine learning techniques, all relying on artificial neural networks (ANNs). This is an exploratory work containing interesting proposals: the presented approach, in fact, uses free-access data that grant worldwide coverage, and seems to allow a realistic prediction of the soil moisture value, which can be useful for irrigation scheduling. The work addresses methods which deserve great attention by the measurement community since, due to the intervention of machine learning techniques, they are disrupting for the classical physical-model based measurement practice by suggesting a rethinking to some extents to the very concept of prediction induced by measurement results.

The second paper selected contains detailed technical notes related to a "rugged" intelligent support system for precision farming, named EVJA. Precision agriculture and livestock farming systems represent milestones in the contemporary innovation process. They are based on the exploitation of suitable technologies that help the implementation of data measurement and subsequent processing paradigms. The goals of these paradigms are the support to immediate decisions capable of assuring increased production, lowered consumption, and reduced environmental impact. In particular the work is focused on the crop production and highlights the details related to the decision support and predictive capabilities of the EVJA system. The decision support module represents the core part of the processing stage of the system and is introduced as a viable diagnostic system to assess the health of plants. Also, the interfacing feasibility of the system that makes data and analytics easily available to the farmer is described.

Finally, we would like to show our gratification for having contributed to this issue of Acta IMEKO journal as Guest Editors. We hope the readers could be inspired by the themes and proposals that have been elected and included in this Special Section related to innovations in metrology for agriculture and forestry.

Mauro D'Arco, Oscar Tamburis  
Guest Editors