Welcome Message from the General Co-Chairs

On behalf of the IEEE International Instrumentation and Measurement Technology Conference (I²MTC) 2022 Organizing Committee, the I²MTC Board of Directors, and the IEEE Instrumentation and Measurement Society (IMS), it is our great pleasure to welcome you to I²MTC 2022 in Ottawa, Canada's capital. I²MTC is IMS's flagship conference and is ranked number one in terms of Google H-5 index in the general field of Instrumentation and Measurement (I&M).

The theme of this year's conference is, appropriately, "Instrumentation and Measurement under Pandemic Constraints." Who could expect that, when we last met in person at I²MTC 2019 in Auckland, New Zealand, it would be another 3 years before we could meet in person again! Such was the devastating and disruptive effect of the COVID-19 pandemic on the planet. As the world emerges from this pandemic, it needs to recover socially, economically, and politically. Leaving our pandemic-induced isolation and meeting face-to-face once again is the first step towards this recovery.

Indeed, the pandemic caused us to lose many opportunities in the past two I²MTCs, which were mandatorily held online. While the accepted papers were presented virtually as well as technology allowed, the "conferring" part of the conference was still missing: no opportunities for in-person networking, collaboration, discussions, brainstorming, lobby talks, socialization, random conversations, volunteering, etc. Today's technology simply cannot fully replace our face-to-face meetings.

It is therefore with great pleasure that we are returning to the conference in person. And the fact that it happens in Ottawa feels as if the conference is "coming home". Some in our community might remember that I²MTC's predecessor, the Electrical and Electronic Measurement and Test Instrument Conference (EEMTIC), was held in Ottawa from 1966 until 1981. In 1984, the IMS revived EEMTIC as IEEE Instrumentation and Measurement Technology Conference (IMTC), slightly renamed in 2011 to IEEE International Instrumentation and Measurement Technology Conference (I²MTC). Interestingly, in all of its incarnations, the conference name can be and often is pronounced as *eem·tek*, especially by senior members of our community. Ottawa also hosted IMTC 1997 and 2005 conferences, both of which were successful.

You will notice that despite the in-person mode of the conference, some presentations will be given virtually. The reason is that the ongoing government-imposed COVID-19 travel restrictions in some regions of the world have prevented some of our authors from being able to come to Ottawa in person. Technically speaking, this makes I²MTC 2022 the first hybrid I²MTC.

On Wednesday evening, we will visit the Canadian Museum of History for gala dinner. This is a national museum on anthropology, Canadian history, cultural studies, and ethnology and promotes the history and heritage of Canada, including Canada's First Nations, Inuit, and Métis peoples. It is a must visit for people interested in human history, and we are sure that all I²MTC attendees will enjoy the museum's atmosphere and the social opportunity.

We are fortunate to have four distinguished and high-profile plenary speakers at the conference, and we thank them sincerely for dedicating their valuable time to give exciting talks to the conference audience. On Tuesday morning, the 2022 winner of the prestigious IEEE Joseph F. Keithley Award in Instrumentation & Measurement, Prof. Ian Hunter from MIT's BioInstrumentation Lab, will deliver the talk "Nonlinear System Identification: 40 years of Applications to Instrumentation". On the same day after lunch, Dr. Andreas Steiger of Germany's national metrology institute Physikalisch-Technische Bundesanstalt (PTB), and winner of the prestigious 2021 IEEE Instrumentation and Measurement Society Andy Chi Best Paper Award, will deliver the talk titled "Linking the Power Scales of Free-Space and Waveguide-Based Electromagnetic Waves". On Wednesday, we will listen to Dr. Marina Gertsvolf of National Research Council (NRC) Canada and Chair of the International Atomic Time Working Group at the Consultative Committee of Time and Frequency (CCTF-WGTAI) give the talk "SI Second and UTC – Today and Tomorrow" which will reflect on

preparations for the redefinition of the second in the next few years. Finally on Thursday, multi-award-winning Professor and Canada Research Chair in Attosecond Photonics, Prof. Paul Corkum of the University of Ottawa and of NRC will deliver the talk "Optically Generated Magnetic Fields".

In addition, we are fortunate to have three panel sessions at the conference. On Wednesday afternoon, a key-note presentation by Ms. Georgette Macdonald, Director General of the NRC Metrology Research Centre, will open the Diversity and Inclusion in I&M Presentation. This will be followed by an Industry Panel Session on the Role of I&M in Response to COVID-19. On Thursday afternoon, an Industry Panel Session on Optical Instrumentation & Measurements in High-Tech Industry is scheduled. Our special "thank you" goes to Dr. Jean-François Houle, VP engineering, NRC, for organizing the Industry Panel Session on the Role of I&M in Response to COVID-19, and to Dr. Wahab Almuhtadi for organizing the Industry Panel Session on Optical Instrumentation & Measurements in High-Tech Industry.

We are also delighted to have our valued supporters at I²MTC 2022 in Ottawa, and we would like to acknowledge them with a big "thank you": the continuous conference sponsors IEEE and IEEE IMS, this year's patrons Carleton University, NRC, and the University of Ottawa, and our exhibitors Siborg Systems Inc., Guildline Instruments Inc., and HV Technologies Inc. Support from the patrons and exhibitors was an important factor for organizing this conference successfully. We also extend our gratitude to Ottawa Tourism for their support since the time we submitted our competitive bid to bring I²MTC to Ottawa.

Of course, this conference would not have happened without the countless hours of effort and energy that the Organizing Committee generously and freely gave. Our Technical Program Co-Chairs, Drs. Kristen Donnell, Pawel Niewczas, and Sergio Rapuano, have done a fantastic job of putting together a very strong technical program. They worked with our 32 outstanding Associate TPC Chairs to assign papers to reviewers, receive and analyze the review reports, and make decisions. The scheduling of the program was even more challenging this year because of the hybrid mode. Our hats off to Kristen, Pawel, and Sergio! Immense thanks go also to all reviewers who spent their valuable time to review the papers and submitted high-quality reviews in a timely manner. Naturally, we would also like to sincerely thank all submitting authors for choosing I²MTC for their participation. Last but not least, our sincere special thanks to all at Conference Catalysts, especially Ms. Laura LeBlanc for managing all aspects of the conference so skillfully and efficiently, and to Ms. Madison Musselman and Ms. Judy Scharmann for their valuable support.

Our "thank you" also goes to the Steering Committee: Dr. Rafik Goubran of Carleton University (CU), Dr. Emil Petriu of University of Ottawa (UO), and Dr. Wahab Almuhtadi of Algonquin College in Ottawa; the Tutorials Chair: Dr. Sreeraman Rajan of CU; Special Sessions Co-Chairs: Dr. Abdulmotaleb El Saddik of UO, Dr. M. Shamim Hossain of King Saud University, Riyadh, Saudi Arabia, and Dr. Platon Sovilj of University of Novi Sad, Novi Sad, Serbia; Finance & Registration Co-Chairs: Mr. Ajit Pardasani of NRC Canada, and Dr. Ferdinanda Ponci of RWTH Aachen University, Germany; Awards Chair: Dr. Voicu Groza of UO; Publicity Chair: Dr. Shamsodin Taheri of Université du Québec en Outaouais, Gatineau; Publication Co-Chairs: Dr. Miodrag Bolic and Dr. Hilmi Dajani both of UO; Diversity and Inclusion in I&M organizers: Drs. Kristen Donnell of Missouri University of Science and Technology and Melanie Ooi of the University of Waikato, New Zealand; Industrial Relations & Patronage Co-Chairs: Dr. Mostafa Farrokhabadi of BluWave-ai, Ottawa, and Mr. Raed Abdullah of Hydro Ottawa, Ottawa.

We hope that all attendees will find the conference experience informative, stimulating, and enjoyable, both technically and socially, and we encourage everyone to take advantage of this face-to-face opportunity to its fullest.

Have an excellent and productive stay in Ottawa!

Branislav Djokic and Shervin Shirmohammadi, General Co-Chairs

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- Lorenzo Ciani
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SPS 2: Electrical Impedance Measurement and Its Applications
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SPS 3: Application of Modern Measurement, Control (MC) Technology and Instruments
- Zhihan Lv
- Jaime Lloret
- Houbing Song

SPS 4: Machine Leaning for Measurement Uncertainty and Decision Making in Machine Intelligent Diagnosis
- Weihua Li
- Xingwu Zhang
- Chuang Sun

SPS 5: IOT - Based Smart Measurement Systems: New Communication and Artificial Intelligence Techniques
- Tommaso Fedullo
- Federico Tramarin
- Emiliano Sisinni
- Luigi Rovati

SPS 6: Sensors, Instrumentation, and Artificial Intelligence technologies for Environmental Measurement and Modelling
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- Tuan Guo
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SPS 7: Laser Sensing and Imaging Techniques and System
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SPS 8: Metrological Performance of Low-cost Platforms for Measurement Applications
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SPS 9: Measurement Systems for Harsh Operating Conditions
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2022 IEEE Joseph F. Keithley Award in Instrumentation and Measurement Presentation and Award

Sponsored by Keithley Instruments, a Tektronix Co., and the IEEE Instrumentation and Measurement Society
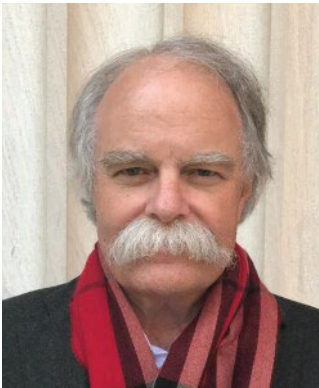
Ian Hunter
BioInstrumentation Lab, Department of Mechanical Engineering,
Massachusetts Institute of Technology (MIT) Cambridge, MA USA

For the development and commercialization of nonlinear system identification techniques in instrumentation and measurement applications

Biography: Having spent much of his childhood designing and building various machines and measurement instruments in a home electronics shop and chemistry laboratory, Ian Hunter's passion is the creation of new instruments and measurement techniques at the micro scale that benefit society. He and his students have developed many novel instruments and devices including confocal laser microscopes, scanning tunneling electron microscopes, miniature mass spectrometers, new forms of Raman spectroscopy, needle-free drug delivery technologies, microsurgical robots, robotic endoscopes, high-performance Lorentz-force motors, and microarray technologies for massively parallel chemical and biological measurements. He has founded or cofounded over 30 companies, many of which feature technologies incorporating the novel use of nonlinear system identification techniques both in conducting measurements and in the control of their instrumentation systems.

An IEEE Life Member, Hunter is the Hatsopoulos Professor in Thermodynamics at the Massachusetts Institute of Technology, Cambridge, MA, USA.

Nonlinear System Identification: 40 years of Applications to Instrumentation

Summary: In this talk I will describe the use of various nonlinear system identification techniques to many instruments we have developed both in our university labs (Auckland, McGill and MIT) and in over 30 companies we have founded. Early techniques included Quasi-linear, Wiener kernel system ID and Hammerstein and Wiener type nonlinear system ID methods. Later methods included Volterra kernel, parallel cascade and NARMAX nonlinear system ID. Instruments and other systems modeled and controlled include Raman spectrometers, IR spectrometers, mass spectrometers, nuclear magnetic resonance spectrometers, electrical impedance spectrometers, acoustic spectrometers, real-time gas chromatographs, needle free drug delivery devices, robotic endoscopes, eye surgery robots, wireless power transfer systems, in wheel multi-degree of freedom electric vehicle actuators, active electric vehicle suspension systems, artificial muscle type actuators, living muscle and skin nonlinear mechanics measurement instruments, dissolved oxygen sensors and conducting polymer energy storage technologies. The talk will include our experience in teaching linear and nonlinear system identification techniques to undergraduate and graduate students at MIT in our Instrumentation and Measurement, and Advanced Instrumentation and Measurement courses. We have developed a large number of teaching demos which may be used by students to learn system identification techniques in the context of hands-on instruments and devices. This initiative is called MICA (Measurement, Instrumentation, Control and Analysis) and is designed for use in teaching any STEM subject. In this initiative, system ID techniques are considered to be the formalized scientific method.

IEEE Instrumentation and Measurement Society Andy Chi Best Paper Award Presentation

Summary: Two independent methods for absolute power measurement of electromagnetic waves are compared in the millimeter wave range. Depending on frequency and wave propagation, electromagnetic power is traced back to the International System of Units (SI) in different ways at National Metrology Institutes (NMIs) such as the PTB in Germany. From microwave to millimeter-wave frequencies, traceability is achieved in coaxial lines and metallic waveguides, and in the terahertz range in free space. Since modern waveguide-based power sensors and free-space power detectors are overlapping with respect to their operating frequency, a comparison of the two independent power scales was performed for the first time in the millimeter-wave range in the WR-10 band (i.e., for frequencies from 75 GHz to 110 GHz).

For this comparison, a special measuring setup has been developed. It consists of a tailor-made, large elliptical mirror which focuses a known radio frequency (RF) power, radiated by a special corrugated horn antenna, into the aperture of a calibrated free-space detector. The experiment confirmed the consistency of the two traceability approaches within their uncertainties.

This proof of equivalence opens the promising possibility of accurately measuring RF power in higher-frequency waveguide bands up to the THz range with the free-space method applied.

Biography: Andreas Steiger received the Diploma degree in physics from the TU Karlsruhe, now KIT in Karlsruhe, Germany, in 1984, and the Dr. rer. nat. degree in physics from the TU Berlin, in Berlin, Germany, in 1993. He joined the Physikalisch-Technische Bundesanstalt (PTB) in Berlin, Germany in 1986 as a research scientist in the field of plasma diagnostics by means of laser spectroscopy. From 2003 to 2008, he was head of the working group radiation sources for radiometry. Since 2009, after the first calibration of a terahertz detector traceable to the International System of Units (SI), he is leading PTB's working group terahertz radiometry. Large-area pyroelectric detectors with constant spectral responsivity in the entire THz spectral range were developed jointly with a manufacturer. These unique THz detectors were awarded the German Association for Sensor and Measurement Technology (AMA) special Innovation Award 2017 for Young Companies after the absolute THz power of a time-domain spectroscopy (TDS) system was measured for the first time.

Within the scope of his THz standardization activities at the German metrology institute PTB, Dr. Steiger is a founding member of the German VDI/VDE Technical Committee 8.17 "Terahertz Systems". Its task is to develop first technical guidelines for time- and frequency-resolved THz systems.

