



# Introductory notes for the Acta IMEKO Special Issue on the “19<sup>th</sup> Symposium on Measurement of Electrical Quantities” and the “17<sup>th</sup> Workshop on ADC/DAC Modelling and Testing”

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## 1. INTRODUCTION

The first issue of Volume 4 of Acta IMEKO is in your hands. This issue is centered on the 19th Symposium on Measurement of Electrical Quantities and 17th Workshop on ADC/DAC Modelling and Testing which were held in the city of Barcelona on July 2013. The main goals of these time-honored scientific events were to show the latest investigations and exchange of information and points of view on current research in the development and use of electrical and electronic instruments for measuring, monitoring and recording electrical signals. As a novelty, the 19th IMEKO TC4 expands the topics covered in previous editions in order to address issues related to marine technologies and applications.

Since August till November 2013, the members of the IMEKO TC4 Board identified 24 valuable contributions presented in the Barcelona events, for eventual publication in ACTA IMEKO. Their authors were invited, in December 2013 to submit extended and updated versions of their selected papers. All of the authors that gave positive responses to this challenge started sending their extended papers into the ACTA IMEKO online submission system in early 2014. A significant number of representative reviewers proceeded in successive stages, their task of assessing the papers and submitting their recommendations. The final list of 17 published papers in this issue is a high-quality exhibition of the first-class papers submitted to our

Symposium. All the reviewers involved in the process gave their support aiming to further improve the shape and the intrinsic content of the papers and their work.

We sincerely hope that all the contributions that you will find in the next pages provide you information of your interest.

## 2. ABOUT TC4

The essential interest and activity of the IMEKO TC4 (Measurement of Electrical Quantities) is the development of theoretical and practical research in the topics of electrical and electronic measurements. This Technical Committee organizes in every year, since its establishment in 1984, specific Symposia and workshops. The continuous increase of general relevance and inclusion in everyday life of the electrical and electronic instruments for measuring, monitoring and recording electrical signals has significantly enhanced our activities and enlarged our addressability.

The current members of TC4 are:

Janusz Mindykowski, Chairperson - Poland  
Dominique Dallet, Deputy Chairperson - France  
Pedro M. Ramos, Scientific Secretary - Portugal  
Linus Michaeli, Past Chairperson - Slovak Republic  
Miloš Sedlacek, Past Chairperson - Czech Republic  
Pasquale Daponte, Past Chairperson - Italy  
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Istvan Kollar - Hungary  
Turgay Özkan - Turkey  
Umberto Pogliano - Italy  
Gelson Rocha - Brazil  
Alexandru Salceanu - Romania  
Jan Saliga - Slovak Republic  
Sergey G. Semenchinsky - Russia  
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Vladimir Vujicic - Serbia  
Olfa Kanoun - Germany  
Dušan Agrež - Slovenia  
Victor I. Didenko - Russia  
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Leo van Biesen - Belgium  
Mihai Cretu - Romania  
Christian Eugène - Belgium  
Sohair Fakhry - Egypt  
Vladimir Haasz - Czech Republic  
Jouko Halttunen - Finland  
Peter Händel - Sweden  
Damir Ilic - Croatia  
Voicu Groza - Canada  
Jae Kap Jung – Republic of Korea  
Eleferios Kayafas - Greece  
Wang Xiaofei - China  
He Qing - China

### 3. THE ARTICLES

In the paper by Asensio et al (p. 5), the authors, improved a traditional approach, by using a microphone array linked to a noise-monitoring unit, aiming to enable the tracking of the direction of arrival of the sound, thus getting better the classification rates. Another advantage is to track the aircraft location along the runway, wanting to transform the sound pressure measurements into sound power level estimations. This novel instrument delivered results with quite good classification rates.

The behavior of systems that are prone to noise is investigated in the paper by Angrisani et al (p. 11), mainly from the perspective of the noise sources available on the market, with focus on the generators of colored noise. The authors propose an analog generator that exploits an arbitrary waveform generator as noise source, being capable of producing noise signals characterized by arbitrary power spectral densities.

The implementation and characterization of a data acquisition (DAQ) system controlled by a 450 MHz SHARC digital signal processor (ADSP 21489), being capable of on-board processing the acquired data, is proposed in the next article by Pinto et al (p. 19). The system's main highlights are four differential channels with 1 MHz bandwidth, allowing simultaneous acquisition, 9 independent bipolar ranges and a maximum sampling rate of 600 kS/s. The analog DAQ inputs are protected against

incorrect connections, ensuring full operation recovery, not being necessary to replace the damaged components or fuses.

The aim of the paper by Garcia-Benadí et al (p. 26) is to provide the core for the "in situ", calibration of a hydrophone using a directional 10 kHz source. Anyway, even if the assigned value of uncertainty is high, the overall results are useful and interesting.

The energy management, including the control of the state of charge of the batteries, allowing simultaneous charging of all batteries from outside of the vehicle, and a wireless connection/disconnection mode for an autonomous underwater vehicle is the core of the next article by I. Masmitjà et al (p. 35). The methodology for measuring the charge level of the battery is current integration. The associated measured data are sent to the mission control of the vehicle, aiming to optimize and guarantee its navigation.

