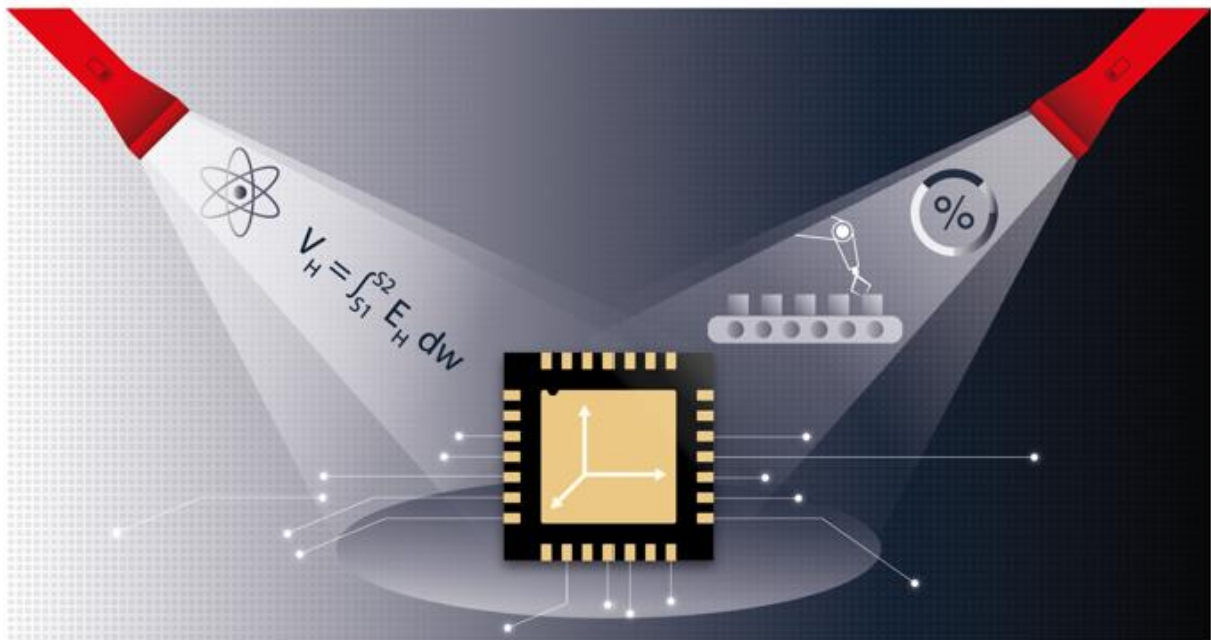


26th IMEKO TC4 International Symposium
24th International Workshop on ADC/DAC Modelling&Testing
Pordenone, 20/21 September 2023



ACADEMIA meets INDUSTRY

IMEKO TC-4 International Symposium

PROGRAM

ISBN: 978-3-033-09885-5



26th IMEKO TC4 International Symposium

24th International Workshop on ADC and DAC Modelling and Testing (IWADC)

IMEKO TC-4 2023

PROGRAM

September 20-21, 2023

Pordenone, Italy

© 2023 IMEKO

ISBN: 978-3-033-09885-5

All rights reserved. No part of this publication may be reproduced in any form, nor may it be stored in a retrieval system or transmitted in any form, without written permission from the copyright holders.

Welcome Message from the Organizing Committee

On behalf of the Organizing Committee, we extend a warm welcome to you for the 26th IMEKO TC4 International Symposium and 24th International Workshop on ADC and DAC Modelling and Testing (IWADC).

The conference commences with an elegant evening of networking at the IMEKO-TC4 Gala Dinner, held at the renowned Villa Gozzi on September 19th, 2023. Villa Gozzi holds a distinguished reputation as one of the most notable Venetian residences in the Pordenone area, and it is particularly associated with the Gozzi brothers, Gasparo and Carlo, who were prominent 18th-century Venetian writers. Originally built in the 17th century by the Gozzi family, who were esteemed merchants in the silk trade from Venice, the Villa served as their family residence and the headquarters of their agricultural business. Moreover, it became a vibrant center for cultural exchanges and gatherings. Gasparo and Carlo Gozzi, sons of Jacopo Antonio and Angiola Tiepolo, who belonged to ancient Venetian nobility, were renowned for hosting literary salons and delightful strolls, warmly welcoming guests from Venice and beyond.

Following this exquisite evening, the Scientific Conference IMEKO-TC4 takes place on September 20th and 21st at the Exhibition Center in Pordenone, Italy. Notably, this prestigious International Symposium IMEKO-TC4 is organized concurrently with the industry-driven World Magnetic Conference at the international trade show COILTECH Italy for the very first time.

The main objective of the IMEKO-TC4 symposium is to foster collaboration between academic researchers and industry engineers, with a specific focus on promoting innovation. This event aims to bring together experts and researchers from diverse communities engaged in measurements, sensors, and related fields, creating an environment that facilitates the exchange of scientific knowledge and ideas.

IMEKO-TC4's primary interest lies in the theoretical and practical aspects of measuring electrical quantities through electronic instruments. The organization provides a forum for the dissemination of ideas about electrical and electronic measuring techniques, as well as the principles of implementing information and communication technology for measurement and accuracy enhancement.

We would like to take this opportunity to express our gratitude to all the members of the Technical Program Committee, the Special Session Organizers, and the anonymous Reviewers, whose contributions have made this outstanding program possible. We also extend our appreciation to the Authors for submitting their papers and sharing their scientific findings with the IMEKO TC-4 community. The symposium received and peer-reviewed 59 papers from all over the world, and 48 of them have been accepted for either oral or poster presentation.