Having performed an initial international comparison of spectral responsivity in the THz spectral range at two laser frequencies (2.52 THz and 762 GHz), Dr. Steiger now chairs the Discussion Forum on THz Metrology (CCPR-WG-SP-TG8) at the Bureau International des Poids et Mesures (BIPM).

I²MTC 2022 Plenary Speaker: Dr. Marina Gertsvolf

Biography: Marina Gertsvolf is the Team Leader for Frequency and Time (F&T) group at National Research Council (NRC) Canada and is responsible for realising the second, an SI unit of time, and for maintaining and disseminating the official time for Canada, UTC(NRC).

Dr. Gertsvolf received her PhD from the University of Ottawa in 2009 and joined NRC as a research officer the same year. In 2016 she became the F&T team leader and has been leading the group and the development of the next generation frequency standards and dissemination services that meet and exceed current industry and society needs. NRC F&T group operates and develops among others, the cesium fountain atomic clock, the primary realization of SI second; the single trapped strontium ion clock, the most accurate frequency standard in Canada and one of the best in the world; the nanosecond accuracy time dissemination service to remote clients in support of the critical infrastructure needs, and the frequency comb systems for frequency calibration and comparisons.

Dr. Gertsvolf serves on several international committees and working groups. Among others she is the Commission A Chair of Canadian National Committee for the International Union of Radio Science (URSI), the Chair of the International Atomic Time Working Group at the Consultative Committee of Time and Frequency (CCTF-WGTAI) and the Deputy Technical Chair of the Systema Interamericano de Metrologia (SIM).

SI Second and UTC – Today and Tomorrow
Wednesday, May 18th from 11:00 – 12:00
International Ballroom ABC

Summary: The second still remains the best realised unit in SI (it has the smallest uncertainties), but this is no longer enough for frequency and time (F&T) metrologists and they are preparing for the redefinition of the second in the next few years. International F&T community is working hard nowadays to prepare all stakeholders for the new optical second that will have the realisation uncertainties at 1E-18 level, compared to 1E-16 level of the microwave Caesium standards.

In addition to new frequency standards, the attention to the accessibility and stability of UTC is high priority; modern technologies require high accuracy and secure time synchronization and F&T metrology is developing systems and methods that allow the transition of nanosecond accuracy from the National Labs to the client's systems.

I will present NRC F&T work that covers a wide range of activities – Caesium fountain NRC primary frequency standard realizing the SI second for Canada, portable single trapped Strontium Ion optical clock that will provide NRC with access to new optical SI second, and nanosecond accuracy time dissemination for the most demanding applications.

I²MTC 2022 Plenary Speaker: Dr. Paul Corkum

Biography: Paul Corkum graduated from Lehigh University, USA, with a Ph.D. in theoretical physics in 1972. In 1973, he joined the staff of the National Research Council (NRC) of Canada where he built one of the world's most famous groups working on the interaction of very short light pulses with matter. Dr. Corkum is a Full Professor of Physics and a Canada Research Chair at the University of Ottawa, and directs the Joint NRC/University of Ottawa Attosecond Science Laboratory. He is a member of the Royal Society of London and of the Royal Society of Canada, and also a foreign member of the US National Academy of Science, the Austrian Academy of Science, and the Russian Academy of Sciences. Among his many honours and recognitions, he has received the 2017 Royal Medal for his major contributions to laser physics and the development of the field of attosecond science, as well as the Schneider Medal, the highest NRC distinction bestowed upon NRC researchers. In 2018, Dr. Corkum was awarded both the SPIE Gold Medal, and the Isaac Newton Medal and Prize from the UK Institute of Physics. In 2019, he received the Willis E. Lamb Award for Laser Science and Quantum Optics. Most recently, the Wolf Foundation selected Dr. Corkum as the recipient of the 2022 Wolf Prize Laureate in Physics.

Optically Generated Magnetic Fields
Thursday, May 19th from 10:30 – 11:30
International Ballroom ABC

based on a joint work of
P. B. Corkum1, K. Jana1, S. Möller1, Y. Mi1, S. Sederberg1, M. Mountney2 and A. Emmanouilidou2
1Joint Attosecond Science Laboratory, University of Ottawa, and National Research Council of Canada
2University College London

Summary: Isolated magnetic fields are used extensively in solid state physics, medical physics, and chemistry. These magnetic fields are often generated in wire loops with Biot-Savart law relating the time-dependent current flowing to a dynamic magnetic field. However, physical wires constrain the magnitude, the time-dependence, and the dimensions of the fields.

Controlled currents can be optically injected into semiconductors, dielectrics, gases, or plasmas using coherent control – the perturbative or non-perturbative interference of quantum pathways from an initial state to a final state in the material itself. Like their wire counterparts, these material currents create fields, but with different constraints than those generated by physical wires.

Optical injection allows the spatial dimensions to be confined to the focal volume of a vacuum ultraviolet (VUV) pulse (~100 nm) while the rise time of the current is determined by the femtosecond pulse duration of the exciting beams. Furthermore, since the magnitude and direction of these currents are controlled by interference, the motion of the charge carriers can be controlled with a spatial-light modulator. I will describe how we measure current in GaAs and the dynamic near-field magnetic structure that Maxwell's equations imply. I will also describe the space-time coupled field that is radiated (sometimes called a "flying doughnut") and measured by electro-optic sampling. I will conclude with a space-time measurement of the linear electronic spectrum of water vapor in the THz spectral region.

I²MTC 2022 Tutorial Speakers

Data Preprocessing Techniques for Multiscale Measurements Analytics
- Grigore Stamatescu, University Politehnica of Bucharest
- Mihaela M. Albu, University Politehnica of Bucharest

Material State Determination for Process State Awareness
- James A. Smith, Idaho National Laboratory

Multiscale Microwave and Millimeter-Wave Nondestructive Testing and Evaluation
- Kamel Haddadi, University of Lille

Stone Soup: an open-source tracking and state estimation framework; principles, use and applications
- Lyudmil Vladimirov, University of Liverpool
- David Kirkland, Defence Research and Development Canada
- Peter Carniglia, Defence Research and Development Canada
- Emily Hunter, Defence Research and Development Canada
- Divy Raval, Defence Research and Development Canada
- Nikki Perree, Defence Science and Technology Laboratory
- James Wright, Defence Science and Technology Laboratory

The Measurement and Application of Permittivity Using Vector Network Analyzers
- Phil Bartley, Innovative Measurement Solutions, Inc.

Diversity and Inclusion in I&M

Georgette Macdonald
Director General, Metrology
National Research Council Canada
https://www.linkedin.com/in/georgettemacdonald/
Twitter: @GeorgetteM

Biography: Georgette Macdonald is the Director General of the NRC Metrology Research Centre, Canada's National Metrology Institute. Georgette provides leadership and direction to the research and measurement services within NRC Metrology in support of NRC's strategic goals to promote the advancement of knowledge. She links ideas to implementation through collaborations with stakeholders across the innovation landscape. She is committed to fostering innovations that are enabled by high-precision measurement science and advancements in metrology. Her programs deliver coherent metrological advice, and improve and inform national decision making for commerce, standards development, regulation, and trade agreements. Her research centre's activities ensure the Canadian market has access to and confidence in competent measurement solutions and while supporting the international recognition of Canada's National Accreditation schemes and National Measurement System.

Georgette's technical background is in mass and related quantities. She started her career in metrology with GJS Mass Measurement and Fisher Scientific Canada, as a Laboratory Technologist, and then as the Laboratory Supervisor and Quality Manager. She holds an MBA from Queen's and a B.A.Sc. from uOttawa

Abstract: In my talk, I will not specifically address the benefits of diversity or the need for equity and inclusion. I will take for granted that it is understood that research organizations benefit from the diversity of thought and approaches that come from diverse community, with systems in place to encourage equity, inclusivity, and accessibility.

I will share some reflections on my personal experiences as a woman working in STEM. I'll follow-up with a presentation on the work that the NRC has been engaged in over the last number of years to better understand and improved the experiences of women in STEM that work in our organization. I will tie this work and its outcomes into the larger EDI strategy that NRC has developed. The implementation of this strategy will take actions to address the challenges of building an equitable, inclusive, and accessible work environment for all our employees and to attract a diverse pool of candidates to join our workforce.

I'll conclude with an invitation to connect, reflect, and build on our experiences by finding ways to learn from our missteps and sharing our successes.

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I²MTC Tradition

The first IEEE Instrumentation and Measurement Technology Conference was held in 1984 aboard the Queen Mary in Long Beach, California. But its origins stretch back nearly 20 years earlier to the Electrical and Electronic Measurement and Test Instrument Conference held each year from 1966 until 1981 in Ottawa, Canada. The latter was revived by the IEEE Instrumentation and Measurement Society with a new focus on all aspects of instrumentation and measurement. The following list contains locations and themes of the I²MTC conferences:

1984 – Long Beach, CA, USA, Automation-Quality-Productivity
1985 – Tampa, FL, USA, Measurement Science
1986 – Boulder, CO, USA, Standards of Excellence
1987 – Boston, MA, USA, The Changing Face of I&M Technologies
1988 – San Diego, CA, USA, Intelligence in Instrumentation
1989 – Washington, DC, USA, Persuasive I&M Technology – A Resource
1990 – San Jose, CA, USA, Emerging Measurement Technologies
1991 – Atlanta, GA, USA, Enhancing Productivity with Instrumentation and Measurement Technologies
1992 – Meadowlands, NJ, USA, Smart People, Smart Instruments, Smart Measurements
1993 – Irvine, CA, USA, Innovative Ideas for Industry
1994 – Hamamatsu, Japan, Advanced Technologies in Instrumentation and Measurement
1995 – Waltham, MA, USA, I3C – Integrating Intelligent Instrumentation and Control
1996 – Brussels, Belgium, Quality Measurements – The Indispensable Bridge between Theory and Reality (No Measurements? No Science!)
1997 – Ottawa, Canada, Sensing, Processing, Networking
1998 – St. Paul, MN, USA, Where Instrumentation is Going
1999 – Venice, Italy, Measurements for the New Millennium
2000 – Baltimore, MD USA, Smart Connectivity: Integrating Measurement and Control
2001 – Budapest, Hungary, Rediscovering Measurement in the Age of Informatics
2002 – Anchorage, AK, USA, The Frontier of Instrumentation and Measurement
2003 – Vail, CO, USA, Instrumentation and Measurement at the Summit
2004 – Lake Como, Italy, From the Electrometer to the Networked Instruments: A Giant Step toward a Deeper Knowledge
2005 – Ottawa, Canada, The 22nd Reunion
2006 – Sorrento, Italy, A View on the New Technologies for Instrumentation and Measurement
2007 – Warsaw, Poland, Synergy of Science and Technology in Instrumentation and Measurement
2008 – Victoria, British Columbia, Canada, Advances in the Science of Measurement Technology
2009 – Singapore, Always On: Instrumentation and Measurement in the Networked World
2010 – Austin, TX, USA, Innovative and Integrated Applications of I&M
2011 – Binjiang, Hangzhou, China, Instrumentation and Measurement for Improving Quality of Life
2012 – Graz, Austria, Smart Measurements for a Sustainable Environment
2013 – Minneapolis, MN, USA, Instrumentation and Measurement for Life
2014 – Montevideo, Uruguay, Instrumentation and Measurement for Sustainable Development
2015 – Pisa, Italy, The "Measurable" of Tomorrow: Providing a Better Perspective on Complex Systems
2016 – Taipei, Taiwan, Measuring the Pulse of Industries, Nature and Humans
2017 – Torino, Italy, "Man is the measure of all things" - Protagoras
2018 – Houston, TX, USA, Discovering New Horizons in Instrumentation and Measurement
2019 – Auckland, New Zealand, The Lords of the IMS: Expanding the Frontiers of Metrology Innovations
2020 – Dubrovnik, Croatia (Moved Fully Virtual), Technology Advancement Through Strong Foundation and Persistent Innovation
2021 – Glasgow, Scotland (Moved Fully Virtual), To Measure Is To Know
2022 – Ottawa, Canada, Instrumentation & Measurement Under Pandemic Constraints

Awards and Distinctions

Each year the IEEE Instrumentation and Measurement Society accepts nominations for its awards. The AdCom Awards Committee manages the nominations process, reviews the candidates, and recommends a slate. The slate of candidates is then submitted to the Society AdCom for approval and the awards are presented at our annual Awards Ceremony held as part of the I²MTC conference. The Awards Committee is pleased to announce the 2021 I&M Society Award and 2022 I&M Society Education Award winners.

2021 IEEE Transactions on I&M Outstanding Associate Editors

Adam Polakk
Alessio De Angelis
Anirban Mukherjee
Arunava Naha
Bruno Albuquerque de Castro
Chi Hung Wang
Datong Liu
Dimitrios Georgakopoulos
Eduardo Cabal-Yepez
Fabricio Guimaraes Baptista
Guglielmo Frigo
Helko E. van den Brom
Hongrui Wang
Jianbo Yu
Jing Lei
Kristen Donnell
Lorenza Ciani
Mohamad Forouzanfar
Qiang Miao
Rajarshi Gupta
Seyed Hossein Hesamedin Sadeghi
Subhas Mukhopadhyay
Yan Zhuang
Yuan Gao
Zhigang Liu

2021 I&M Society Awards

IEEE Instrumentation and Measurement Society Andy Chi Best Paper Award

"Linking the Power Scales of Free-Space and Waveguide-Based Electromagnetic Waves," *IEEE Transactions on Instrumentation and Measurement*, vol. 69, no. 11, pp. 9056-61, Nov. 2020
R.Judaschke, M. Kehrt, K. Kuhlmann and A. Steiger

IEEE Instrumentation and Measurement Society Best Application Award

Wuqiang Yang, University of Manchester, United Kingdom

"For the impact of his work on online monitoring of fluidized beds in the following three aspects: (1) pharmaceuticals, (2) methanol-to-olefin (MTO) conversion, and (3) clean coal combustion."

IEEE Instrumentation and Measurement Society Outstanding Young Engineer Award

Roberto Ferrero, University of Liverpool, United Kingdom

"For contributions to the advancement of I&M methods and algorithms for electrical and electrochemical power systems."

IEEE Instrumentation and Measurement Society Technical Award

Leopoldo Angrisani, University of Napoli, Federico II, Italy

"For contributions in the advancement of innovative methods and techniques for communication systems test and measurement."

IEEE Instrumentation and Measurement Society Distinguished Service Award

Shervin Shirmohammadi, University of Ottawa, Canada

"For exceptional and tireless service to the I&M Society and its members and for dedication to elevate the stature of the IEEE Transactions on Instrumentation and Measurement through quality."