The paper by Liccardo et al (p. 44) mainly deals with the propagation channel aboard trains, propagation path loss, the delay spread and the coherence bandwidth. The results sustain that due to reflections by metal walls, the path loss exponent is slightly smaller than in free space, while not being significantly influenced by the position of transmitter and receiver. It is proven that the polarization and the distance between transmitter and receiver have influence on the delay spread and coherence bandwidth. Finally the functional law between coherence bandwidth and delay spread was determined.

The development of a low-cost, space saving device that could simultaneously take measurements from all (usually eight or up to twelve) outgoing three-phase feeders in distribution substation is the main focus of the contribution by Nikolic et al (p. 53). Aiming to save space without reducing the measurement accuracy, the authors designed a data acquisition system based on real-time multiprocessing with microcontroller and FPGA circuit. A fast FPGA circuit is used for voltage and current measurements including high-order harmonics. The proposed solution was validated by the results obtained in the developed laboratory.

The properties of the spectrum measured by the Time Domain ElectroMagnetic Interference systems that are influenced by imperfections in the multi-resolution analog-to-digital converter are analyzed by Kamenský and Kováč (p. 61). The authors propose a dedicated process of the identification of discrepancy parameters from experimental data, influencing the expressions of the model and enabling the comparison of experimental with theoretical results.

The paper by Kızılkaya et al (p. 68) is a study on analyzing and synthesizing new, multi-path, time-interleaved, digital sigma-delta modulators, able to operate at any arbitrary frequency. Dual- and quadruple-path fourth-order Butterworth, Chebyshev, Inverse Chebyshev and Elliptical based digital sigma-delta modulators are discussed, offering to designers the flexibility of specifying the centre-frequency, pass-band/stop-band attenuation as well as the signal bandwidth. Detailed simulations

performed at the behavioral-level in MATLAB are compared with the experimental results of the FPGA implementation of the designed modulators. The paper presents the mathematical modeling and evaluation of the tones caused by the finite word-lengths of these digital multi-path sigma-delta modulators, stimulated by sinusoidal signals.

A new architecture of the Multi-Tap-Delay-Line time-interval measurement module of high resolution implemented in single FPGA device is proposed in the paper by Zieliński et al (p.77). The here designed measurement module enables to collect sixteen time-stamps during a single measuring cycle. The main improvement is the increased resolution, the reduction of the total duration time of the measurements and the mitigation of the duty cycle of the measurement instrument.

A real time and simultaneously low-cost compensation method for the extension of the frequency bandwidth of medium voltage dividers whose performances would not have satisfied the requirements is developed by Crotti et al (p. 82). This entails the spread of transducers with suitable frequency bandwidths, as required by the relevant standards.

The next paper by Giordano et al (p. 90) describes the arrangement of a first experimental set-up which allows the comparison between the measurement of the electromagnetic field quantities induced inside a simple cylindrical phantom and the same quantities estimated numerically through a boundary element method. Even if a metallic non-magnetic element which roughly simulates a medical implant was introduced inside the phantom, the method assessed its robustness.

A Power Quality measurement system, intended for measurements in substations at medium voltage level including voltage and current transducers and a self-developed measuring instrument is designed by Crotti and Giordano (p. 97). While the measuring instrument is based on a Reconfigurable I/O-FPGA system with embedded software, the used voltage and current transducers are classical: Rogowski coil and a voltage divider. An effective application of the measurement system in a private substation is analyzed, connecting an industrial load and two photo-voltaic generation plants to the public medium voltage network. A significant decrease of the current and voltage measurement uncertainty was obtained.

The starting point of the paper by Skórkowski et al (p. 105) is based on the diagrams of a virtual quasi-balanced

instrument, continuing with the verification of a quasi-balanced circuit, virtual realization, for capacitance measurements. The DAQ card NI-6009 and the calculation were controlled by an application developed in LabVIEW.

Bao et al proposed test methods for Analog-to-Information Converters (p. 111); the main objective was to verify if figures of merit and test methods for traditional Analog-to-Digital Converters might be applied to AICs based on the random demodulation architecture. Starting from commercially available integrated circuits, an AIC prototype was designed. A simulation analysis and an experimental investigation have been carried out to study the additional influencing factors such as the parameters of the reconstruction algorithm. It was demonstrated that standard figures of merit are in general capable of describing the performance of AICs, provided they are slightly modified according to the proposals reported by the authors.

The main topic of contactless measurements for industrial applications is developed by Di Leo et al (p. 121). A vision-based system expressly realized for the measurement of geometric and/or chromatic parameters of rubber profiles is designed, for application in the automotive industry. The stereo vision system for the on-line measurement of the dimensional characteristics of the profile transversal section is described in all details.

An improvement of the non-destructive Eddy Current Testing (ECT) aiming to detect the presence of thin defects in conductive materials is presented in the last paper, by Betta et al (p. 128). An experimental comparison of different excitation signal designed was developed to improve the quality of experimental data associated with small cracks and consequently, to obtain a more reliable determination of the geometrical features of the inspected defects.

#### 4. CONCLUSIONS

We were deeply honored to act as Guest Editors for this innovative and challenging issue of ACTA IMEKO and we have the satisfaction of finalizing a very useful outcome. The here presented release is the result of the tireless efforts of a large but homogenous team, integrating the authors, the reviewers and, last but not least, Paul Regtien, Paolo Carbone and Pedro Ramos, providing salutary support for all this period.