Special thanks are due to all the local Organizing Committee members, whose significant efforts were devoted to the successful organization of this event. In particular, we extend our heartfelt appreciation to our main sponsor, COILTECH, for their generous support, which made this event possible.

The Organizing Committee:

Symposium Chair – Dr. Dragana Popovic Renella, SENIS Switzerland

Scientific Chair – Prof. Alexandru Salceanu, IMEKO officer

Deputy Chairs – Sebastian Küster, COILTECH and Prof. Marco Villani, WMC

Technical Program Overview

The technical program of the 26th IMEKO TC4 International Symposium and 24th International Workshop on ADC and DAC Modelling and Testing (IWADC) evolves over two days and includes five keynote speeches, eleven oral sessions and a poster session.

The keynote speeches are:

- Academia meets Industry - and boosts Innovation and Entrepreneurship by Dr. Dragana Popovic Renella, SENIS Group, Switzerland
- The AMPWISE project by Mr. Damien Piguat, CSEM Switzerland, Prof. Eric M. Yeatman, Imperial College London, England and Mr. Sasa Spasic, SENIS, Switzerland
- Nano-scale traceable magnetic field measurements by Prof. Hans Werner Schumacher, Physikalisch-Technische Bundesanstalt (PTB), Germany
- Contactless electric current sensors by Prof. Pavel Ripka, Czech Technical University, Czech Republic
- EMF Monitoring: from the general public requirements to the industrial needs by Prof. Nikola Djuric, University of Novi Sad, Serbia

The sessions cover the whole spectrum of electrical measurements, from primary metrology to topics shared with other disciplines.

The oral sessions titles are:

- Metrology, Calibration, Standards and Electrical Quantities Measurements
- Quantum Electrical Metrology
- Biomedical Measurements
- Measurement Systems and ADC&DAC Modelling and Testing
- Signal and Image Processing
- Waveform Analysis and Measurements
- E-Mobility and Sensor Networks
- Special Session: New Trends and Applications of Magnetic Field and Electric Current Measurement in Industry and Science
- Special Session: Magnetic Sensor Systems
- Special Session: Metrology in Industry 4.0: The Bridge of Uncertainty
- Special Session: Innovations in Measurements for Electrical Machines Condition Monitoring

As Technical Program Chairs, we would like to thank all the members of the Technical Program Committee and the Reviewers, who allowed to improve the level of the contributions.

The Technical Program Chairs:

Dr. Jakub Svatos, Czech Technical University, Czech Republic
Prof. Platon Sovilj, University of Novi Sad, Serbia

The Committee

IMEKO TC4 CHAIR

Prof. Jan Saliga, *Technical University of Kosice, Slovakia*

GENERAL SYMPOSIUM CHAIR

Dr. Dragana Popovic Renella, *SENIS AG, Switzerland*

SCIENTIFIC CHAIR

Prof. Alexandru Salceanu, *Technical University of Iasi, Romania and International Measurement Confederation Officer*

DEPUTY CO-CHAIRS

Mr. Sebastian Küster, *COILTECH, Italy*

Prof. Marco Villani, *World Magnetic Conference, Italy*

TECHNICAL PROGRAM CO-CHAIRS

Prof. Platon Sovilj, *University of Novi Sad, Serbia*

Dr. Jakub Svatos, *Czech Technical University, Czech Republic*

SPECIAL SESSIONS CHAIR

Prof. Luca De Vito, *University of Sannio, Italy*

INTERNATIONAL PROGRAM COMMITTEE

IMEKO TC4 members: <https://www.imeko.org/index.php/tc4-homepage/tc4-members>

TC-4 Chair Jan Saliga, Technical University of Košice, Slovakia
TC-4 Vice-Chair Dragana Popovic Renella, SENIS Group, Switzerland
TC-4 Vice-Chair Luca Callegaro, Istituto Nazionale di Ricerca Metrologica, Italy
TC-4 Scientific Secretary Platon Sovilj, University of Novi Sad, Serbia
TC-4 Scientific Secretary Jakub Svatos, Czech Technical University, Czech Republic
TC-4 Honorary Chair Mario Savino, Politecnico di Bari, Italy
TC-4 Past Chairs:
Linus Michaeli, Technical University of Kosice, Slovakia
Pasquale Daponte, University of Sannio, Italy
Antonio Manuel da Cruz Serra, University of Lisbon, Portugal
Janusz Mindykowski, Uniwersytet Morski w Gdyni, Poland
Dominique Dallet, University of Bordeaux, France
Alexandru Salceanu, Technical University of IAȘI, Romania

Raul Land, Estonia
Dušan Agrež, Slovenia
Pedro M. Ramos, Portugal
Joaquin Del Rio Fernández, Spain
Gelson Rocha, Brazil
George Milushev, Bulgaria
Yurij Tesyk, Ukraine
Olfa Kanoun, Germany
Victor I. Didenko, Russia
Izzet Kale, United Kingdom
Laurent Francis, Belgium
Leo van Biesen, Belgium
Mihai Cretu, Romania
Luca De Vito, Italy
Christian Eugène, Belgium
Vladimir Haasz, Czech Republic
Cristian Fosalau, Romania
Damir Ilic, Croatia
Oleh Velychko, Ukraine
Voicu Groza, Canada
Elefterios Kayafas, Greece
He Qing, China
Michael M. Surdu, Ukraine
Vilmos Pálfi, Hungary
Theodore Laopoulos, Greece