IEEE Instrumentation and Measurement Society Career Excellence Award

Emil Petriu, University of Ottawa, Canada

"For a career dedicated to academic research, engineering education, industry R&D, training and mentorship in the field of intelligent sensors, and for outstanding and continuous service to I&M society's conferences, journal, technical committees, and Administrative Committee."

2022 I&M Society Education Awards

IEEE Instrumentation and Measurement Society Graduate Fellowship Awards

Zihan Xia, University of Manchester, United Kingdom

For the project titled, "Multimodality sensing technique for monitoring complex structures enhanced by deep learning and advanced electromagnetic modelling."

Francesca Mancino, University Federico II, Naples, Italy

For the project titled, "Transdermal Delivery Universal Meter (TDeUM)."

Hui Wang, Southeast University, China

For the project titled, "An Online Intelligent Fault Diagnosis Method and Device for Industrial Equipment."

Anne Tryphosa Kamatham, Indian Institute of Technology Delhi, India

For the project titled, "Sonomyography-based muscle activity sensing and control of bionic devices."

IEEE Instrumentation and Measurement Society Faculty Course Development Award

Mathias Bonmarin, Zurich University of Applied Sciences, Switzerland

For the course entitled, "Thermal Devices and Instrumentation in Medicine and Biology"

IEEE Instrumentation and Measurement Society Best Dissertation Award

Andrea Alimenti, Università Roma Tre, Italy

For the dissertation titled, "Advanced microwave resonant measurement techniques for the characterization and study of dielectrics, conductors and superconductors"

2022 Instrumentation and Measurement Society Fellows

Ruqiang Yan, Xi'an Jiaotong University, China

"For contributions to defect/fault detection and diagnosis of rotating machines."

2021 Instrumentation and Measurement Society Senior Member Elevations

Juan Aguilar
Arslan Ahmed Amin
Fahd Banakhr
Wolfgang Boss
Duane Brown
Alice Buffi
Murat Celep
Katudampe Vithanage Chathuranga
Euclides Chuma
Richard Cselko
Alfredo De Blas Del Hoyo
Debanjan Das
Paul Desmarais
Lamiaa El Menzhi
Ahmed Ghoneim
Melvin Hayes
Abhishek Kandwal
Tae-Weon Kang
Zachary Kratzer
Chung-Hsien Kuo
Satoru Kurokawa
Consolatina Liguori
Ming Lu
Zeljka Lucev Vasic
Suresh M
Jiayi Ma
Carlo Massaroni
Adam Mehrabani
George Mois
Boon Yaik Ooi
Carmen Perez
Xiangchen Qian
Fabien Ravet
Kamran Raza
Khairur Rijal
Ilona Rolfes
Nirmala Sanikommu
Bill Sekulic
Maarten Schoukens
Elie Shammas
Shiraz Sohail
Manish Shrivastava
Marco Tarabini
Jason Vosatka
Mark Wehde
Emanuele Zappa

IEEE Instrumentation and Measurement Society Standing Committee Chairs

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Boston Scientific Corporation, USA

Conferences Committee
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Federal University of Rio Grande do Norte (UFRN), Brazil

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Missouri University of Science & Technology, USA

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Nominations & Appointments Committee
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Iowa State University, USA

Publications Committee
George Xiao
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Technical & Standards Activities Committee
Marco Parvis
Politecnico di Torino, Italy

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National Research Council, Canada

Vice President Technical & Standards Activities
Marco Parvis
Politecnico di Torino, Italy

Treasurer
Helena Geirinhas Ramos
Technical University of Lisbon, Portugal

IEEE Instrumentation and Measurement Society: Administrative Committee

Members-at-Large 2019-2022

Lee Barford, Keysight Technologies, USA
Melanie Ooi, The University of Waikato, New Zealand
Ferdinanda Ponci, RWTH Aachen University, Germany
Wendy Van Moer, M&W Technics BVBA, Belgium

Members-at-Large 2020-2023

Sabrina Grassini, Politecnico di Torino, Italy
Chi Hung Hwang, Taiwan Instrument Research Institute, NARLabs, Taiwan
Juan Manuel Ramirez Cortés, National Institute of Astrophysics, Optics, & Electronics, Mexico
Reza Zoughi, Iowa State University, USA

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Kurt Barbé, Vrije Universiteit Brussel, Belgium
Branislav Djokic, National Research Council, Canada
Sergio Rapuano, University of Sannio, Italy
Ruqiang Yan, Xi'an Jiaotong University, China

Members-at-Large 2022-2025

Katelyn Brinker, Iowa State University, USA
Luca De Vito, Università degli Studi del Sannio, Italy
Ruth A. Dyer, Kansas State University, USA
Salvatore Graziani, Università di Catania, Italy

Other Administrative Committee Members

IMM Editor-in-Chief, Bruno Andò, University of Catania, Italy
OJIM Editor-in-Chief, Shervin Shirmohammadi, University of Ottawa, Canada
TIM Editor-in-Chief, Ruqiang Yan, Xi'an Jiaotong University, China
Graduate Student Representative, Matthew Dvorsky, Iowa State University, USA
Undergraduate Student Representative, Aaron McCarville, Iowa State University, USA
Young Professionals Representative, Judy Amanor-Boadu, Intel Corporation, USA

I²MTC 2022 Social Events

Tutorial/Young Professional Reception
- Time: 17:00 – 18:30
- Location: Delta Hotel – Penthouse

Welcome Reception
- Time: 17:30 – 19:00
- Location: Delta Hotel – Penthouse

Gala Dinner
- Time: 17:30 – 21:00
  - Shuttle Buses to the Museum will run from 17:30 – 18:30. Return shuttle buses to the Delta Hotel will run from 20:30 – 21:30.
- Location: Canadian Museum of History

I²MTC 2022 General Information

Registration & Information Desk:
> The Registration & Information desk is located in Victoria.
> Name Badges can be picked up at registration and are required for access to all conference events.

Registration Hours:

Monday, May 16	7:30 – 17:00
Tuesday, May 17	7:00 – 17:00
Wednesday, May 18	7:30 – 17:00
Thursday, May 19	7:30 – 17:00

Electronic Proceedings:
> A download link for the conference proceedings will be emailed to registered attendees. The proceedings download link will be available from May 16-June 16, 2022.

Conference Attire:
> Attire during the duration of the conference is business casual.

WiFi:
> WiFi Access is available to attendees.
> Browser: Delta_Conference
> Password: delta2022

Cellular Phones:
> As a courtesy to fellow attendees, please silence electronic devices.

Conference App:
> Instructions to download and access the conference app will be emailed to registered attendees within 72 hours of the start of the conference.
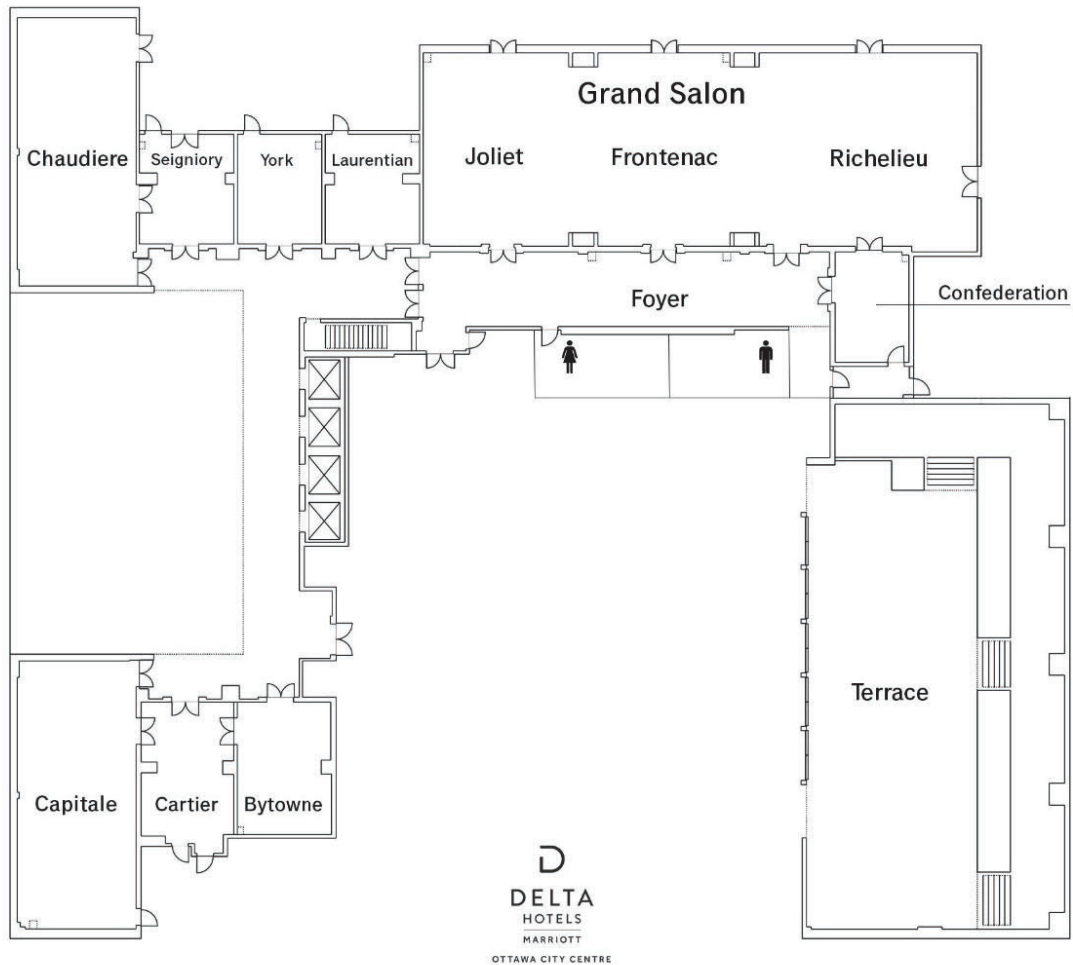
Exhibit Hours:

Exhibitor Set-Up – Monday, May 16	13:30 – 17:00
Exhibit Hall Open - Tuesday, May 17	10:00 – 17:00
Exhibit Hall Open - Wednesday, May 18	10:00 – 17:00
Exhibit Hall Open - Thursday, May 19	10:00 – 17:00
Exhibitor Clean-Up – Thursday, May 19	17:00 – 18:30

I²MTC 2022 Venue Layout

Lobby Level

Lobby

Entrance

Victoria

International Ballroom

A   B   C

Foyer

DELTA HOTELS MARRIOTT

Convention Level

Chaudiere

Seigniory

York

Laurentian

Grand Salon

Joliet   Frontenac   Richelieu

Foyer

Confederation

Capitale   Cartier   Bytowne

Terrace

DELTA HOTELS MARRIOTT OTTAWA CITY CENTRE

Penthouse Level

Foyer

Pinnacle

Panorama

DELTA
HOTELS
MARRIOTT
OTTAWA CITY CENTRE
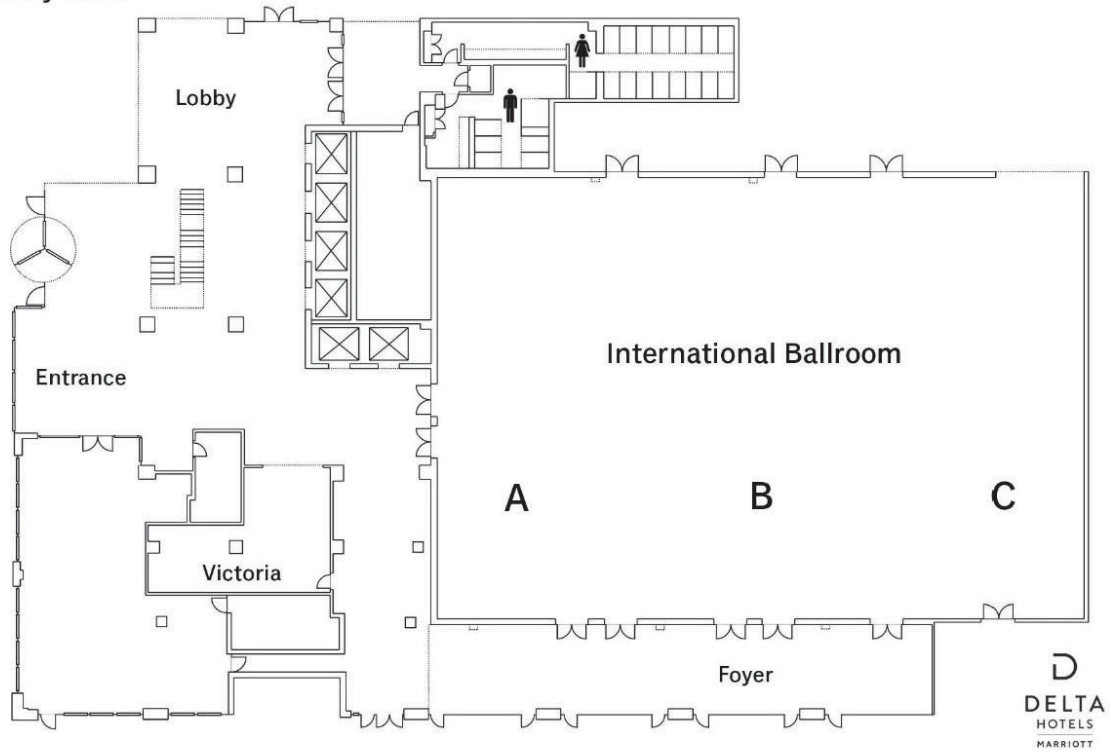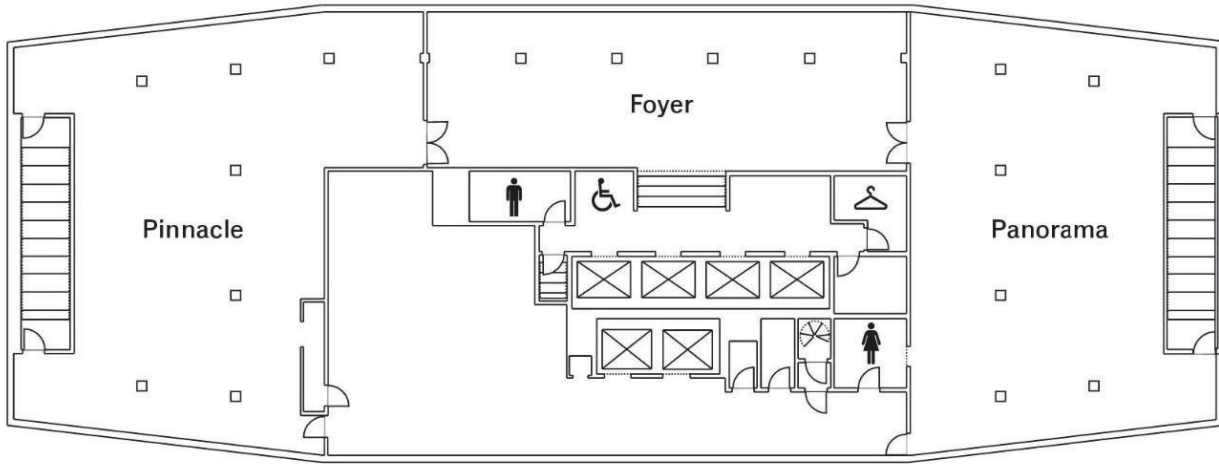
I²MTC 2022 Exhibit and Poster Hall Layout

