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### EXPLORING NEW FRONTIERS OF INSTRUMENTATION AND METHODS FOR ELECTRICAL AND ELECTRONIC MEASUREMENTS IN LIGHT OF THE IMEKO TC4 SYMPOSIUM IN FLORENCE, ITALY, SEPTEMBER 2008

From 21<sup>st</sup> to 24<sup>th</sup> September 2008, at the University of Florence, Morgagni Conference Center, significant scientific events took place, held under the auspices of the International Measurement Confederation.

These events were organized by the University of Florence (Faculty of Engineering and Faculty of Economics), University of Siena (Faculty of Engineering) jointly with INRIM (National Institute for Metrological Research, Italy).

Traditionally, the IMEKO TC4 Symposia were integrated with and supported by the International Workshop on ADC Modelling and Testing (IWADC). This year, the 13<sup>th</sup> ADC Workshop was held in Florence as a parallel event to the IMEKO TC4 Symposium. Moreover, one more interesting metrological event associated with the previously mentioned symposium and workshop was organized, i.e. the IEEE TC10 Technical Meeting on "Waveform Generation Measurement and Analysis". Additionally, it is worth to mention an interesting initiative undertaken by Prof. Franco Pavese – the IMEKO TC4 – TC21 Joint Session, focusing on selected aspects of measurement and instrumentation for electrical quantities as well as on mathematical tools for measurements.

Among the honorable guests of the symposia events there were present representatives of the University of Florence, the National Metrological Organization and also distinguished IMEKO representatives: Prof. Antonio Cruz Serra – IMEKO President, Prof. Pasquale Daponte – IMEKO TC4 Chairman, Prof. Mario Savino – IMEKO TC4 Honorary Chairman, Prof. Milos Sedlacek – former IMEKO TC4 Chairman and Prof. Franco Pavese – IMEKO TC21 Chairman. All scientific and social symposia and workshop events were perfectly organized and conducted under the leadership of the Symposium and Local Organizing Committee Chairman, Prof. Marcantonio Catelani.

The Local Organizing Committee was pleased to receive 222 papers. After the reviewing process 193 papers (21 from Poland) were accepted for presentation, of which 107 in oral style and 86 in one poster.

Comparing these data with the previously organized IMEKO TC 4 events it is worth to mention that the presented numbers are the highest in the history of those symposia. On the other hand, the 16<sup>th</sup> IMEKO TC4 Symposium and 13<sup>th</sup> ADC Workshop were combined with the 1<sup>st</sup> IMEKO TC21 Symposium, so the number of submissions was additionally increased. The Symposia and Workshop program consisted of the opening ceremony and plenary lecture, 15 working sections under the TC4 topics, 4 working sections under the IAWDC topics, IMEKO TC4 – TC21 joint session, 2 plenary poster sessions, 5 special sessions, 5 IEEE – TC10 meetings (including 2 Subcommittee meetings dedicated to DAC and ADC Subjects), the IMEKO TC4 Board meeting and closing session. The working sessions were conducted in parallel, usually in three streams.

The symposium and workshop program has been inaugurated by the plenary IMEKO TC4 opening lecture entitled “Systematic–error modelling, with an application to complex permittivity measurement” presented by Maurice G. Cox from the National Physical Laboratory, Teddington, Middlesex, UK, and dedicated to the fond memory of friend and colleague Professor Gaetano Iuculano.

A starting point to the lecture was the assumption that systematic errors often have greater influence on a measurement than random errors. Cases where these errors vary in an unknown functional manner with an independent variable, e.g. time or frequency were considered. The presented approach was applied to a set of complex permittivity data, in which the physical model was inconsistent with the data, but augmenting this model by a systematic–error model gave consistency.

Some interesting aspects, being in the neighbourhood of the opening lecture theme and concerning the expression of uncertainty, description of measurement accuracy and different mathematical tools for monitoring of environmental parameters and statistical characterization of selected phenomena, were presented and discussed during the TC4 – TC21 joint session.