Onsite Program IMEKO-TC4 2023

Online Program in collaboration with UK Magnetics Society and COILTECH

September 19th

19.30-23	Gala Dinner at Villa Gozzi
----------	----------------------------

September 20th

	<i>ONLINE Program</i>	<i>IMEKO Hall 9-1</i>	<i>COILTECH Halls</i>	<i>IMEKO Hall 9-2</i>
9:00			Registration and Coffee	
9:30-10:15	Opening Ceremony – Welcome Addresses from IMEKO, COILTECH, UK Magnetics Society - Online Chair Introduction	Opening Ceremony – Welcome Addresses from IMEKO, COILTECH, UK Magnetics Society		
10:15-11	1 st Key Note	1 st Key Note		
11-12	2 nd Key Note	2 nd Key Note		
12-12:05	Welcome words from the IMEKO president	Welcome words from the IMEKO president Prof. Frank Härtig, PTB		
12:05-12:35	Session B (#8, #15)	Session B (#8, #15)		Session A (#37, #39)
12:35-13:20	Session B (#16, #26, #31)	Session B (#16, #26, #31)		Session C (#48, #49)
13:20-14			Lunch	
14-14:30	Special Session 3 (#33, #38)	Special Session 3 (#33, #38)		Special Session 4 (#44, #45)
14:30-15	Special Session 3 (#52, #55)	Special Session 3 (#52, #55)		Session E (#11, #35)
15-15:30		Session D (#12, #42)		Session F (#7, #21)
15:00-16:30	UKMS Online Session			
16-16:20			Coffee Break	
16:20-17:30		Poster Session		
17:30-21			Apéro Party	

September 21st

	<i>Online Program</i>	<i>IMEKO Hall 9-1</i>	<i>COILTECH Halls</i>	<i>IMEKO Hall 9-2</i>
9:00-9:45	3 rd Key Note	3 rd Key Note		
9:45-10:30	4 th Key Note	4 th Key Note		
10:30-11			Coffee Break	
11-11:45	5 th Key Note	5 th Key Note		
11:45-13	UKMS Online Session	TC4 Board Meeting	Company booths visiting at COILTECH	
13-14	UKMS Online Session		Lunch	
14-14:30	Special Session 5 (#27, #29)	Special Session 5 (#27, #29)		Session G (#9, #30)
14:30-15:15	Session Session 5 (#32, #34, #36)	Session Session 5 (#32, #34, #36)		Special Session 7 (#23, #57, #58)
15:15	Closing Online Event			
15:30-16:15		Closing and Award Ceremony		

Online Chair: Dr. Graeme Finch, National Physical Laboratory (NPL), London

- **Key note 1:**

Onsite Chairs: Prof. Jan Saliga, Technical University of Kosice, Slovakia and Prof. Luca De Vito, University of Sannio, Italy

Academia meets Industry - and boosts Innovation and Entrepreneurship by Dr. Dragana Popovic Renella, SENIS Group, Switzerland

Related papers to this key note:

#25 Novel 3D Hall sensor and its application in inspection robots

Dragana Popovic Renella, Thomas Kaltenbacher, Sasa Spasic, SENIS Group, Switzerland
Andrea Cavelti, Giorgio Valsecchi, Lennart Nachtigall, Marco Hutter, RSL ETH Zurich, Switzerland

#40 Introducing the SENIS SENCS1Dx: A Novel Current Sensor IC with Ultra-High Bandwidth and Exceptional Magnetic Resolution

Radivoje S. Popovic, Dragana Popovic Renella, Sasa Dimitrijevic, Bojan Milenkovic, Sasa Spasic, SENIS Group, Switzerland

Keynote 1: Academia meets Industry - and boosts Innovation and Entrepreneurship

In search of breakthrough innovation and to develop highly competitive products companies increasingly collaborate with academic research. While the companies get fresh ideas and access to state of the art knowledge, the academic partners learn about industrial trends and needs. Industrial-academic collaborations therefore significantly contribute to build, sustain and often transform entire industrial ecosystems. In this presentation I will show how our company SENIS was able to strongly grow by combining the considerable academic competence of its founders with extensive industrial collaborations. It will be discussed how fresh concepts led to a paradigm shift in Hall based magnetic sensors, laying the ground for the world class performance of our magnetic field and electric current measurement devices. As SENIS is constantly trying to move the limits of the feasible in magnetometry and sensor technology the demand for our products is continuously growing, giving proof of a successful academic-industrial collaboration.

Dragana Popovic Renella is cofounder and COO of SENIS Group, Switzerland and the Vice-Chair of the IMEKO Technical Committee TC4. Prior to cofounding SENIS, Dragana worked for ETH Zurich and Sentron (acquired by Melexis). She holds a MSc degree in Electrical Engineering from the Swiss Federal Institute of Technology (ETH Zurich), a PhD in Technology Management from University of Novi Sad and she received an executive education in Marketing and Communication Management at SDA Bocconi Milan. Her company SENIS received the AMA Innovation Award and the Seal of Excellence from the European Commission.



Dr. Dragana Popovic Renella,
Cofounder and COO SENIS Switzerland

- **Key note 2:**

Chairs: Dr. Dragana Popovic Renella, SENIS Group, Switzerland and Prof. Pavel Ripka, Czech Technical University, Czech Republic

The AMPWISE project by Mr. Damien Piguet, CSEM Switzerland, Prof. Eric M. Yeatman, Imperial College London, England and Mr. Sasa Spasic, SENIS, Switzerland

Related papers to this key note:

#50 The AMPWISE Project

M. Blagojevic¹, A. Dieudonne², L. Kamecki³, M. E. Kiziroglou⁴, K. Krastev², D. Marty³, D. Piguet⁵, S. Spasic¹, S. W. Wright⁴ and E. M. Yeatman⁴