International Ballroom ABC
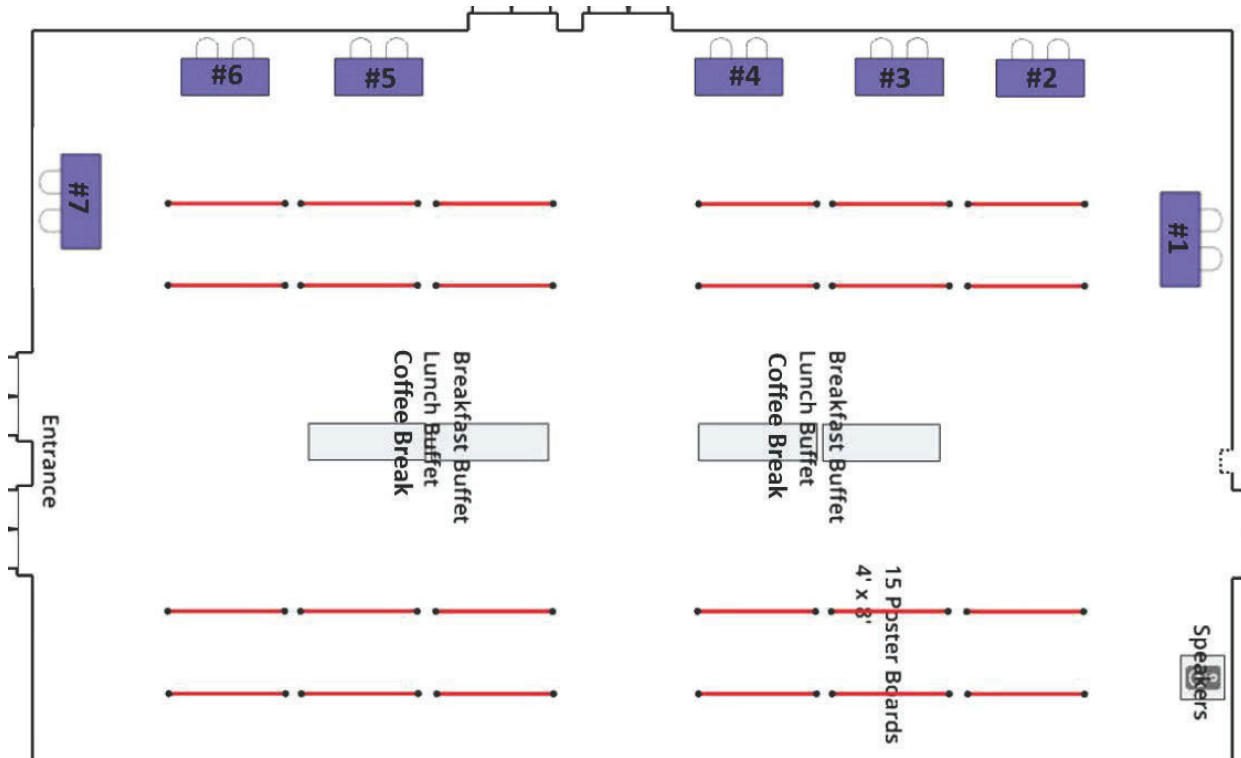
Exhibit Booth Assignments

Booth #1	IEEE Instrumentation & Measurement Society
Booth #2	Siborg Systems Inc.
Booth #3	Guildline Instruments
Booth #4	HV Technologies, Inc.
Booth #5	uOttawa
Booth #6	National Research Council Canada
Booth #7	Carleton University

I²MTC 2022 Program Grid – Tutorials – Monday, May 16, 2022

Registration Hours: 7:30 – 17:00 *(Victoria)*
Exhibitor Set-Up: 13:30 – 17:00 *(International Ballroom ABC)*

8:30 – 10:00		**Material State Determination for Process State Awareness** *(Richelieu)*
10:00 – 10:30	**Break** *(Foyer)*	
10:30 – 12:00	**Multiscale Microwave and Millimeter-Wave Nondestructive Testing and Evaluation** *(Frontenac)*	**The Measurement and Application of Permittivity Using Vector Network Analyzers** *(Richelieu)*
12:00 – 13:30	**Lunch Break** *(International Ballroom ABC)*	**YP Meeting** *(Richelieu)*
13:30 – 15:00	**Data Preprocessing Techniques for Multiscale Measurements Analytics – Part 1** *(Frontenac)*	**Stone Soup: An Open-Source Tracking and State Estimation Framework; Principles, Use and Applications – Part 1** *(Richelieu)*
15:00 – 15:30	**Break** *(Foyer)*	
15:30 – 17:00	**Data Preprocessing Techniques for Multiscale Measurements Analytics – Part 2** *(Frontenac)*	**Stone Soup: An Open-Source Tracking and State Estimation Framework; Principles, Use and Applications – Part 2** *(Richelieu)*
17:00 – 18:30	**Tutorial/Young Professional Reception** *(Penthouse)*	

I²MTC 2022 Program Grid – Tuesday, May 17, 2022

Registration Hours: 7:00 – 17:00 *(Victoria)*
Exhibit Hall Hours: 10:00 – 17:00 *(International Ballroom ABC)*

8:00 – 8:30	**Opening Ceremony** *(International Ballroom ABC)*
8:30 – 9:30	**2022 IEEE Joseph F. Keithley Award in Instrumentation and Measurement Presentation** *(International Ballroom ABC)*
9:30 – 10:00	**2022 IEEE Joseph F. Keithley Award Ceremony** *(International Ballroom ABC)*
10:00 – 10:30	**Break** *(International Ballroom ABC)*

10:30 – 12:30	**Image Processing and Vision Based Measurement** *(Chaudiere)*	**Sensors and Transducers** *(Joliet)*	**Instrumentation and Measurement for Industry 4.0 and for the Automotive and Transportation Industry** *(Frontenac)*	**Optical and Fiber Optic Instrumentation and Measurement** *(Richelieu)*

12:30 – 13:30	**Lunch** *(International Ballroom ABC)*
13:30 – 14:30	**IEEE Instrumentation and Measurement Society Andy Chi Best Paper Award Presentation** *(International Ballroom ABC)*

14:30 – 15:30	**Tuesday Poster Session & TIM Poster Session** *(International Ballroom ABC)*	**Break** *(International Ballroom ABC)*

15:30 – 17:30	Instrumentation and Measurement for the Energy and Power Industry *(Chaudiere)*	SPS 1: Instrumentation and measurement for improving quality, reliability and safety: new perspectives for research and industry *(Joliet)*	SPS 5: IOT - Based Smart Measurement Systems: New Communication and Artificial Intelligence Techniques, SPS 6: Sensors, Instrumentation, and Artificial Intelligence technologies for Environmental Measurement and Modelling *(Frontenac)*	Instrumentation and Measurement for Non-Destructive Testing and Evaluation *(Richelieu)*
17:30 – 19:00	**Welcome Reception** *(Penthouse)*			

I²MTC 2022 Program Grid – Wednesday, May 18, 2022

Registration Hours: 7:30 – 17:00 *(Victoria)*
Exhibit Hall Hours: 10:00 – 17:00 *(International Ballroom ABC)*

8:00 – 10:00	**Machine Learning and Big Data for Instrumentation and Measurement** *(Chaudiere)*	**Instrumentation and Measurement for Non-Destructive Testing and Evaluation** *(Joliet)*	**Image Processing and Vision Based Measurement** *(Frontenac)*	**Instrumentation and Measurement for the Oil and Gas Industry** *(Richelieu)*
10:00 – 10:30	**Break** *(International Ballroom ABC)*			
10:30 – 11:00	**Award Ceremony** *(International Ballroom ABC)*			
11:00 – 12:00	**Plenary Speaker: Dr. Marina Gertsvolf** *(International Ballroom ABC)*			
12:00 – 13:00	**Lunch** *(International Ballroom ABC)*			
13:00 – 14:00	**Wednesday Poster Session** *(International Ballroom ABC)*			**Diversity and Inclusion in I&M** *(Richelieu)*
14:00 – 15:30	**Industry Session** *(International Ballroom ABC)*			**Break** *(International Ballroom ABC)*
15:30 – 17:30	**Data Acquisition Systems** *(Chaudiere)*	**Circuits and Embedded Systems for Instrumentation and Measurement** *(Joliet)*	**SPS 2: Electrical Impedance Measurement and Its Applications** *(Frontenac)*	**Instrumentation and Measurement in Aerospace and Space Systems** *(Richelieu)*
17:30 – 21:00	**Gala Dinner** *(Canadian Museum of History)*			

I²MTC 2022 Program Grid – Thursday, May 19, 2022

Registration Hours: 7:30 – 17:00 *(Victoria)*
Exhibit Hall Hours: 10:00 – 17:00 *(International Ballroom ABC)*
Exhibitor Clean-Up: 17:00 – 18:30 *(International Ballroom ABC)*

8:00 – 10:00	**Image Processing and Vision Based Measurement** *(Chaudiere)*	**Instrumentation and Measurement in Agriculture, Food Production and Food Safety and in Environmental Monitoring** *(Joliet)*	**Sensors and Transducers** *(Frontenac)*	**Instrumentation and Measurement in Medical, Biomedical and Healthcare Systems** *(Richelieu)*
10:00 – 10:30	**Break** *(International Ballroom ABC)*			
10:30 – 11:30	**Plenary Speaker: Dr. Paul Corkum** *(International Ballroom ABC)*			
11:30 – 12:30	**Lunch** *(International Ballroom ABC)*			
12:30 – 14:00	**Industry Session** *(International Ballroom ABC)*			
14:00 – 16:00	**SPS 8: Metrological performance of Low-cost platforms for measurement applications and SPS 9: Measurement Systems for Harsh Operating Conditions** *(Chaudiere)*	**Instrumentation and Measurement in Medical, Biomedical and Healthcare Systems** *(Joliet)*	**SPS 7: Laser Sensing and Imaging Techniques and System** *(Frontenac)*	**Signal Processing for Instrumentation and Measurement** *(Richelieu)*

16:00 – 17:00	**Break** *(International Ballroom ABC)*	**Thursday Poster Session** *(International Ballroom ABC)*	**Presentations of IM Patents @ I²MTC** *(International Ballroom ABC)*	**Late Results Poster Session** *(International Ballroom ABC)*
17:00 – 18:00	**Closing Ceremony & 2023 Announcement** *(International Ballroom ABC)*			

8:30 - 10:00
Material State Determination for Process State Awareness
Room: Richelieu

By: James A. Smith, Idaho National Laboratory

Abstract: Materials State Awareness (MSA) research and development has advanced science and technology that addresses the sensing of the material's state at the microstructure level. A crucial element of MSA is predicting the future state of the material system. MSA technology can be used to predict and control process states. The key difference between Process State Awareness (PSA) and standard control techniques is that the in-situ materials characterization of the product is a major input into the control system along with standard industrial process sensors. Successful implementation of a PSA program will require close collaboration between sensor researchers, materials experts and measurement specialists.

This tutorial will discuss PSA development efforts within industrial, national lab, and medical sectors. The MSA techniques and philosophy will be confirmed to be at the core of PSA development that will determine and predict the state of a process.

10:00 - 10:30
Monday AM Break
Room: Foyer

10:30 - 12:00
Multiscale Microwave and Millimeter-Wave Nondestructive Testing and Evaluation
Room: Frontenac

By: Dr. Kamel Haddadi, University of Lille

Abstract: RF and microwave techniques and instrumentations have been widely described in the literature to address electrical or/and dielectric characterization of devices and materials. Thanks to its high potential, microwave nondestructive testing and evaluation (MNDT&E) has attracted industry in a wide range of sensing applications at different scales of dimensions. MNDT&E of materials is an important science that involves the development of RF and microwave instrumentations including sensors/probes, methods and calibration techniques to extract the quantities of interest from the measured signals, applications including detection of cracks, defects, dielectric homogeneities, characterization of complex permittivity. MNDT&E refers to alternating signals or electromagnetic waves in the frequency range 300 MHz – 300 GHz. The spatial resolution mainly governed by the wavelength of operation is theoretically limited by the diffraction limit, i.e. half free-space wavelength. Thanks to their penetrations in non-metallic materials, MNDT&E techniques have advantages over established NDT techniques. This talk will review the foundations including wave to material interaction, microwave instrumentation, measurement methods and applications.

10:30 – 12:00
The Measurement and Application of Permittivity Using Vector Network Analyzers
Room: Richelieu

By: Phil Bartley, Innovative Measurement Solutions, Inc.

Abstract: The permittivity (dielectric properties) of a material is one of the factors that determine how the material interacts with an electromagnetic field. The knowledge of the permittivity of materials and its frequency and temperature dependence is important in various areas of science and engineering in both basic and applied research. It has always been an important quantity to electrical engineers and physicists involved in the design and application of circuit components. Over the past several decades the knowledge of permittivity has become an important property to scientists and engineers involved in the design of stealth vehicles. These applications are most often associated with the defense and space industries. For the typical electrical engineer permittivity is a number that is needed to apply Maxwell's equations. Besides discussing the various techniques that can be used to measure permittivity, one of the purposes of the tutorial is to explain why a material has a particular permittivity. The short answer is that a material has a particular permittivity because of its molecular structure. Another purpose is show how permittivity can be related to other physical material properties.

