



# Introductory notes for the Acta IMEKO Special Issue on the 23<sup>rd</sup> IMEKO TC4 International Symposium “Electrical and Electronic Measurements promote Industry 4.0” – Part II

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## Introductory notes on the “23<sup>rd</sup> Symposium on Measurement of Electrical Quantities” – Part II

Measurement is one of the oldest human activities and one which is the essential tool and need of any science, engineering projects or of industrial production. The ongoing revolution in industry known as Industry 4.0 means transformation of traditional manufacturing practises to new, more effective with high quality of production based on the latest smart technology such as Internet of Thing and machine to machine communication. This transformation has not been possible without new measuring and test methods and instrumentation together with improved metrology and standardisation. Nowadays nearly all data acquisition systems focused on any physical quantity convert the sensed quantity to an electrical quantity process in industrial systems using the sophistic digital signal processing. This is the reason why the measurement of electrical quantities including AD and DA conversion and signal processing methods have been continually in the scope of scientists, researchers and engineers over all the world.

The 23<sup>rd</sup> Symposium on Measurement of Electrical Quantities offered a chance to present the newest ideas and results of research to scientists in the field from all the world. The symposium was held in September 2019 in amazing historical town Xi'an, China. The famous Silk Road, which began in the town Xi'an was the ancient route linking the East and West, China and Europe allowing not only trade and exchange of goods, but it was a mean for exchange of knowledge and experiences. Therefore, the IMEKO TC-4 symposium in Xi'an was a symbolic continuation of this history. The symposium addressed the work of a wide forum of experts across academia as well as industry and gave to the attenders an opportunity for

presenting their latest research. IMEKO TC4 is one of IMEKO technical comities, which task and goal is to create an international platform for experts in the field of measurement of electrical quantities, emphasizing both theoretical and practical aspects of research in the field. The country members of IMEKO which have current representatives in the TC4 board are: Belgium, Brazil, Bulgaria, Canada, Croatia, Czech Republic, Egypt, Estonia, Finland, France, Germany, Greece, Hungary, China, Italy, Poland, Portugal, Republic of Korea, Romania, Russia, Serbia, Slovakia, Slovenia, Spain, Switzerland, Turkey, Ukraine, United Kingdom. Any new country is cordially welcome to join IMEKO TC4 activities.

Many papers dedicated to a range of problems and questions related to the measurement of electrical quantities which is under scope of IMEKO TC-4 Technical committee were submitted to the symposium, and a number were accepted for the symposium and workshop. As it was mentioned in the previous issue of Acta IMEKO v9.2, the member of IMEKO TC-4 board identified nineteen the most valuable papers and their authors were invited to write extended and updated version of their papers to be submitted for refereeing. By the end some seventeen papers were accepted. The first seven papers were published in the previous issue of Acta IMEKO and the resting nine are being chosen for this issue.

Metrological aspects of measurements are closely bound with uncertainty analysis and improvement of measurement accuracy and precision as it is required for Industry 4.0. The new definition of kilogram based on the fixed value of Planck constant leads also to the improvement of reference standards in national metrological institutes, what is not possible without new electronic apparatus. Haci Ahmedov et al. present the new definition realized in National Metrology Institute in Turkey via Oscillating-Magnet Kibble Balance. The procedure is less sensitive to environmental disturbances using Michelson or

Fabry-Perot interferometer to precisely determine the displacement.

Daniel Belega et al. deal by the influence of disturbing signal component in the form of a small amplitude interharmonic component to the sine-wave parameters estimation returned by the classical interpolated discrete Fourier transform algorithm. The derived expressions allow to analyse the impact of an interharmonic on the accuracies of frequency, amplitude, and phase estimators using the classical interpolated discrete Fourier transform algorithm.

The microwave material characterisation is in the centre of scope also of paper presented by Andrea Alimenti et al. The authors deal with a convenient measurement method for the complex permittivity evaluation based on a dielectric loaded resonator. The method was evaluated for 3D-printer materials that becoming increasingly more appealing also for high frequency applications.

Paper of Haci Ahmedov et al. is dedicated to the Kibble balance apparatus as effective primary realisation for the new definition of kilogram. Balance apparatus operating at National Metrology Institute of Turkey is designed with a stationary coil and an oscillating magnet. This paper describes method and model based on external magnetic flux measurements to consider the effect of the field on realisation of kilogram.