¹ Senis AG, Baar, Switzerland

² Safran Electrical & Power, Blagnac, France

³ Serma Ingenierie, Cornebarrieu, France

⁴ Imperial College London, U.K

⁵ CSEM, Neuchatel, Switzerland

Keynote 2: The AMPWISE project

The AMPWISE was funded by the European Union Cleansky 2 program. In aviation, fuselages of recent aircrafts are more and more made of composite material which is a poor electrical conductor, meaning it can no longer be used to carry the return current of the aircraft electrical systems. The structure that form an aircraft's skeleton, which is still conductive was identified as an alternative capable of carrying current. However, it was not designed to carry currents thus their effects are not well-known. The AMPWISE consortium developed a new wireless sensing solution capable of measuring current flowing through beam's rails, which in addition would not add extra weight or add to the complexity of aircraft wiring. The sensor nodes' communication system consumes less than 25 mA in average. The accuracy of the miniaturized Hall-effect electrical current sensor is 1% and the system is self-powered by the current it actually measured thanks to an inductive energy harvester which generates 0.4 mW from a 25 A RMS 360 Hz current flowing in the aircraft structure."



Mr. Damien Piguet,
PM, Integrated and Wireless Systems,
CSEM Switzerland

Damien Piguet received a Master in Communication Systems Engineering from EPFL in Switzerland in 2003 and joined CSEM in 2008. His main competences are embedded software, C/C++, Python, Matlab, wireless communications, low power, protocols, applications and driver development. He is a seasoned project manager and system architect in the IoT field, with applications to environmental monitoring, disaster prevention, potable water network, aviation and space.



Prof. Eric M. Yeatman,
Imperial College London, England

Eric M. Yeatman obtained his B.Sc from Dalhousie University, Canada, in 1983, and his Ph.D. from Imperial College London in 1989. He is currently a professor of micro-engineering and head of the electrical and electronic engineering department at Imperial College London. His research interests include motion and thermal energy harvesting for wireless devices, pervasive sensing, and sensor networks. He is a Fellow and Silver Medalist of the Royal Academy of Engineering, and is a cofounder and director of Microsaic Systems, which develops and markets miniature mass spectrometers for portable chemical analysis.



Mr. Sasa Spasic,
CEO SENIS Switzerland

Prior to joining SENIS, Mr. Spasic worked in the energy management and software development business areas at Landis & Gyr, Siemens, Metso Automation and AnyDoc Software as technology development and professional service manager (EMEA and worldwide). Mr. Spasic has many years of experience in technology development, team management and sales of magnetic sensors, magnetic measurement instruments and current sensors. Mr. Spasic obtained the M.Sc. degree in Electronic Engineering at University of Nis in Serbia.

- **Key note 3:**

Chairs: Dr. Alexander Stuck, SENIS Group Switzerland and Prof. Luca Callegaro, Istituto Nazionale di Ricerca Metrologica, Italy

Nano-scale traceable magnetic field measurements by Prof. Hans Werner Schumacher, Physikalisch-Technische Bundesanstalt (PTB), Germany

Keynote 3: Nano-scale traceable magnetic field measurements

Macroscopic magnetic field measurements are well traceable to primary quantum standards based on nuclear magnetic resonance and various calibration chains to industry are established. In contrast, for magnetic field measurements on micrometer length scales and below quantitative measurements are more complex, since the spatially varying field distribution is averaged over the non-negligible volume of the field probe. The European metrology project Nanomag has addressed this problem and has established routes for traceability of highly spatially resolved magnetic field measurements. The project addressed three complementary measurement techniques, namely scanning Hall magnetometry, magneto optical indicator film magnetometry and quantitative magnetic force microscopy (qMFM). One key outcome of the project was the first validation of qMFM with 50 nm spatial resolution by an international round robin comparison and the development and publication of the first international standard for nanomagnetic field measurements published by IEC TC 113 - Nanotechnologies for electrotechnical products and systems. This work was funded in the EMPIR programme (Project 15SIB06) co-financed by the Participating States and from the European Union's Horizon 2020 research and innovation programme.

Hans Werner Schumacher studied physics at the Universities of Braunschweig and Göttingen and received his PhD from University of Hanover for a thesis on nanofabrication of single electron transistors. As a post doc he worked at the University of Paris Sud in France on ultra fast magnetization dynamics. He joined the Physikalisch-Technische Bundesanstalt (PTB), the German National Metrology Institute in 2004 working on mesoscopic transport and nanomagnetism. Since 2009, he is heading PTB's Department Semiconductor Physics and Magnetism which maintains the primary NMR standard for the Tesla and develops primary quantum standards for the Ohm and Ampere, among others. In 2014 his research on "A self-referenced single-electron quantized-current source" was awarded the Helmholtz-Prize for Metrology. He has published more than 150 peer reviewed papers and has coordinated several projects among them three European projects on nanomagnetic metrology.



Prof. Hans Werner Schumacher,
Physikalisch-Technische Bundesanstalt (PTB), Germany

- **Key note 4:**

Chairs: Prof. Platon Sovilj, University of Novi Sad, Serbia and Prof. Daniel Belega, Politehnica University Timisoara, Romania

Contactless electric current sensors by Prof. Pavel Ripka, Czech Technical University, Czech Republic

Keynote 4: Contactless electric current sensors

Current sensors are required for applications such as smart grids, smart buildings, power conversion, and electric drives. With increasing prices of electricity, electric power consumption monitoring is required in multiple points, sometimes even for individual appliances. Many current sensors will be soon required for electromobility, both onboard vehicles and inside the charging stations. These sensors should cover large dynamic range, exhibit small errors and be resistant to the influence of large external currents in the close vicinity. There is also a pressure for low price, small size and light weight. Currents to be measured often contain large DC component and also high-frequency component. Gapped magnetic core with Hall sensor is the classical solution: we will discuss peculiarities of this design and possibilities of replacing Hall sensor with short SDT magnetoresistor. Magnetic yoke without gap is used in current transformers and for the measurement of DC current fluxgate principle is used. However, for many applications these sensors are too heavy and large to be competitive to modern galvanically isolated shunt modules. This is why yokeless current sensors become more important. We will discuss various designs and their properties. We will also mention the effect of eddy currents in the busbar on the frequency dependence of the yokeless current sensor and how it can be compensated.