12:00 - 13:30
Monday Lunch Break
Room: International Ballroom ABC

12:00 - 13:30
YP Meeting
Room: Richelieu

13:30 - 15:00
Data Preprocessing Techniques for Multiscale Measurements Analytics - Part 1
Room: Frontenac

By: Grigore Stamatescu, University Politehnica of Bucharest
Mihaela M. Albu, University Politehnica of Bucharest

Abstract: Distributed measurement systems generate large quantities of online and streaming datasets that need to be processed in real-time for decision support and/or control purposes. In many situations the resulting data cannot be used directly by intelligent algorithms and suitable data preprocessing pipelines need to be defined and implemented. Furthermore, the heterogenous reporting rates, embedded measurement models and spatial scales at which the measurements are collected need to be aligned in a robust manner for many tasks. The tutorial will present current approaches for time series data mining with the goal of information extraction in imbalanced class problems e.g. labelling of micro-scale transient regimes, noise reduction, and improving the computational efficiency of learning algorithms for prediction and anomaly detection. Automatic feature extraction and selection is described as a useful tool that reduces the input space size while conserving the key features of the data generative process that yields the measurements. Domain knowledge is required to adapt generic algorithms and tools to the specific nature of the application. Hands-on activities will highlight the practical use of the Python tsfresh and matrixprofile open-source packages on real residential active power measurements collected in the context of two research projects.

13:30 - 15:00
Stone Soup: An Open-source Tracking and State Estimation Framework; Principles, Use and Applications - Part 1
Room: Richelieu

By: Lyudmil Vladimirov, University of Liverpool
David Kirkland, Defence Research and Development Canada
Peter Carniglia, Defence Research and Development Canada
Emily Hunter, Defence Research and Development Canada
Divy Raval, Defence Research and Development Canada
Nikki Perree, Defence Science and Technology Laboratory
James Wright, Defence Science and Technology Laboratory

Abstract: It is currently difficult and time-consuming for academic researchers to recreate state-of-the-art tracking and state estimation algorithms to benchmark their work. Comparison of new algorithms with existing solutions involves recoding algorithms from the literature. Industrial users also find it difficult to assess which algorithms meet their requirements.

The Stone Soup framework is designed to provide a flexible and unified software platform for researchers and engineers to develop, test and benchmark a variety of existing multi-sensor and multi-object estimation algorithms. It profits from the object-oriented principles of abstraction, encapsulation and modularity, allowing users and developers to focus only on the most critical aspects of their problem.

These tutorials will introduce participants to Stone Soup's basic components and how they fit together. They are delivered by way of demonstrations, set tasks and interactive sessions where participants will be encouraged to write and modify algorithms.

The first tutorial will begin with basic examples using linear transition models, abstract range-bearing sensors and single-targets using the extended and unscented Kalman and particle filters. Multiple targets, clutter and methods of data association will be introduced. The second tutorial session is an interactive grouped activity, applying Stone Soup to several scenarios involving simulated and real-world data.

15:00 - 15:30
Monday PM Break
Room: Foyer

15:30 - 17:00
Data Preprocessing Techniques for Multiscale Measurements Analytics - Part 2
Room: Frontenac

By: Grigore Stamatescu, University Politehnica of Bucharest
Mihaela M. Albu, University Politehnica of Bucharest

Abstract: Distributed measurement systems generate large quantities of online and streaming datasets that need to be processed in real-time for decision support and/or control purposes. In many situations the resulting data cannot be used directly by intelligent algorithms and suitable data preprocessing pipelines need to be defined and implemented. Furthermore, the heterogenous reporting rates, embedded measurement models and spatial scales at which the measurements are collected need to be aligned in a robust manner for many tasks. The tutorial will present current approaches for time series data mining with the goal of information extraction in imbalanced class problems e.g. labelling of micro-scale transient regimes, noise reduction, and improving the computational efficiency of learning algorithms for prediction and anomaly detection. Automatic feature extraction and selection is described as a useful tool that reduces the input space size while conserving the key features of the data generative process that yields the measurements. Domain knowledge is required to adapt generic algorithms and tools to the specific nature of the application. Hands-on activities will highlight the practical use of the Python tsfresh and matrixprofile open-source packages on real residential active power measurements collected in the context of two research projects.

15:30 - 17:00
Stone Soup: An Open-source Tracking and State Estimation Framework; Principles, Use and Applications - Part 2
Room: Richelieu

By: Lyudmil Vladimirov, University of Liverpool
David Kirkland, Defence Research and Development Canada
Peter Carniglia, Defence Research and Development Canada
Emily Hunter, Defence Research and Development Canada
Divy Raval, Defence Research and Development Canada
Nikki Perree, Defence Science and Technology Laboratory
James Wright, Defence Science and Technology Laboratory

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17:00 - 18:30
Tutorial/Young Professional Reception
Room: Penthouse

8:00 - 8:30
Opening Ceremony
Room: International Ballroom ABC

8:30 - 9:30
2022 IEEE Joseph F. Keithley Award in Instrumentation and Measurement Presentation
Room: International Ballroom ABC

Nonlinear System Identification: 40 years of Applications to Instrumentation
By: Ian Hunter, Massachusetts Institute of Technology (MIT) Cambridge, MA USA

In this talk I will describe the use of various nonlinear system identification techniques to many instruments we have developed both in our university labs (Auckland, McGill and MIT) and in over 30 companies we have founded. Early techniques included Quasi-linear, Wiener kernel system ID and Hammerstein and Wiener type nonlinear system ID methods. Later methods included Volterra kernel, parallel cascade and NARMAX nonlinear system ID. Instruments and other systems modeled and controlled include Raman spectrometers, IR spectrometers, mass spectrometers, nuclear magnetic resonance spectrometers, electrical impedance spectrometers, acoustic spectrometers, real-time gas chromatographs, needle free drug delivery devices, robotic endoscopes, eye surgery robots, wireless power transfer systems, in wheel multi-degree of freedom electric vehicle actuators, active electric vehicle suspension systems, artificial muscle type actuators, living muscle and skin nonlinear mechanics measurement instruments, dissolved oxygen sensors and conducting polymer energy storage technologies. The talk will include our experience in teaching linear and nonlinear system identification techniques to undergraduate and graduate students at MIT in our Instrumentation and Measurement, and Advanced Instrumentation and Measurement courses. We have developed a large number of teaching demos which may be used by students to learn system identification techniques in the context of hands-on instruments and devices. This initiative is called MICA (Measurement, Instrumentation, Control and Analysis) and is designed for use in teaching any STEM subject. In this initiative, system ID techniques are considered to be the formalized scientific method.

9:30 - 10:00
2022 IEEE Joseph F. Keithley Award Ceremony
Room: International Ballroom ABC

10:00 - 10:30
Tuesday AM Break
Room: International Ballroom ABC

Image Processing and Vision Based Measurement
Session Chairs: Chairs: Kushsairy Abdul Kadir (UNIKL-BMI, Malaysia)
Voicu Groza (University of Ottawa, Canada)
Room: Chaudiere

Hybridized Yolov4 for Detecting and Counting People in Congested Crowds

Sheroz Khan (Inetrnational Islamic University Malaysia, Malaysia); Haidawati Nasir (Universiti Kuala Lumpur, Malaysia); Kushsairy Kadir (Universiti Kuala Lumpur British Malaysian Institute, Malaysia); Muhammad Haris Kaka Khel (Electrical Section, Malaysia); Megat Norulazmi Megat Mohamed Noor (Universiti Kuala Lumpur, Malaysia)

Integration of Hough Transform and Inter-Frame Clustering for Road Lane Detection and Tracking

Sandeep Bisht (Indian Institute of Technology Roorkee, India); N. Sukumar (Indian Institute of Technology, Roorkee, India); P Sumathi (IIT Roorkee, India)

Panoptic Segmentation of Animal Fibers

Oliver Rippel and Nikolaj Schönfelder (RWTH Aachen University, Germany); Khosrow Rahimi, Juliana Kurniadi and Andreas Herrmann (DWI - Leibniz-Institut Für Interaktive Materialien, Germany); Dorit Merhof (RWTH Aachen University, Germany)

Automatic Placental Distal Villous Hypoplasia Scoring using a Deep Convolutional Neural Network Regression Model

Afsoon Khodaee (Carleton University, Canada); David Grynspan (University of British Columbia, Canada); Shannon Bainbridge (University of Ottawa, Canada); Eranga Ukwatta (University of Guelph, Canada); Adrian D.C. Chan (Carleton University, Canada)

Skin Cancer Classification based on Cosine Cyclical Learning Rate with Deep Learning

Yali Nie and Jan Lundgren (Mid Sweden University, Sweden); Marco Carratù and Paolo Sommella (University of Salerno, Italy); Mattias O'Nils (Mid Sweden University, Sweden); Moise Avoci Ugwiri (University of Salerno, Italy)

A novel image processing technique based on deep learning for water consumption detection

Marco Carratù, Salvatore Dello Iacono, Giuseppe Di Leo, Vincenzo Gallo and Consolatina Liguori (University of Salerno, Italy); Antonio Pietrosanto (University of Salerno & CEO of Metering Research srl, Italy)

10:30 - 12:30
Instrumentation and Measurement for Industry 4.0 and for the Automotive and Transportation Industry
Session Chairs: Maximilian Gruber (Physikalisch-Technische Bundesanstalt, Germany)
Chao Lui (Iowa State University, USA)
Room: Frontenac

Vertices Independent Component Analysis-based Status Monitoring Strategy for Processes with Uncertainties

Sijia Wang and Shumei Zhang (Tianjin University, China)

Application of Uncertainty-Aware Sensor Fusion in Physical Sensor Networks

Maximilian Gruber (Physikalisch-Technische Bundesanstalt, Germany); Wenzel Pilar von Pilchau (University of Augsburg, Germany); Varun Gowtham (Fraunhofer FOKUS, Germany); Nikolaos-Stefanos Koutrakis (Fraunhofer IPK, Germany); Nicolas Schönborn (Endress+Hauser Level+Pressure, Germany); Sascha Eichstädt (Physikalisch-Technische Bundesanstalt, Germany); Jörg Hähner (University of Augsburg, Germany); Marius Corici (Fraunhofer FOKUS, Germany); Thomas Magedanz (Fraunhofer Institute FOKUS / TU Berlin, Germany); Julian Polte and Eckart Uhlmann (Fraunhofer IPK, Germany)

Pavement Macrotexture Evaluation for Tire Test Benches using Surface Profile Measurements

Johannes Handler and Paul O'Leary (University of Leoben, Austria)

Small-scale test bench of maritime thruster for digital twin research

Sampo Haikonen and Ivar Koene (Aalto University, Finland); Joni Keski-Rahkonen (Kongsberg Maritime Finland Oy, Finland); Raine Viitala (Aalto University, Finland)

Traffic Safety Detection System by Digital Twins and Virtual Reality Technology

Zhihan Lv (Uppsala University, Sweden); Dongliang Chen (Qingdao University, China); M. Shamim Hossain (King Saud University & University of Ottawa, Saudi Arabia)

A simple method for the preliminary analysis and benchmarking of automotive LiDARs in fog

Davide Cassanelli (Università degli studi di Modena e Reggio Emilia, Italy); Giorgio Di Loro (University of Modena and Reggio Emilia, Italy); Stefano Cattini (University of Modena and Reggio Emilia & Science & Technology Park for Medicine, Mirandola, Modena, Italy); Luca Di Cecilia (CNH Industrial Italia Spa, Italy); Luca Ferrari (CNH Industrial, Italy); Luigi Rovati and Daniele Goldoni (University of Modena and Reggio Emilia, Italy)

10:30 – 12:30
Sensors and Transducers
Session Chairs: Bruno Ando (University of Catania, Italy)
Logan M Wilcox (Missouri University of Science and Technology, USA)
Room: Joliet

Effects on the Accuracy Performance of Rogowski Coils Due to Temperature and Humidity

Alessandro Mingotti, Federica Costa, Lorenzo Peretto and Roberto Tinarelli (University of Bologna, Italy)

Measurement Procedure to Investigate Ageing of Low-Power Voltage Transformers

Alessandro Mingotti, Lorenzo Peretto and Roberto Tinarelli (University of Bologna, Italy)

Investigation of Q Factor of the QCM Resonator Under Overtone Modes

Jianguo Hu (Tsinghua University, China)

High-sensitivity narrow-band CSRR-based Microwave Sensor for Monitoring Glucose Level

Gabriele Restifo Pecorella and Gianluca Verderame (University of Palermo, Italy); Antonio Lombardo (University College London, United Kingdom (Great Britain)); Patrizia Livreri (University of Palermo, Italy)

In Silico Study of the Use SPR for Detecting Cancer in the Colorectal Mucosa
Arthur Aprígio de Melo (Federal University of Campina Grande, Brazil); Eloise Rodrigues (Universidade Federal de Campina Grande, Brazil); Antonio Marcus Nogueira Lima (Universidade Federal de Campina Grande & Center for Electrical Engineering and Informatics, Brazil); Cleumar da Silva Moreira (Instituto Federal da Paraíba & Campus Joao Pessoa, Brazil); Rossana Moreno Santa Cruz (Instituto Federal da Paraíba, Brazil)

10:30 – 12:30
Optical and Fiber Optic Instrumentation and Measurement
Session Chairs: Grzegorz Fusiek (University of Strathclyde, United Kingdom (Great Britain))
Sivagunalan Sivanathan (Treforest Campus & University of South Wales, United Kingdom (Great Britain))
Room: Richelieu

Development of a Hardware for Frequency Scanning Interferometry for Long Range Measurement
Sivagunalan Sivanathan (Treforest Campus & University of South Wales, United Kingdom (Great Britain)); Mohammed Ali Roula (Co-Author, United Kingdom (Great Britain)); Nigel Copner (University of South Wales, United Kingdom (Great Britain)); Bethan Copner (Co-Author, United Kingdom (Great Britain))

Measurement of spray droplet velocity and size distribution by a tapered optical fiber probe
Dandan Zheng (Tianjin University, China); Maosen Wang (School of Electrical and Information Engineering, Tianjin University, China)

Measurement of interfacial characteristics and droplet entrainment in nearly horizontal liquid-liquid flows using PLIF method
Lusheng Zhai, Xinyu Meng and Zihan Meng (Tianjin University, China); Hongxin Zhang (Tianjin University of Technology and Education, China); Ningde Jin (Tianjin University, China)

Design of an optical sensor with varied sensitivities for overhead line sag, temperature and vibration monitoring
Grzegorz Fusiek (University of Strathclyde, United Kingdom (Great Britain)); Pawel Niewczas (University of Strathclyde & Synaptec Ltd, United Kingdom (Great Britain))