Kibble balance implemented in the form of table-top version Planck-Balance is in the scope of paper presented by Shan Lin et al. Authors analysed influence of different perturbations such as additive Gaussian noise, time jitter etc. on amplitude accuracy estimation of a sinusoidal moving coil. The amplitude is calculated by three parameter fitting method. By optimizing measurement and data processing approach, the bias and standard deviation of the estimated amplitude can be effectively reduced.

Results of uncertainty investigation in the microwave field are presented by Kostiantyn Torokhtii et al., where they extended the analysis of the effect of the uncalibrated microwave measurements for material characterisation to have a more complete generalized picture of the resonant parameters. A key objective of the study is the determination of the uncertainty to be associated to the quality factor and resonant frequency for measurements where no calibration could be performed.

Influence of electromagnetic field on human being and its biological and health effects are becoming very important for human mankind with growing of EM sources in our living environment. Marius Valerian Paulet et al. performed a study of the relative position relevance of human torso to the plane of various overhead high voltage power lines towers. The simulations were performed for a few relative positions of the human trunk with respect to the plane of the transmission towers and for two common types of symmetric, doubled three-phase networks. The obtained results allow to formulate recommendations on the reduction of human exposure to magnetic fields.

The biological and health effect of electromagnetic field is also in scope of the paper by Ovidiu Bejenaru et al. The authors studied influence of far field effects for the human body inside the building in an empty room.

The paper presented by Jakub Svatos et al. describes a long-term measurement system for diagnostics of modern woodhouse, which is one of nowadays trends for our green sustainable future. The system allows acquiring all important parameters for evaluation building materials and construction of houses.

The papers chosen for this special issue of Acta IMEKO cover wide range of topics bound with measurement of electric quantities and I as the guest editor hope that each reader of this issue will find interesting and useful information in the papers. Finally, I would like to thank all authors for their cooperation and improvements of the papers, the reviewers for highly professional reviews, notes and recommendations to the authors, and also to the editors of Acta IMEKO Dušan Agrež and Dirk Röske for their help and valuable advices.

Ján Šaliga  
Guest Editor

## Editorial to additional papers

Dear Reader, two additional papers are closing this third issue of Acta IMEKO in 2020.

The paper presented by Giorgia Bucci et al. is the last selected paper from the IEEE International Workshop on Metrology for Agriculture and Forestry held in Portici, Naples on October 2019. It presents the topic of Precision agriculture (PA), which offers the opportunity for farmers to improve both efficiency in managing resources and optimisation of process inputs, thus increasing their whole farm's profitability. The economic aspect is undoubtedly one of the most important aspects to consider before adopting PATs (PA technologies). In most of the cases, farmers are reluctant to introduce precision farming systems since the costs and uncertainty about the profitability and advantages need to be addressed. This study aims to explore how PATs could affect the profitability of a representative Italian farm specialising in the production of cereals, making this a case study. In detail, an economic analysis was applied to determine the profitability of the farm, which showed that the adoption of PAT's increased the yield of durum and soft wheat and significantly reduced the cost of mechanical operations and technical means. Therefore, the potential gains from the adoption of PATs challenges policymakers to design targeted interventions which could encourage their uptake.

The Philippine Industrial Technology Development Institute (ITDI) pioneered the development of reference materials (RMs) as part of its vision to establish metrological traceability and to support the RM needs of chemical testing laboratories in the country. Food safety of Philippine products were prioritised in this activity as these could affect the health of consumers as well as trade issues. The focus of this study presented by Benilda Ebarvia et al. was on contaminants like histamine and benzoic acid in canned tuna and mango juice, respectively. The materials were prepared and characterised, and they were found to be homogeneous and stable for at least six months. Higher order methods like the isotope dilution technique, coupled with liquid chromatography–triple quadrupole mass spectrometry, were used to assign reference values to the RMs, and the results were cross-checked using gravimetric techniques for high-performance liquid chromatography analysis. These steps resulted in RMs for histamine and benzoic acid in Philippine products, and ITDI disseminated the measurement traceability to local laboratories through proficiency testing schemes organised and conducted for the analyses.

On behalf of the Editorial Board I sincerely hope that you will enjoy the scientific content of this Acta IMEKO issue.

Dušan Agrež,  
Editor-in-Chief of Acta IMEKO