Pavel Ripka received a CSc. (equivalent to Ph.D.) in 1989 from the Czech Technical University. During 1990 – 94 he spent 13 months as a visiting researcher at the Danish Technical University, in 2001 he was a Marie Curie Advanced Researcher Fellow at University of Galway, Ireland, and in 2005/6 he was Visiting scientist at the Institute for the Protection and the Security of the Citizen, Ispra, Italy. Since 2001 he is a full professor at CTU.

His main research interests are Magnetic Measurements and Magnetic Sensors, including their applications. He is a co-author of 3 books and 170 journal papers. He also participates in industrial research and holds 12 patents.

Pavel Ripka was Associated Editor of IEEE Sensors Journal, and member of the editorial boards of Technisches Messen, Measurement Science and Technology and other journals. He has been a member of the EuroSensors Steering Committee and Program committees of IEEE Intermag IEEE Sensors, SMM and other conferences. He was a member of ERC panel. He also served as a representative of IEEE Magnetics Society in the IEEE Sensors Council.



Prof. Pavel Ripka
Czech Technical University

- **Key note 5:**

Chair: Dr. Jakub Svatos, Czech Technical University, Czech Republic and Prof. Theodore Laopoulos, Aristotle University of Thessaloniki, Greece

EMF Monitoring: from the general public requirements to the industrial needs by Prof. Nikola Djuric, University of Novi Sad, Serbia

Keynote 5: EMF Monitoring: from the general public requirements to the industrial needs

The electromagnetic field (EMF) has become an integral part of modern technological development, following any application with electric power use. The majority of today's EMFs are artificially, man-made produced, in wide range of frequencies, triggering health concerns on EMF exposure and requiring appropriate investigation. The objective is to highlight any potential adverse health effects, as well as beneficial ones, along with technical characterization in specific case-use. In this Keynote Speech, the technology of EMF monitoring will be analyzed from perspective of the general public requirements to the industrial needs, focusing on the overview of state-of-the-art monitoring concept, measurement equipment and their technical applications. Several details for one of the major wireless networks for EMF monitoring – the Serbian EMF RATEL system, will be presented, underlining its use as valuable public tool for dissemination of daily present EMF in the environment. On the other side, industrial applications will be overviewed, among them those inspired by electromobility.

Professor Nikola Djuric received his Ph.D. degree in Telecommunication and Signal Processing from the Faculty of Technical Sciences, University of Novi Sad (FTN-UNS). Currently, his research is focused on computational and applied electromagnetics, particularly on systems for electromagnetic field (EMF) monitoring. He is the Head of Laboratory for Electromagnetic Compatibility and leader of the research team that has been specialized in environmental EMF measurement and monitoring for EMF compliance testing, estimation and simulation of the whole-body exposure to EMF. In the last four years, professor Djuric has been a Project Coordinator of several nationally funded projects, regarding continuous broadband EMF monitoring and EMF exposure assessment. He was also the MC Member for the EU COST BM1309 Action – "European network for innovative uses of EMFs in biomedical applications (EMF-MED)". Professor Djuric is a Member of Technical Committee of the Accreditation Body of the Republic of Serbia (ATS), then the ATS Commission for the Accreditation of Laboratories for EMF Compliance Testing and the ATS Commission for the Adaptation of Legislative Acts. Additionally, he is an IEEE Member and author of more than 100 journal and conference articles.



Prof. Nikola Djuric,
University of Novi Sad, Serbia

- **Session A - Metrology, Calibration, Standards and Electrical Quantities Measurements**

Chairs: Prof. Luca De Vito, University of Sannio, Italy and Prof. Platon Sovilj, University of Novi Sad, Serbia

#37 A 10 V PJVS-based DC voltage realization at INRiM

Paolo Durandetto, Bruno Trinchera, Danilo Serazio, Emanuele Enrico, INRiM - Istituto Nazionale di Ricerca Metrologica, Torino, Italy

#39 Power System Frequency and ROCOF Measurement by Means of Electronic Instruments

Daniel Belega, Gabriel Găspăresc, Department of Measurements and Optical Electronics, University Politehnica Timisoara, Timisoara, Romania

- **Session B - Quantum Electrical Metrology**

Chairs: Prof. Luca Callegaro, Istituto Nazionale di Ricerca Metrologica, Italy and Dr. Jakub Svatos, Czech Technical University, Czech Republic

#8 The development and tests of a preamplifier for the spectrum analyzer adopted for noise measurements in quantum Hall standard

Marcin Wojciechowski, Kateryna Hovorova, GUM (Central Office of Measures), Warsaw, Poland

#15 A calibration procedure for dc resistance ratio bridges

Martina Marzano, Cristina Cassiogo, Vincenzo D'Elia, Enrico Gasparotto, Luca Callegaro, INRiM - Istituto Nazionale di Ricerca Metrologica, Torino

#16 A simple and accurate resistance comparator with a long-scale ratiometric digital multimeter

Martina Marzano, Vincenzo D'Elia, Luca Callegaro, INRiM Istituto Nazionale di Ricerca Metrologica, Torino, Italy

Massimo Ortolano, Politecnico di Torino, Torino, Italy

#26 Atomic density calibration at high-temperature

Exrat Arkin, Jia Kong, Department of physics, Hangzhou Dianzi University, China
Jiqing Fu, Qing He, Magnetic quality laboratory, National Institute of Metrology, Beijing, China

