



# Introductory notes to selected papers from the 2022 IMEKO TC4 symposium

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Dear Readers,

One of the most essential and typical phenomena of the current information and communication technology era is the expansion of measurement to a broad spectrum of human activities, including monitoring various physical quantities. Developing and maintaining any technical system requires adequate measurement systems, usually based on acquiring and processing various electrical signals. The development of human beings is bound with an appeal for new, more and more accurate, and precise measurement systems and sophisticated signal processing. IMEKO – the International Measurement Confederation creates a critical international platform connecting researchers and experts worldwide to share and exchange the newest scientific results and establish new international cooperation and personal friendship. One such IMEKO event was the 25<sup>th</sup> IMEKO TC4 International Symposium on the measurement of Electrical Quantities and the 23<sup>rd</sup> International Workshop on ADC and DAC Modelling and Testing.

The symposium was held on September 12 – 14, 2022, in Brescia - the fantastic historical UNESCO town in Italy. The scientific committee consisted of TC4 board members completed with eternal reviewers selected and accepted 67 from 96 submissions for presentation at the symposium.

The accepted papers were from 19 countries. The committee, during the symposium, selected and invited the authors of the seven best papers to prepare extended versions of their symposium papers for the special issue of Acta IMEKO. The papers have been fully rewritten, extended by the newest research results, and again reviewed for the journal. We hope you will enjoy reading the papers in this special issue of Acta IMEKO.

Victor Cabral et al. [1] introduce a project focused on developing technical capability and scientific knowledge to

implement a quantum resistance standard based on memristive devices characterized by high scalability down to the nanometre scale, CMOS compatibility, and working in the air at room temperature. The relevant characteristics and working principles of memristive devices and potential applications of them with a focus on metrological application with framing allowed by the last revision of the International System of Units have been highlighted in the paper.

Kostiantyn Torokhtii et al. [2] deal with the property of surface impedance of superconductors in an intense static magnetic field. The achieved knowledge of the electric phenomena gives a tool for new applications in material engineering and fundamental physics experiments. The main focus in this preliminary work is put on the sensitivity attainable on the surface resistance, i.e., the real part of the surface impedance.

Guglielmo Frigo et al. [3] focused their research on the very actual field - renewable energy sources. The paper presents a new metric that can quantify the discrepancy between the acquired signal and the reconstruction based on the phasor measurement unit estimates. Their results indicate the significance of evaluating quantity for correct control and the importance of the Phasor Measurement Units choice settings to maintain proper control.

Stanislas Dubois et al. [4] discuss the linearization of active electronic components such as power amplifiers or analogue-to-digital converters, addressing behavioural modelling, model selection, identification, and compensation issues. Using a refined power series model, the authors proposed a novel low-complexity approach to mitigate baseband intermodulation distortion with instantaneous frequency dependence. They present a calibration method based on a two-tone signal and demonstrate real-time operation with very low computational complexities, making it suitable for embedded systems.

Erkan Danaci et al. [5] study focuses on the importance of frequency response measurements for communication system materials. The laboratory measurements may not capture the actual operating conditions adequately. The free space dielectric measurement method achieves more accurate results in millimetre wave frequencies. The study compares measurement outcomes and uncertainty calculations for materials such as Teflon, Fr4, Komacel, or Air with known low-frequency responses. They also discussed the uncertainty calculation model used in the study.

Oleh Velychko et al. [6] discuss the importance of international agreements on mutual recognition of measurement results to facilitate trade between countries and point out the role of National Metrology Institutes and Designated Institutes, which is crucial in implementing these agreements. The study presents a comparative analysis of NMI/DI standards' results from COMET.EM-K5 and GULFMET.EM-S5 comparisons of AC active power and energy, focusing on regional and metrological traceability for Regional Metrology Organizations. The analysis aims to minimize costs while achieving the required metrological traceability, considering the geographical locations of leading National Metrology Institutes and/or Designated Institutes.

Lastly, Paolo Durandetto et al. [7] work focuses on quantum voltage standards based on the AC Josephson effect, which have been used in metrology since discovering the phenomenon. With the SI redefinition in 2019, where electrical units are now defined in terms of fundamental constants of elementary charge and Planck's constant, the role of quantum standards has become crucial. While these standards have demonstrated extremely low uncertainty in DC measurements, extending their application to AC and time-varying signals is challenging. The research discusses advancements achieved at the Istituto Nazionale di Ricerca Metrologica using programmable and pulsed Josephson junction arrays and recent developments using He-free device cooling techniques to approach DC accuracy in AC measurements.

We hope you will enjoy your reading.

Jan Saliga  
Jakub Svatos  
Platon Sovilj  
Acta IMEKO Special Issue guest editors

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