Through the motto of IMEKO TC4 Symposium “Exploring New Frontiers Instrumentation and Methods for Electrical and Electronic Measurements”, and the subject issue of the Symposium papers, the mutually penetrating relationships between electrical and electronic measurements were emphasized, but not only those. This year it was very clearly visible that a list of the conference topics usually taken into account, covering measurements dedicated to different electrical and non–electrical quantities, methods of their analysis and measurement, as well as different sensors, transducers and systems, in many cases is not enough to present a full-dimension picture of state-of-the-art in the selected area. Some of the traditionally formulated topics, like “Power” (including its “Quality Assessment”) and “Energy Measurement” (17), “Sensors and Transducers” (19) or “Automated Test and Measurement Systems” (19) were characterized by a quite high number of papers. Although, in my opinion, the main focus of the Symposium was shifted to and concentrated on the interdisciplinary, multi-subject special sessions. The titles of those special sessions give a very good

overview of the current development trends in the domain of metrology covered by the IMEKO TC4 and IWADC competencies:

- “Measurement on Human Being” (17 papers),
- “Instrumentation, Measurements and Methods for Quality, Reliability, Testing and Fault Diagnosis” (12),
- “EMC Measurements and Testing” (8),
- “E-learning as Educational and Technological Innovation (17),
- “Measurement in Telecom” (4).

A distinctive feature of the first special session was introducing a considerably large number of weakly-defined mesurands related to human activity which appeared in many presentations e.g. in those concerning the mammographic images for breast cancer identification, level of consciousness when driving an automobile or prediction of sportsmen performances. At the same time some new concepts related to the assessment of human life, behavior and perception, like bio-impedance, trans-thoracic impedance or skin impedance were described and analyzed.

Another distinctive feature of this conference was its common preoccupation with widely understood problems of quality, reliability and diagnostics in the light of appropriately applied methods and measuring systems for a very wide spectrum of different scientific and industrial applications. The third special session was motivated by the more and more serious problem of electromagnetic disturbances and the necessity of their compensation.

As usually, the topic concerning E-learning appeared to be a very up-to-date issue and was concentrated, among others, on the application of Virtual Measurement Laboratories in Engineering Education. As the result of this session it is worth to note the interesting paper which indicates some weaknesses of the Bologna Declaration implementation in the Czech Republic. There are three areas, where Czech technical universities indicate problems with application on new bachelor curricula: assertion in practice, continuing in master stage and mobility. It seems that the remarks presented above have a more general character related not only to Czech technical universities' experiences.

And last but not least, a special session addressed to the measurements in telecom which was a logical continuation of the previous tendency provoked by the rapid progress in communication networks and increase of related applications.

The development of new technologies and their applications in the above mentioned areas would not be possible without ADC intensive research and its achievements.

This year, this segment was introduced by the IMEKO IWADC opening lecture titled “A brief history of the Analog Digital Converter” presented by Colin Lyded from Analog Devices, Cork, Ireland.

This talk took the audience for a brief walk through the history of Analog to Digital converter, with a bias forwards commercial application. The lecture illustrated how today's main architectures evolved in the context of the most important driving

applications of the time and of the manufacturing technology available. The lecture also addresses the evolution of ADC performance.

The topics mostly discussed during the ADC Workshop were related to 2 leading subjects:

- “AD & DA advanced techniques, circuits and application” (7 papers) and
- ADC Modelling and testing (10).

Consequently, the programme of IWADC 2008 was extended and enriched by a special session on project PRIN 2006: “Development of Innovative Methods for Characterizing, Modelling and Correcting the Non-Ideal Behaviour of A/D and D/A Conversion Channels, in Order to Contribute Towards Harmonizing and Upgrading International Standards”, covering 6 papers.

Preliminary evaluation of the level of papers submitted and presented during the IMEKO TC4 Symposium and ADC Workshop in Florence, as usually, is a somewhat difficult question. Nevertheless, a rough assessment indicates that the level of the papers under consideration was comparable with the last symposia and 16 papers were recommended by the group selected *ad hoc* from among the TC4 Board for publication in “Computer Standards and Interfaces Journal”, based on the previous indications prepared by Session Chairmen.

The next opportunity to present and discuss new metrological ideas and new research results will be during the IMEKO XIX World Congress, which will take place in Lisbon, Portugal, September 6-11, 2009. Afterwards, the next 17th IMEKO TC4 Symposium and 15<sup>th</sup> ADC Workshop will be held in Kosice, Slovak Republic, September 8-10, 2010.