#31 Quantum sampling modular setup for practical power measurements based on a programmable binary Josephson voltage standard

Bruno Trinchera, Paolo Durandetto, Danilo Serazio, INRiM-Istituto Nazionale di Ricerca Metrologica, Strade delle Cacce 91, 10135-Torino, Italy

- **Session C - Biomedical Measurements**

Chair: Prof. Jan Sobotka, CTU, Prague and Prof. Platon Sovilj, University of Novi Sad, Serbia

#48 Novel quality assessment protocol based on Kiviat diagram for pulsed wave Doppler diagnostic systems: first results

Giorgia Fiori, Gabriele Bocchetta, Maurizio Schmid, Silvia Conforto, Salvatore Andrea Sciuto, Andrea Scorza, Dep. of Industrial, Electronic and Mechanical Engineering, Roma TRE University, Rome, Italy

#49 First experimental results of a novel arterial simulator with PWV adjustment

Federico Filippi, Giorgia Fiori, Gabriele Bocchetta, Salvatore Andrea Sciuto, Andrea Scorza, Dep. of Industrial, Electronic and Mechanical Engineering, Roma TRE University, Rome, Italy

- **Session D - Measurement Systems and ADC&DAC Modelling and Testing**

Chair: Prof. Theodore Laopoulos, Aristotle University of Thessaloniki, Greece and Prof. Jan Saliga, Technical University of Kosice, Slovakia

#12 ADC Input Currents Measurement

Jakub Svatos, Jan Fischer, Jan Holub, Czech Technical University in Prague, Faculty of Electrical Engineering, Department of Measurement, Prague, Czechia

#42 Case study of NI G Web technology application for remote educational laboratory

Jozef Kromka, Levente Fekete, Jan Saliga, Technical University of Kosice, Kosice, Slovakia

- **Session E - Signal and Image Processing**

Chair: Prof. Daniel Belega, Politehnica University Timisoara, Romania and Prof. Jan Saliga, Technical University of Kosice, Slovakia

#11 Lossless real-time signal encoding for two-channel signals: A case study on ECG

Jozef Kromka, Ondrej Kovac, Jan Saliga, Technical University of Kosice, Kosice, Slovakia

#35 Custom Synthesizable VHDL Processor for Embedded Capacitive Angle Sensor Data Processing

Milos Drutarovsky¹, Ondrej Benedik², Miroslav Sokol¹, Pavol Galajda¹, Jan Saliga¹, Jan Ligus², Cristian D Stratyinski²

¹ Technical University of Kosice, Kosice, Slovakia

² CTRL Ltd., Kosice, Slovakia

- **Session F - Waveform Analysis and Measurements**

Chair: Prof. Jan Holub, CTU, Prague and Dr. Ondrej Kovac from TUKE, Kosice, Slovakia

#7 Accurate Frequency and Damping Factor Estimation by Means of an Improved Three-point Interpolated DFT Algorithm

Daniel Belega, Department of Measurements and Optical Electronics, University Politehnica Timisoara, Timisoara, Romania

Dario Petri, Department of Industrial Engineering, University of Trento, Trento, Italy

Dominique Dallet, IMS Laboratory, Bordeaux INP, University of Bordeaux, Talence Cedex, France

#21 Characterization of an accurate phase measurement system using transmission lines

Luca De Vito, Francesco Picariello, Sergio Rapuano, Ioan Tudosa, Department of Engineering, University of Sannio, Benevento, Italy

- **Session G - E-Mobility and Sensor Networks**

Chair: Dr. Jakub Svatos, Czech Technical University, Czech Republic and Prof. Platon Sovilj, University of Novi Sad, Serbia

#9 The Wireless EMF Monitoring in Sensitive Areas around Kindergartens and Schools

Nikola Djuric, Dragan Kljajic, Tamara Skoric, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia

Nicola Pasquino, Dept. of Electrical Engineering and Information Technologies, University of Naples Federico II, Naples, Italy

#30 Rapid Prototyping of Vehicle Software Defined Functions

Jan Sobotka, Jirí Novák, Jirí Pinkava, Czech Technical University in Prague, Prague, Czech Republic

- **Special Session 3: New Trends and Applications of Magnetic Field and Electric Current Measurement in Industry and Science**

Chairs: Dr. Alexander Stuck, SENIS Group Switzerland and Prof. Pavel Ripka, Czech Technical University, Czech Republic

#33 Crosstalk in Gapped-core Contactless Current Sensor

Noby George, Pavel Ripka, Václav Grim, Department of Measurement, FEL, Czech Technical University in Prague, Prague

#38 Quantum magnetometry with OPM: Novel applications in non-destructive testing?

Andreas Blug¹, Kerstin Thiemann¹, Simon Philipp², Thomas Straub², Alexander Bertz¹

¹ Fraunhofer Institute for Physical Measurement Techniques IPM, Freiburg, Germany

² Fraunhofer Institute for Mechanics of Materials IWM, Freiburg, Germany

#52 Teamwork of Simulations and Hall Sensor Measurements for the Design of Magnetic Sensor Systems

Thomas Schliesch, Thomas Lindner, Max Baermann GmbH, Germany,

#55 First results on torque estimation by FEA and experimental analysis in a novel CSFH-based microgripper

Gabriele Bocchetta¹, Giorgia Fiori¹, Federico Filippi¹, Pietro Ursi², Salvatore Andrea Sciuto¹, Andrea Scorza¹

¹ Dep. of Industrial, Electronic and Mechanical Engineering, Roma TRE University, Rome, Italy

² Dep. of General Surgery and Surgical Specialties "Paride Stefanini", Sapienza University of Rome, Rome, Italy