Molecularly Imprinted Polymers and Inkjet-Printer technology to develop Optical-Chemical Sensors
Nunzio Cennamo (University of Campania Luigi Vanvitelli, Italy); Maria Pesavento (University of Pavia, Italy); Francesco Arcadio and Luigi Zeni (University of Campania Luigi Vanvitelli, Italy); Aldo Minardo (Unicampania, Italy); Domenico Del Prete (University of Campania Luigi Vanvitelli, Italy); Giancarla Alberti (University of Pavia, Italy); Vincenzo Marletta and Bruno Ando (University of Catania, Italy)

Simulation and Reduction of Speckle-induced Uncertainty in Laser Triangulation Sensors
Ernst Csencsics (TU Wien, Austria); Johannes Schlarp (Vienna University of Technology, Austria); Tobias Glaser and Tobias Wolf (TU Wien, Austria); Georg Schitter (Vienna University of Technology, Austria)

12:30 - 13:30
Tuesday Lunch Break
Room: International Ballroom ABC

13:30 - 14:30
IEEE Instrumentation and Measurement Society Andy Chi Best Paper Award Presentation
Room: International Ballroom ABC

Linking the Power Scales of Free-Space and Waveguide-Based Electromagnetic Waves
By: Andreas Steiger, Physikalisch-Technische Bundesanstalt (PTB), Germany

14:30 - 15:30
Tuesday PM Break
Room: International Ballroom ABC

14:30 - 15:30
TIM@I²MTC Poster Session
Session Chair: Roberto Ferrero (University of Liverpool, United Kingdom (Great Britain))
Room: International Ballroom ABC

1: Fast-Decaying Sine Ramp Windows for Signals With Limited Frequency Resolution
Jan-Philipp Kitzig (Hochschule Ruhr West, Germany); Gerd Bumiller (Hochschule Ruhr West & University of Applied Sciences, Germany)

Windowing digital signals is essential to digital signal processing. The matter is a complicated one, and choosing a window function is always a tradeoff between certain undesired effects on one hand and important benefits on the other. In this article, a new window class of windows called sine ramp windows is presented, which is very fast decaying with regard to the frequency resolution. These new windows improve the attenuation of far-distant spectral leakage while maintaining an acceptable minimal signal duration, which is beneficial, e.g., in the harmonic analysis of power systems in transient conditions. This window class is then extensively benchmarked against the state of science using common figures of merit proving its advantages, which are then shown in two application examples. https://doi.org/10.1109/TIM.2021.3111077

2: Forced Oscillation Technique measurement apparatus using fan-speaker hybrid

Cedric Busschots, Johan Pattyn, Dries Peumans and Yves Rolain (Vrije Universiteit Brussel, Belgium); Gerd Vandersteen (Vrije Universiteit Brussel (VUB), Belgium)

The number of patients suffering from asthma and Chronic Obstructive Pulmonary Disease (COPD) increases due to deteriorating air quality and smoking. A measurement technique known as the Forced Oscillation Technique (FOT) helps physicians to assess the current state of their patient's lungs. Measurement devices based on either fans or speakers have been developed in the past that can carry out this measurement, but their performance and/or robustness often fall short. This paper proposes a combination of a fan- and speaker-based measurement apparatus that employs the Forced Oscillation Technique to help physicians diagnose patients with these diseases. First, we discuss the currently available measurement devices and their specific problems. Next, a fan-speaker hybrid measurement apparatus is proposed. This fan-speaker hybrid FOT measurement apparatus is then characterized and its performance is improved with a feed forward compensation. Finally, measurements on two test subjects with the proposed measurement apparatus are shown and discussed. DOI: 10.1109/TIM.2021.3139664

3: Best Linear Time-Varying Approximation of a General Class of Nonlinear Time-Varying Systems

Noël A Hallemans, Rik Pintelon and John Lataire (Vrije Universiteit Brussel, Belgium)

This article presents a method for estimating a linear time-varying approximation of a general class of nonlinear time-varying (NLTV) systems. It starts from noisy measurements of the response of the NLTV system to a special class of periodic excitation signals. These measurements are subject to measurement noise, process noise, and a trend. The proposed method is a two-step procedure. First, the disturbing noise variance is quantified. Next, using this knowledge, the linear time-varying dynamics are estimated together with the NLTV distortions. The latter are split into even and odd contributions. As a result, the signal-to-nonlinear-distortion ratio is quantified. It allows one to decide whether or not a linear approximation is justifiable for the application at hand. The two-step algorithm is fully automatic in the sense that the user only has to choose upper bounds on the number of basis functions used for modeling the response signal. The obtained linear time-varying approximation is the best in the sense that the difference between the actual nonlinear response and the response predicted by the linear approximation is uncorrelated with the input. Therefore, it is called the best linear time-varying approximation (BLTVA). Finally, the theory is validated on a simulation example and illustrated on two measurement examples: the crystallographic pitting corrosion of aluminum and copper electrorefining.10.1109/TIM.2021.3086891

4: Adaptive Excitation Signals for Low-Frequency Forced Oscillation Technique Measurements in Patients

Andy Keymolen and Cedric Busschots (Vrije Universiteit Brussel, Belgium); Sylvia Verbanck and Daniël Schuermans (UZ Brussel, Belgium); Hannes Maes, Dries Peumans, Johan Pattyn and Yves Rolain (Vrije Universiteit Brussel, Belgium); Gerd Vandersteen (Vrije Universiteit Brussel (VUB), Belgium); John Lataire (Vrije Universiteit Brussel, Belgium)

The low-frequency forced oscillation technique (FOT) has a high diagnostic potential for the detection of respiratory diseases. However, it is not yet widely accepted in clinical practice, partly because the natural breathing frequency usually interferes with the measurement, thus requiring patient-unfriendly breathing maneuvers. The presence of a subject's breathing generally results in patient-unfriendly measurement protocols. These are needed to extract the important low-frequency information about the subject's respiratory system. This work presents a technique enabling the application of low-frequency FOT during spontaneous breathing. This is accomplished by adding an external visual stimulus to encourage the subject to synchronize his/her breathing to the measurement apparatus, in combination with an excitation signal that is adapted to the subject's natural breathing frequency. In this way, the contributions of the breathing and the excitation signal can be separated. This article discusses the implementation, testing, and actual measurement results in a clinical setting using this method. DOI: 10.1109/TIM.2021.3082279

5: Linking the Power Scales of Free-Space and Waveguide-Based Electromagnetic Waves

Andreas Steiger (PTB, Germany)

Two independent methods of absolute power measurement of electromagnetic waves are compared in the millimeter-wave range. At the National Metrology Institutes (NMIs), dependent on frequency and wave propagation, electromagnetic power is differently traced back to the International System of Units (SI), i.e., from microwave up to millimeter-wave frequencies in coaxial lines and metallic waveguides and terahertz frequencies in free space. As state-of-the-art waveguide-based power sensors and free-space power detectors are overlapping with respect to their operating frequency, for the first time, a comparison of both independent power scales has been carried out in the millimeter-wave range. The experiment verified the consistency of both traceability approaches within their uncertainties. DOI: 10.1109/TIM.2020.2998311

6: Chessboard-Like High-Frequency Patterns for 3D Measurement of Reflective Surface
Zaixing He, Peilong Li, Xinyue Zhao, Lianpeng Kang, Shuyou Zhang and Jianrong Tan (Zhejiang University, China)

Surface reflections severely degrade the performance of the structured-light 3D measurement. In this article, we introduce a novel structured-light 3D measurement technique that works in the presence of reflective highlights. The focus of this article is on designing chessboard-like coding schema and crossover-based decoding schemes. First, we design chessboard-like fringe patterns that are resistant to reflective highlights by using simple logical operations. Compared with conventional coding schemes that inevitably have low-frequency patterns, the chessboard-like coding schemes use all-high-frequency patterns to provide a better highlights-suppression effect. Second, we propose an inverse-pattern method to extract crossover positions for decoding. The chessboard-like patterns have abundant crossover information. The crossover information is more localizable and better preserved than image intensity, which makes the decoding strategy more robust. Moreover, both positive and negative patterns are used to precisely localize the crossover positions. The proposed method can be readily incorporated into existing binary structured-light measurement techniques without significant overhead in terms of capture time or hardware. Extensive experiments are shown to demonstrate the high performance of the proposed method. DOI 10.1109/TIM.2021.3075035

7: Long-term wearable electrocardiogram signal monitoring and analysis based on convolutional neural network
Meng Lu (Northeastern University, China)

Wearable devices are increasingly popular for health monitoring via electrocardiograms (ECGs) as they can portably monitor heart conditions over a long time. However, so far there are no publicly available ECG data sets collected from wearable devices. Most ECG analysis algorithms target ECG data collected by hospital equipment. In the present study, we used the IREALCARE2.0 Flexible Cardiac Monitor Patch as the wearable device to collect ECG signals and formed ECG data sets. Wearable ECG data tended to contain more interference and be large in size. This article proposed a deep CNN approach, named time-spatial convolutional neural networks (TSCNNs), for the automatic classification and analysis of ECG signals from wearable devices. First, the original long-term ECG signals were divided into separate heartbeats and input into the TSCNN. Second, we applied convolution over time and spatial filtering for each heartbeat to extract abundant features. Finally, the cascaded small-scale kernel convolution was applied to improve classification performance and reduce the number of network parameters. To avoid overfitting, some regularized methods such as dropout and batch normalization were adopted. In the experiments, the method proposed in this letter is compared with other eight ECG classification algorithms. Our method attained the highest classification accuracy. The experimental results indicated that the proposed method can achieve better performance for wearable ECG data and can effectively monitor whether the wearer has an abnormal ECG. DOI: 10.1109/TIM.2021.3072144

8: Detecting Mid-Air Gestures for Digit Writing With Radio Sensors and a CNN

Seong Kyu Leem (Samsung Electronics, South Korea); Faheem Khan (Université de Bretagne Occidentale, France); Sung Ho Cho (Hanyang University, Korea (South))

In this paper, we classify digits written in mid-air using hand gestures. Impulse radio ultrawideband (IR-UWB) radar sensors are used for data acquisition, with three radar sensors placed in a triangular geometry. Conventional radar-based gesture recognition methods use whole raw data matrices or a group of features for gesture classification using convolutional neural networks (CNNs) or other machine learning algorithms. However, if the training and testing data differ in distance, orientation, hand shape, hand size, or even gesture speed or the radar setup environment, these methods become less accurate. To develop a more robust gesture recognition method, we propose not using raw data for the CNN classifier, but instead employing the hand's mid-air trajectory for classification. The hand trajectory has a stereotypical shape for a given digit, regardless of the hand's orientation or speed, making its classification easy and robust. Our proposed method consists of three stages: signal preprocessing, hand motion localization, and tracking and transforming the trajectory data into an image to classify it using a CNN. Our proposed method outperforms conventional approaches because it is robust to changes in orientation, distance, and hand shape and size. Moreover, this method does not require building a huge training database of digits drawn by different users in different orientations; rather, we can use training databases already available in the image processing field. Overall, the proposed mid-air handwritten digit recognition system provides a user-friendly and accurate mid-air handwriting modality that does not place restrictions on users. Digital Object Identifier 10.1109/TIM.2019.2909249

9: A Robust System for Thermoelectric Device Characterization

João Ider (Universidade Federal de Itajubá, Brazil)

Due to the large reduction in fossil fuel reservoirs, the consequent cost increase of deepwater extraction, and the emission of pollutants, there is a constant search for alternative ways to obtain clean energy at a lower cost. Among those sources, we focus on the energy produced by thermoelectric materials. In this work, we present a new system for the characterization of thermoelectric generation devices. Such a system performs measurements of electrical resistivity, Seebeck coefficient, and thermal conductivity in a single setup. With this, it is possible to reduce the systematic errors in the figure of merit ZT and the cost of the equipment. Our equipment, together with the developed software, presented excellent results and analyses, and with that, it proves to be a robust alternative for the characterization of commercial thermoelectric devices, and of laboratory thin film thermoelectric materials.

10: A Stacked LSTM-Based Approach for Reducing Semantic Pose Estimation Error

Rana Azzam (Khalifa University, United Arab Emirates)

Achieving high estimation accuracy is significant for semantic simultaneous localization and mapping (SLAM) tasks. Yet, the estimation process is vulnerable to several sources of error, including limitations of the instruments used to perceive the environment, shortcomings of the employed algorithm, environmental conditions, or other unpredictable noise. In this article, a novel stacked long short-term memory (LSTM)-based error reduction approach is developed to enhance the accuracy of semantic SLAM in presence of such error sources. Training and testing data sets were constructed through simulated and real-time experiments. The effectiveness of the proposed approach was demonstrated by its ability to capture and reduce semantic SLAM estimation errors in training and testing data sets. Quantitative performance measurement was carried out using the absolute trajectory error (ATE) metric. The proposed approach was compared with vanilla and bidirectional LSTM networks, shallow and deep neural networks, and support vector machines. The proposed approach outperforms all other structures and was able to significantly improve the accuracy of semantic SLAM. To further verify the applicability of the proposed approach, it was tested on real-time sequences from the TUM RGB-D data set, where it was able to improve the estimated trajectories. https://ieeexplore.ieee.org/document/9235399

11: Microwave synthesis for the PTB caesium fountain clocks

Michael Kazda (PTB, Germany)

Microwave synthesizers used to generate microwave signals for PTB's CSF1 and CSF2 fountain clocks are described. The synthesizers are based on a divider chain and a digital frequency synthesis and have been designed for use with an optically stabilized microwave oscillator. They have been designed in a modular fashion to assure long-term operation and low down-times. The results of an in-depth examination of spectral purity, phase noise and long-term phase stability are presented; implications of measured parameters on the fountain timing are assessed. Two methods of suppressing the frequency-shifting effect of microwave leakage fields are implemented, with one method in each synthesizer. The first method uses an interferometric switch and the second uses a phase-coherent and phase-preserving frequency detuning scheme; their contribution to the systematic uncertainty of the fountains is assessed. The overall systematic uncertainty contribution associated with the fountain electronics is below 1×10^{-17} for both fountain clocks. https://doi.org/10.1109/TIM.2019.2936694

12: Range Estimation of a Moving Target Using Ultrasound Differential Zadoff-Chu Codes

Mohammed AlSharif and Mohamed Saadeldin (King Abdullah University of Science and Technology, Saudi Arabia); Mohamed Siala (Sup'Com, Tunisia); Mohanad Ahmed (KAUST, Saudi Arabia); Tareq Y. Al-Naffouri (King Abdullah University of Science and Technology, USA)