- **Special Session 5: Magnetic Sensor Systems**

Chair: Dr. Jürgen Gerber, INNOMAG e.V., Germany and Prof. Luca De Vito, University of Sannio, Italy

#27 DIN SPEC 91411: A standardized representation of magnetic scales

Jürgen Gerber, INNOMAG e.V., Kaiserslautern, Germany

Rolf Slatter, ITK Dr. Kassen GmbH, Lahnau, Germany

#29 Pole positioning for precise magnetic measurement systems

Sebastian Rivera, Rolf Slatter, ITK Dr. Kassen GmbH, Lahnau- Germany

#32 Analytical Models and Magnetic Position Systems

Michael Ortner¹, Alexandre Boisselet², Luiz G. Enger¹, Florian Slanovc¹, Peter Leitner¹, Daniel Markó¹

¹ Silicon Austria Labs, Villach, Austria

² Infineon Technologies Austria, Villach, Austria

#34 Rapid Prototyping of Automotive Magnetic Positioning Systems

Luiz G. Enger, Aleš Travník, Peter Leitner, Florian Slanovc, Daniel Markó, Michael Ortner, Silicon Austria Labs, Villach, Austria

#36 Practical limitations of accurate magnetic measurements in industrial applications

A.Stuck, M. Mijalkovic, M.Vidojevic, D. Popovic, Senis Group, Switzerland

- **Special Session 4: Metrology in Industry 4.0: The Bridge of Uncertainty**

Chairs: Prof. Platon Sovilj, University of Novi Sad, Serbia and Prof. Marjan Urekar, University of Novi Sad, Serbia

#44 Metrology and Capacity Building in Higher Education: Project Knowledge Triangle for a Low Carbon Economy (KALCEA)

Platon Sovilj, Sanja Mandić, Dragan Pejić, Đorđe Novaković, Marjan Urekar, University of Novi Sad, Faculty of Technical Sciences, Serbia

#45 Digital Stochastic Measurement and Industry 4.0

Platon Sovilj, Dragan Pejić, Marjan Urekar, Sanja Mandić, University of Novi Sad, Faculty of Technical Sciences, Serbia

- **Special Session 7: Innovations in Measurements for Electrical Machines Condition Monitoring**

Chairs: Dr. Andrea Credo, University of l'Aquila, Italy and Dr. Jakub Svatos, Czech Technical University, Czech Republic

#23 Towards new IEC standards for the electrical characterization of graphene

Alessandro Cultrera^{1,2}, Luca Callegaro¹, Danilo Serazio¹, Norbert Fabricius^{2,3}

¹ INRIM – Istituto Nazionale di Ricerca Metrologica, strada delle Cacce 91, 10135 Turin, Italy

² ISC –International Standards Consulting GmbH & Co. KG, Gehrden, Deutschland

³ IEC – International Electrotechnical Commission, Technical Committee 113 "Nanotechnology for electrotechnical products and systems"

#57 Magnetic stray field analysis over large areas using Hall- and magneto-optical sensors

Benjamin Wenzel, Matthias Schmidt, Matesy GmbH, Jena, Germany

#58 Current Measurements for Fault Diagnosis in Induction Motors

Simone Mari, Andrea Credo, Giovanni Bucci, Fabrizio Ciancetta, Edoardo Fiorucci, Andrea Fioravanti, University of L'Aquila, Dept. of Industrial and Information Engineering and Economics, L'Aquila (AQ), Italy

- **Poster Session**

#6 Evaluation of the long-term drift of measuring instruments and standards using time series

Oleh Velychko, Tetyana Gordiyenko, State Enterprise "All-Ukrainian state research and production center for standardization, metrology, certification and consumers' rights protection" (SE "Ukrmetrteststandard"), Kyiv, Ukraine

#10 Evaluation of Long-Term Stability of HighPrecision Standard for Low-Frequency Voltage Measurement

Oleh Velychko, Valentyn Isaiev, State Enterprise "All-Ukrainian state research and production center for standardization, metrology, certification and consumers' rights protection" (SE "Ukrmetrteststandard"), Kyiv, Ukraine

#17 Traceability routes for magnetic measurements

Marco Coisson, INRIM, Torino (TO), Italy

Javier Diaz De Aguilar Rois, Yolanda Alvarez Sanmamed, Sergio Molto González, CEM, Tres Cantos (Madrid), Spain, Oliver Power, Robert Walsh, Orrie Larmour NSAI, Dublin, Ireland

#19 A new type of rack for the clamp ammeter

Hongrui Yan, Xinyan Wang, Xiao Liu, Jianbo Liu, Qian Chen, Bin Deng, Shandong Engineering Research Center of Reliability Evaluation for Electric Energy Metering Devices, Shandong Institute of Metrology, Jinan, China

#22 Study on Calibration Method for Emergency Lighting and Evacuation Indicating System

Bin Deng, Ze-Xin Guan, Xue-Feng Ma, Ru Jia, Hong-Rui Yan, Shandong Engineering Research Center of Reliability Evaluation for Electric Energy Metering Devices, Shandong Institute of Metrology, Jinan, Shandong, China

Dong-Sheng Zhao, Hai-Long Xu, Guang-Kun Dong, Fan-Li Kong, Shandong Institute of Metrology and Science, Jinan, Shandong, China

#24 Verification of thermal converters by means of a pulsed Josephson standard

Krzysztof Kubiczek², Paolo Durandetto¹, Pier Paolo Capra¹, Claudio Francese¹, Marco Lanzillotti¹, Luca Roncaglione¹, Marian Kampik², Andrea Sosso¹

¹ INRiM - Istituto Nazionale di Ricerca Metrologica, Turin, Italy

² Department of Measurement Science, Electronics and Control, Faculty of Electrical Engineering, Silesian University of Technology, Gliwice, Poland

#41 The Design of Vehicle Surround View Monitor

Antonia Juskova and Ondrej Kovac, Technical University of Kosice, Kosice, Slovakia

#43 Phase measurement methods based on timer modules

Sanja Mandić, Dragan Pejić, Đorđe Novaković, Marjan Urekar, Platon Sovilj, University of Novi Sad, Faculty of Technical Sciences, Serbia

#46 Decoding Cognitive Processes in Arithmetic Tasks: An EEG-Based Convolutional Neural Network Model

Nikola Petrović¹, Lemana Spahić², Sanja Mandić¹, Platon Sovilj¹

¹ University of Novi Sad, Faculty of Technical Sciences, Serbia

² Verlab Research Institute for Biomedical Engineering, Medical Devices and Artificial Intelligence, Sarajevo, Bosnia and Herzegovina

#47 Demonstration stand for non-destructive conductive material defect inspection by eddy current

Jan Saliga¹, Pavol Kababik², Ondrej Kovac¹, Alena Pietrikova¹

¹ Technical University of Kosice, Letna 9, 042 00 Kosice, Slovakia

² Magna Electronics Slovakia s.r.o. 044 58 Kechnec 265, Slovakia

#56 A Preliminary Comparison of Three Methods for the Assessment of Pulse Wave Transit Time in an Arterial Simulator

Federico Filippi, Giorgia Fiori, Gabriele Bocchetta, Salvatore Andrea Sciuto, Andrea Scorza, Dep. of Industrial, Electronic and Mechanical Engineering, Roma TRE University, Rome, Italy

#59 Phase Noise Measurement of ASIC Voltage Controlled Oscillator and PLL Circuit ADF4002

Patrik Jurík, Miroslav Sokol, Pavol Galajda, Department of Electronics and Multimedia Telecommunications, Technical University of Kosice, Kosice, Slovakia

CONTENT

# of paper	Title	Page number
6	Evaluation of the long-term drift of measuring instruments and standards using time series	1
7	Accurate Frequency and Damping Factor Estimation by Means of an Improved Three-point Interpolated DFT Algorithm	6
8	The development and tests of a preamplifier for the spectrum analyzer adopted for noise measurements in quantum Hall standard	11
9	The Wireless EMF Monitoring in Sensitive Areas around Kindergartens and Schools	16
10	Evaluation of Long-Term Stability of High-Precision Standard for Low-Frequency Voltage Measurement	22
11	Lossless real-time signal encoding for two-channel signals: A case study on ECG	26
12	ADC Input Currents Measurement	30
15	A calibration procedure for dc resistance ratio bridges	35
16	A simple and accurate resistance comparator with a long-scale ratiometric digital multimeter	39
17	Traceability routes for magnetic measurements	43
19	A new type of rack for the clamp ammeter	48
21	Characterization of an accurate phase measurement system using transmission lines	53
22	Study on Calibration Method for Emergency Lighting and Evacuation Indicating System	59
23	Towards new IEC standards for the electrical characterization of graphene	64
24	Verification of thermal converters by means of a pulsed Josephson standard	69
25	Novel 3D Hall sensor and its application in inspection robots	72
26	Atomic density calibration at high-temperature	76
27	DIN SPEC 91411: A standardized representation of magnetic scales	79
29	Pole positioning for precise magnetic measurement systems	84
30	Rapid Prototyping of Vehicle Software Defined Functions	88
31	Quantum sampling modular setup for practical power measurements based on a programmable binary Josephson voltage standard	92
32	Analytical Models and Magnetic Position Systems	97
33	Crosstalk in Gapped-core Contactless Current Sensor	101
34	Rapid Prototyping of Automotive Magnetic Positioning Systems	105
35	Custom Synthesizable VHDL Processor for Embedded Capacitive Angle Sensor Data Processing	109
36	Practical limitations of accurate magnetic measurements in industrial applications	114
37	A 10 V PJVS-based DC voltage realization at INRiM	117
38	Quantum magnetometry with OPM: Novel applications in non-destructive testing?	122
39	Power System Frequency and ROCOF Measurement by Means of Electronic Instrument	126

40	Introducing the SENIS SENC51Dx: A Novel Current Sensor IC with Ultra-High Bandwidth and Exceptional Magnetic Resolution	131
41	The Design of Vehicle Surround View Monitor	135
42	Case study of NI G Web technology application for remote educational laboratory	140
43	Phase measurement methods based on timer modules	144
44	Metrology and Capacity Building in Higher Education: Project Knowledge triangle for a low carbon economy (KALCEA)	148
45	Digital Stochastic Measurement and Industry 4.0	151
46	Decoding Cognitive Processes in Arithmetic Tasks: An EEG-Based Convolutional Neural Network Model	154
47	Demonstration stand for non-destructive conductive material defect inspection by eddy current	160
48	Novel quality assessment protocol based on Kiviat diagram for pulsed wave Doppler diagnostic systems: first results	165
49	First experimental results of a novel arterial simulator with PWV adjustment	170
50	The AMPWISE Project	174
52	Teamwork of Simulations and Hall Sensor Measurements for the Design of Magnetic Sensor Systems	178
55	First results on torque estimation by FEA and experimental analysis in a novel CSFH-based microgripper	182
56	A Preliminary Comparison of Three Methods for the Assessment of Pulse Wave Transit Time in an Arterial Simulator	186
57	Magnetic stray field analysis over large areas using Hall- and magneto-optical sensors	190
58	Current Measurements for Fault Diagnosis in Induction Motors	194
59	Phase Noise Measurement of ASIC Voltage Controlled Oscillator and PLL Circuit ADF4002	198