High-accuracy range estimation is essential in modern applications and technologies. However, it is challenging to estimate the continuous-range of a moving target, especially under Doppler effects. This article presents a novel signal design, which we name differential Zadoff-Chu (DZC). Under Doppler effects, DZC sequences improve the performance of the maximum likelihood (ML)-based range estimation over its performance when using regular Zadoff-Chu (ZC) sequences. We propose a reduced-complexity ranging algorithm using DZC sequences and show that it outperforms the regular ZC ML-based range estimation. We evaluate the proposed system in a typical indoor environment using a low-cost ultrasound hardware. Under a low signal-to-noise ratio (-10 dB SNR), more than 90% of the range estimates have less than a 1.6-mm error, with a movement range from 0.2 to 2.2 m and a maximum velocity of 0.5 m/s. For the same movement range, the system provides range estimates with a root-mean-square error (RMSE) of less than 0.76 mm in a high SNR scenario (10 dB), and an RMSE less than 0.85 mm in a low SNR scenario (-10 dB). For a larger movement range from 1.8 to 4.2 m with a maximum velocity of 1.91 m/s, the proposed system provides range estimates with an RMSE less than 7.70 mm at 10 dB SNR. Paper link in IEEEXplore: https://ieeexplore.ieee.org/abstract/document/9400888

13: Practical Equivalent Electrical Circuit Identification for Electrochemical Impedance Spectroscopy Analysis With Gene Expression Programming

Maxime Van Haeverbeke, Michiel Stock and Bernard De Baets (Ghent University, Belgium)

Researchers relying on electrochemical impedance spectroscopy need to decide which equivalent electrical circuit to use to analyze their measurements. Here, we present an identification algorithm based on gene expression programming to support this decision. It is accompanied with some measures to enhance the interpretability of the resulting circuits, such as the removal of redundant components to avoid overly complex circuits. We also provide the option to depart from an initial population of widely applied circuits, allowing for a quick identification of known circuits that are capable of modelling the measurement data. As the number of measurements per experiment is typically rather limited in real-life experiments, we examine the number needed to find an adequate circuit topology for two example circuits. Next, the algorithm is tested on impedance simulations for a variety of circuits. Noise robustness is evaluated by subjecting the impedance measurements to increasing amounts of Gaussian noise, demonstrating that the algorithm still works well even for noise levels that are significantly higher than what is typically encountered in practice. Finally, we validate the algorithm by identifying the appropriate circuit for impedance measurements from a biological application. https://ieeexplore.ieee.org/document/9539171

14: Thermal Drifts of Capacitive Flow Meters: Analysis of Effects and Model-Based Compensation

Thomas Suppan, Markus Neumayer, Thomas Bretterklieber and Hannes Wegleiter (Graz University of Technology, Austria)

Capacitive sensing has become a favorable measurement technology for flow metering in pneumatic conveying systems. Multielectrode sensing structures and tomographic signal evaluations enable spatially resolved flow parameter estimation, which is of particular interest for pneumatically conveyed solids due to inhomogeneous particle distributions within the pipeline. The noninvasive working principle of capacitive sensors is an important feature for the application in industrial processes with harsh environments. However, cross sensitivities of the capacitive probe cause effects, such as temperature drifts of the measurements. For a reliable operation of capacitive flow meters in harsh environments, induced drifts have to be compensated. In this article, we present the detailed analyses of thermal effects within capacitive sensors. Based on the findings, a model-based temperature compensation approach is developed within the Bayesian framework. The performance of the proposed compensation approach is analyzed by a measurement-based validation within a climate chamber and by a simulation-based uncertainty quantification. The capability to obtain temperature-independent estimates with calibration measurements acquired at room temperature is demonstrated. https://ieeexplore.ieee.org/document/9244227

15: A Robust Lyapunov's Demodulator for Tracking of Single-/Three-Phase Grid Voltage Variables

Anant Kumar Verma (National Institute of Technology Hamirpur, India); Chandrasekaran S (NIT Hamirpur, India); Raj Kumar Kumar Jarial (National Institute of Technology Hamirpur (HP) India, India); Pedro Roncero-Sanchez (UCLM, Spain); Mohan Rao (University of Quebec, Canada)

This work proposes a robust an enhanced Lyapunov's demodulator (LD) based-OSG in which a moving average filter is incorporated. The rapid rejection of dc-offset and harmonics is, therefore, easily achieved without any additional loop. The proposed structure can accurately estimate the fundamental in-phase and quadrature components. However, these orthogonal components may suffer from amplitude imbalance and errors in the phase information under off-nominal frequency conditions. Nevertheless, the errors in the amplitude and the phase information are eliminated using an open-loop frequency deviation detector and a feed-forward curve-fitting approach. https://ieeexplore.ieee.org/document/9288762

16: Defect Classification with SVM and Wideband Excitation in Multilayer Aluminum Plates

Helena G. Ramos (Instituto de Telecomunicacoes, Instituto Superior Tecnico, Portugal)

This paper presents a nonconventional excitation method with white noise to detect surface and subsurface cracks in aluminum plates, and the performance of the method was compared with the multifrequency excitation method. In a second stage, the best excitation method was combined with the machine learning algorithm support vector machine (SVM) to classify the location and depth of subsurface cracks in multilayer aluminum structures. The experimental measurements were performed on two stacked aluminum plates with their thickness equal to 4 and 3 mm. Several experimental tests were performed for the classification of the subsurface crack location, as well as the depth classification of the cracks. The selected features to train and test the SVM algorithm for classification are reported in this paper. The results obtained from the SVM approach include a classification obtained by training 72% of the experimental measurement data with linear, quadratic, polynomial, and Gaussian radial basis kernels and by testing the remaining 28% of the collecting measurement data. https://ieeexplore.ieee.org/document/8634920

17: Deep Autoencoder Imaging Method for Electrical Impedance Tomography
Zichen Wang, Xinyu Zhang, Rong Fu, Di Wang and Chen Xiao Yan (Tianjin University of Science and Technology, China); Huaxiang Wang (Tianjin University, China)

Electrical impedance tomography (EIT) is an effective technique for real-time monitoring, visualization, and analysis of industrial process in a noninvasive manner. However, due to the nonlinear and ""soft-field"" nature of its inverse problem, image reconstruction of EIT is always limited in image resolution and, in particular, the accuracy of identifying object boundaries. In order to solve the above problems, a novel multilayer autoencoder (MLAE) image reconstruction network that consists of a feature extraction module and an image reconstruction module is proposed. In the proposed method, hierarchical structures are applied to increase the forward information flow and the selected appropriate hidden layers can solve the disappearance of the reverse gradient flow. The training process of MLAE containing self-supervised pretraining and supervised fine-tuning can provide better complex nonlinear mapping and improve the model performance. The experimental and analytical results prove that the MLAE image reconstruction method can obtain higher quality images than the typical algorithms and certain methods based on deep learning.

18: Experimental Evaluation of the Forkbeard Ultrasonic Indoor Positioning System
Vincent Thio (University of Oslo, Norway); Joaquín Aparicio (University of Alcalá, Spain); Kjetil Bergh Ånonsen and Jan Kenneth Bekkeng (Norwegian Defence Research Establishment, Norway)

Indoor positioning systems are crucial to provide location based services in areas that are not covered by a Global Navigation Satellite System. Among the many technologies applied to this field, ultrasound has emerged as a potential low-cost, high-accuracy approach to positioning based on trilateration. Several ultrasonic systems have been proposed over the years. Of these, academic systems are typically prototypes that are unavailable to the public, whereas commercial systems generally do not provide characterization test results. In this work, we have conducted a detailed characterization study of a commercial indoor positioning system for smart devices developed by Forkbeard Technologies AS. We tested the system under static and dynamic conditions in a motion capture lab of approximately 150 m2. We considered different room occupancies, beacon configurations, and device positions. The results, given in terms of 2D absolute errors at different confidence levels, show great variation depending on the aforementioned conditions. The worst case scenario corresponds to a pedestrian in motion in an office setup with 4 beacons, with the phone placed in the pocket. In this case, 80% of the errors were below 143 cm. The best results were obtained under static conditions using 10 beacons, for which 80% of the errors were below 44 cm. https://ieeexplore.ieee.org/document/9654214

19: Comparison of the Carbon Nanofiber-/Fiber- and Silicone-Based Electrodes for Bioimpedance Measurements

Mart Min, Raul Land, Hip Kõiv and Ksenija Pesti (Tallinn University of Technology, Estonia); Indrek Must (University of Tartu, Estonia)

Electrodes for bioimpedance measurements remain a challenge. In practice, commercially available nonpolarizable silver/silver chloride (Ag/AgCl) gel electrodes prove to be the best option for bioimpedance-based testing. The hydrogel layer reduces the problematic electrode-skin interface impedance, which results in a highly reliable signal. Our work group is developing a wearable device that estimates aortic blood pressure from the bioimpedance taken from the wrist area. Understandably, wet electrodes do not suit for a wearable, and there is a need for dry, soft, reusable, and stable electrodes. This study proposes stretchable carbon nanofiber/carbon fiber silicone electrodes as an alternative for cardiac signal measurements with bioimpedance. Five different electrode materials are tested and analyzed: Ag/AgCl gel, Ag/AgCl dry, two carbon and silicone composite materials, and carbon textile. To compare the electrodes' characteristics, the current through the tissue under the changing pressure, frequency, contact duration, and skin preparation is registered, and the electrode-skin impedance is calculated. The soft and stretchable carbon fiber silicone electrodes proved to have similar response as rigid nonpolarizable Ag/AgCl dry electrodes. Selected methods and proposed instrumentation ensure acceptable reproducibility of the base value and the modulation depth of the measured impedance despite the different electrode materials, large variation of the electrode-skin impedance, and the actual measurement current.

20: Improving Accuracy and Robustness in HF-RFID-Based Indoor Positioning With Kalman Filtering and Tukey Smoothing

Ali Asghar Nazari Shirehjini (D!fintech AG, Switzerland); Shervin Shirmohammadi (University of Ottawa, Canada)

In this article, we present a scalable, robust, and accurate indoor positioning system that uses a passive high-frequency radio frequency identification (HF RFID)-based positioning measurement system combined with Tukey smoother and a linear Kalman filter to locate mobile objects with an average measurement error of less than 3.7 cm. The proposed system is implemented and tested with extensive experiments, and our results show that the proposed system outperforms similar existing systems in minimizing the average positioning error and has better robustness against noisy sensor readings caused by hardware malfunctions or external error sources. https://ieeexplore.ieee.org/document/9094698

21: Measurement Uncertainty of Precise Interpolating Time Counters

Ryszard Szplet (Military University of Technology, Poland)

This paper presents a comprehensive analysis of measurement uncertainty of a wide class of precise time interval counters based on the most common two-stage time interpolation method. All nonnegligible sources of errors are discussed, includ- ing the quantization process, nonlinearity of time interpolators, timing jitter induced by elements of signal paths as well as inher- ent jitter of input pulses, and reference clock signal. A formula of the total measurement uncertainty and several design suggestions aiming at improving the time counter accuracy and precision is provided.

22: An Efficient Scheme for Acoustic Echo Canceller Implementation using Offset Binary Coding

Mohammed A Alhartomi (University of Tabuk, Saudi Arabia); Mohd. Tasleem Khan (IIT Dhanbad, India); Shaik Rafi Ahamed (Indian Institute of Technology Guwahati, India)

This article presents an efficient design and implementation scheme for a low-area and low-power acoustic echo canceller. The design employs the block least mean square algorithm-based adaptive filter (ADF) using offset binary coding. The proposed approach first formulates the ADF by splitting the matrix-vector multiplication into smaller ones. Each of them is then realized with lookup tables and shift accumulate units with offset terms. An efficient scheme is suggested to update the offset terms from the corresponding lookup tables. In addition, a novel optimization scheme is proposed based on the grouping of partial products (PPs) and moving windows. The PPs are generated in two parallel styles using adders, multiplexers, and registers. The optimized architecture is shared to compute both the filter output and coefficient increment terms in every iteration. The fixed-point quantization model for the architecture is also discussed. Accuracy measure is defined to characterize the proposed design and compare it with the Cramer-Rao lower bound. Simulations are carried out to evaluate the performance of the proposed design. Field-programmable gate array implementation results and application-specific integrated circuit synthesis show that the proposed design outperforms the state-of-the-art architectures. https://ieeexplore.ieee.org/abstract/document/9635631

23: ADC Resolution Requirement for an Intra-Quantum Signal Digitization

Baptiste Laporte-Fauret (THALES, France); Guillaume Ferré (University of Bordeaux, France); Dominique Dallet (IMS Laboratory - Bordeaux INP - University Bordeaux, France); Bryce Minger and Loïc Fuché (Thales, France)

This article discusses a new approach to size an analog-to-digital converter (ADC) for the simultaneous acquisition of two signals. It allows evaluating the resolution, which fulfills a certain dynamic range (DR) in the case of multiple signals with different powers. Experimental results with software-defined radios (SDRs) confirm our simulations. It shows that we are able to acquire an intra-quantum signal due to the contribution of a stronger transmission, which makes it cross the quantization levels. Some insights about another way to exceed the theoretical DR with the inherent noise in electrical systems are also provided. Thus, we propose to give the ADC required resolution to detect an intra-quantum signal when simultaneously received with a stronger one which, to the best of our knowledge, has never been thoroughly studied. https://ieeexplore.ieee.org/document/9107098

14:30 – 15:30
Tuesday Poster Session
Session Chairs: Baki Karaböce (TÜBİTAK UME & National Metrology Institute of Turkey, Turkey)
Markus Neumayer (Graz University of Technology, Austria)
Room: International Ballroom ABC

24: Measurement of Excess Noise in Thin Film and Metal Foil Resistor Networks

Nikolai Beev (CERN, Switzerland)

25: Research on a Novel Calibration Method of Broadband Shunt

Ziyue Yang and Jing Wu (Beihang University, China); Haiming Shao, Jiafu Wang and Lixin Wang (National Institute of Metrology, China)

26: Analysis of non-ideal remote pole in Electrical Resistivity Tomography for subsurface surveys
Gabriele Patrizi, Giulia Guidi, Lorenzo Ciani, Marcantonio Catelani, Luca Cappuccini, Agnese Innocenti and Nicola Casagli (University of Florence, Italy); Veronica Pazzi (University of Trieste, Italy)

27: Range extension of a scanning confocal chromatic sensor for precise robotic inline 3D measurements
Daniel Wertjanz (Technische Universität Wien, Austria); Nikolaus Berlakovich and Ernst Csencsics (TU Wien, Austria); Georg Schitter (Vienna University of Technology, Austria)

28: Design of miniaturized MEMS gyro north finder based on two-phase axial flux PMSM
Xueling Zhao, Chengbin Wang, Jianqiang Chen, Bin Zhou and Rong Zhang (Tsinghua University, China)

29: Optimized Signal Generation in Pulse Voltammetry for Segmented R-String DACs
Inge Siegl (Graz University of Technology & Infineon Technologies Austria AG, Austria); Norbert Sailer (Infineon Technologies Austria AG & Graz University of Technology, Austria); Markus Haberler, Carolin Kollegger and Christoph Steffan (Infineon Technologies Austria AG, Austria)

30: Improvement of communication distance for an unconventional channel
Paolo Caruso, Salvatore Dello Iacono, Domenico Di Caro and Vincenzo Paciello (University of Salerno, Italy)

31: An Evaluation of Machine Learning Algorithms in an Experimental Structural Health Monitoring System Incorporating LoRa IoT Connectivity
Ashraf A Tahat (Princess Sumaya University for Technology, Jordan); Chamseddine Talhi (École de Technologie Supérieure, Canada); Azmi Al-Zaben, Lubna Saad El-Deen and Sara Abbad (Princess Sumaya University for Technology, Jordan)

32: Detection of Cracks under Cover and Corrosion using UHF Probe
Mohammed Saif ur Rahman, Ademola Akeem Mustapha and Mohamed A Abou-Khousa (Khalifa University of Science and Technology, United Arab Emirates)

33: Temperature Measurement Methodologies in Ultrasound Hyperthermia for Cancer Treatment
Baki Karaböce (TÜBİTAK UME & National Metrology Institute of Turkey, Turkey); Begüm Apaydın (Boğaziçi University, Turkey)

34: A bioimpedance-based transducer for insulin bioavailability assessment after subcutaneous administration
Pasquale Arpaia (University of Naples Federico II, Italy); Davide Cuneo (University of Tuscia, Viterbo, Italy); Francesca Mancino (University of Federico II, Naples, Italy); Nicola Moccaldi (University of Naples Federico II, Italy)

35: Induction sensor characterisation for electromagnetic tracking systems
Herman Alexander Jaeger and Kilian O'Donoghue (Tyndall National Institute, Ireland); Padraig J Cantillon-Murphy (Tyndall National Institute & Quadrant Scientific, Ireland)

36: The Physical Meaning of Reactive Power and Distortion Power

Harold Kirkham (Pacific Northwest National Laboratory, USA); Rod White (Measurement Standards Laboratory of NZ, New Zealand)

37: Low-cost capacitive sensor for oil-level monitoring in aircraft

Luisa De Palma and Francesco Adamo (Polytechnic University of Bari, Italy); Filippo Attivissimo (Politecnico of Bari, Italy); Sergio de Gioia (Polytechnic University of Bari, Italy); Attilio Di Nisio (Politecnico di Bari, Italy); Anna Maria Lucia Lanzolla (Polytechnic of Bari, Italy); Marco Scarpetta (Polytechnic University of Bari, Italy)

38: Stability Analysis of Mutually Synchronized Spatially Distributed 24 GHz Oscillators

Christian Hoyer (Technische Universität Dresden, Germany); Lucas Wetzel and Dimitris Prousalis (Max Planck Institute for the Physics of Complex Systems, Germany); Jens Wagner (Technische Universität Dresden & Chair for Circuit Design and Network Theory, Germany); Frank Jülicher (Max Planck Institute for the Physics of Complex Systems, Germany); Frank Ellinger (Technische Universität Dresden, Germany)

39: Capacitive Sensing for Magnetic Nanoparticles in Molecular Communication

Max Bartunik, Johannes Reichstein and Jens Kirchner (Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany)

40: InARMS: Individual Activity Recognition of Multiple Subjects with FMCW radar

Hossein Raeis and Mohammad Kazemi (University of Isfahan, Iran); Shervin Shirmohammadi (University of Ottawa, Canada)

41: Real-time Blast Furnace Monitoring based on Temporal Sub-mode Recognition

Xin Wang (Zhejiang University, China); Xiao-Yu Tang (Zhejiang University & Yuquan Compus, China); Zheng Hao, Songchen Li and Chunjie Yang (Zhejiang University, China)

42: Lossy Flange for Open-Ended Rectangular Waveguide Materials Characterization

Anna Case (Iowa State University & Center for Nondestructive Evaluation, USA); Reza Zoughi, Mohammad Tayeb Al Qaseer and Aaron McCarville (Iowa State University, USA)

43: Enhanced IpD2FT-based Synchrophasor Estimation through Narrowband Interferers Compensation

Xuansheng Shan (Hunan University, China); David Macii and Dario Petri (University of Trento, Italy); He Wen (Hunan University & College of Electrical and Information Engineering, China)

44: Microwave Harmonic Synthetic Aperture Radar (SAR) Imaging for Detecting Weak-Scattering Defects Exhibiting Nonlinear Behavior

Chao Liu (Iowa State University & Center for Nondestructive Evaluation, USA); Reza Zoughi (Iowa State University, USA)

45: Dynamic Behavior Analysis Based Process State Monitoring for Gas-liquid Two Phase Flow in Horizontal Pipe
Zhao Li, Shumei Zhang and Feng Dong (Tianjin University, China)

46: A Blender-based simulation tool for Visible Light Positioning with portable devices
Juan D. Gutiérrez (Universidad de Extremadura, Spain); Teodoro Aguilera, Fernando J. Álvarez Franco and Jorge Morera (University of Extremadura, Spain); Fernando J. Aranda (Universidad de Extremadura & Sensory Systems Research Group, Spain)

47: Investigation of Accuracy Requirements for Delta Differential Capacity and Voltage Measurements of Li-Ion Batteries
Daniel Schürholz, Bernhard Schweighofer, Hannes Wegleiter and Markus Neumayer (Graz University of Technology, Austria); Andreas Klug (AVL List GmbH, Austria); Rüdiger Teichmann (AVL LIST GmbH, Austria)

48: A Survey of Impedance Measurement Methods in Power Electronics
Huamin Jie, Zhenyu Zhao and Fei Fan (Nanyang Technological University, Singapore); R Simanjorang (Advanced Technology Centre, Rolls-Royce Singapore Pte. Ltd, Singapore); Firman Sasongko (Rolls-Royce Electrical, Rolls-Royce Singapore Pte. Ltd, Singapore); Kye Yak See (Nanyang Technological University, Singapore)

49: A fast reconstruction strategy to image small objects in electrical tomography
Peng Suo, Jiangtao Sun, Xiaolin Li, Shijie Sun and Lijun Xu (Beihang University, China)

50: Detection of Pressure Ulcers Using Electrical Impedance Tomography
Saiqiang Liu, Yanbin Xu, Sitong Chen, Qingwei Hu and Feng Dong (Tianjin University, China)

51: Lab Investigation of Thermal Anemometers for Mass Flow Measurements in Harsh Operating Conditions
Giancarlo Benincasa, Markus Neumayer, Bernhard Schweighofer, Christoph Gabauer and Hannes Wegleiter (Graz University of Technology, Austria); Thomas Leitner, Gerald Klösch and Matthias Berger (Voestalpine, Austria)

15:30 - 17:30
Instrumentation and Measurement for the Energy and Power Industry
Session Chairs: Grzegorz Fusiek (University of Strathclyde, United Kingdom (Great Britain))
Sergio Toscani (Politecnico di Milano, Italy)
Room: Chaudiere

Quality Index for the Phase Information in Spectral Power Quality Analysis
Jan-Philipp Kitzig and Christoph Szymczyk (Hochschule Ruhr West, Germany); Gerd Bumiller (Hochschule Ruhr West & University of Applied Sciences, Germany)

Definition and Identification of an Improved Preisach Model for Magnetic Hysteresis Based on the KP operator
Massimiliano Amato and Luca Ghezzi (ABB Electrification, Italy); Luigi Piegari and Sergio Toscani (Politecnico di Milano, Italy)

Porcelain Bushing Internal Defects Intelligent Detection Based on Transient Thermography

Zekai Shen (Tsinghua University & Tsinghua Shenzhen International Graduate School, China); Hongwei Mei (Graduate School at Shenzhen, Tsinghua University, China); Yanxin Tu and Chenjun Guo (Tsinghua University, China); Wang Liming (& China Southern Power Grid Shenzhen Digital Power Grid Research Institute Company, China)

Advanced Architecture for Training and Testing NILM Systems

Simone Mari (University of L'Aquila, Italy); Giovanni Bucci (Universita' Dell' Aquila, Italy); Fabrizio Ciancetta, Edoardo Fiorucci and Andrea Fioravanti (University of L'Aquila, Italy)

A single-point approach based on nonactive power factor for the assessment harmonic distortion sources in power systems

Giovanni Artale (Università di Palermo, Italy); Giuseppe Caravello (Unversity of Palermo, Italy); Antonio Cataliotti (Università degli Studi di Palermo, Italy); Valentina Cosentino (University of Palermo, Italy); Dario Di Cara (National Research Council, Italy); Vito Ditta (Università degli Studi di Palermo, Italy); Salvatore Guaiana and Nicola Panzavecchia (National Research Council, Italy); Giovanni Tinè (CNR-INM, Italy & PALERMO UNIT, Italy)

Factors Affecting Performance of Noninvasive Magnetic Sensors for Current Measurement in Power Systems

Prasad Shrawane and Tarlochan Sidhu (Ontario Tech University, Canada)

15:30 – 17:30
SPS 5: IOT - Based Smart Measurement Systems: New Communication and Artificial Intelligence Techniques, SPS 6: Sensors, Instrumentation, and Artificial Intelligence technologies for Environmental Measurement and Modelling
Session Chairs: Gianfranco Miele (University of Cassino and Southern Lazio, Italy)
Marco Parvis (Politecnico di Torino, Italy)
Room: Frontenac

Human Activity and Posture Classification using Smartphone Sensors and Matlab Mobile

Syahirah Jamian, Teddy Surya Gunawan and Mira Kartiwi (International Islamic University Malaysia, Malaysia); Robiah Ahmad (Universiti Teknologi Malaysia, Malaysia); Kushsairy Kadir (Universiti Kuala Lumpur British Malaysian Institute, Malaysia); Muhammad Noor Nordin (Universiti Kuala Lumpur, Malaysia)

5G DSS communications: pilot signals' variability analysis from measurements on the field

Giovanni Betta (University of Cassino, Italy); Domenico Capriglione (University of Cassino and Southern Lazio, Italy); Gianni Cerro (University of Molise, Italy); Gianfranco Miele (University of Cassino and Southern Lazio, Italy); Marco Donald Migliore (University of Cassino, Italy); Darko Suka (University of East Sarajevo, Bosnia and Herzegovina)

Improving classification capability of industrial-grade ATE by means of cloud architecture

Paolo Ferrari, Emiliano Sisinni, Paolo Bellagente, Alessandro Depari, Alessandra Flammini, Marco Pasetti and Stefano Rinaldi (University of Brescia, Italy)

Compressed Sensing of Skin Conductance Level for IoT-based wearable sensors

Grazia Iadarola (Polytechnic University of Marche, Italy); Angelica Poli (Universita' Politecnica delle Marche, Italy); Susanna Spinsante (Università Politecnica Delle Marche, Italy)

A WiFi-based System for Recognizing Fine-grained Multiple-Subject Human Activities

Majid G Moghaddam (University of Ottawa, Canada); Ali Asghar Nazari Shirehjini (D!fintech AG, Switzerland); Shervin Shirmohammadi (University of Ottawa, Canada)

A deep learning approach for the development of an Early Earthquake Warning system

Vincenzo Gallo, Marco Carratù and Vincenzo Paciello (University of Salerno, Italy); Antonio Pietrosanto (University of Salerno & CEO of Metering Research srl, Italy)

15:30 – 17:30
SPS 1: Instrumentation and measurement for improving quality, reliability and safety: new perspectives for research and industry
Session Chairs: Lorenzo Ciani (University of Florence, Italy)
Antonio Pietrosanto (University of Salerno & CEO of Metering Research srl, Italy)
Room: Joliet

Validation of RUL estimation method for battery prognostic under different fast-charging conditions

Gabriele Patrizi, Benedetta Picano, Marcantonio Catelani, Romano Fantacci and Lorenzo Ciani (University of Florence, Italy)

Preliminary low-frequency dielectric measurement of 3D printed materials

Livio D'Alvia (Sapienza University of Rome, Italy & Luiss Universty, Italy); Francesco Castelli Gattinara Di Zubiena and Eduardo Palermo (Sapienza University of Rome, Italy); Zaccaria Del Prete (SAPIENZA University of Rome, Italy)

An Innovative Model-Based Algorithm for Power Control Strategy of Photovoltaic Panels

Loredana Cristaldi, Marco Faifer, Christian Laurano, Roberto Ottoboni, Emil Petkovski and Sergio Toscani (Politecnico di Milano, Italy)

Parameter estimation for fault detection and classification in centrifugal pumps

Moise Avoci Ugwiri, Consolatina Liguori and Vincenzo Paciello (University of Salerno, Italy); Antonio Pietrosanto (University of Salerno & CEO of Metering Research srl, Italy); Aime' Lay-Ekuakille (University of Salento, Italy)

Temperature stress tests on low-cost IMU systems: Analysis and first proposal for enhancing performance

Gabriele Patrizi, Marcantonio Catelani and Lorenzo Ciani (University of Florence, Italy); Marco Carratù (University of Salerno, Italy); Antonio Pietrosanto (University of Salerno & CEO of Metering Research srl, Italy); Paolo Sommella (University of Salerno, Italy); Giovanni Betta and Domenico Capriglione (University of Cassino, Italy)

Preliminary design of a scanning resonant cell for beam screen surface impedance measurements

Kostiantyn Torokhtii (Università Roma Tre, Italy); Andrea Alimenti (Roma Tre University, Italy); Nicola Pompeo and Enrico Silva (Università Roma Tre, Italy)

Guided Lamb wave tomography using angle beam transducers and inverse radon transform for crack image reconstruction

Dario J. Pasadas (Instituto Telecomunicações & Instituto Superior Técnico, Portugal); Mohsen Barzegar (Instituto de Telecomunicações & Instituto Superior Técnico, Portugal); Artur L. Ribeiro (Instituto de Telecomunicações & Instituto Superior Técnico, University of Lisbon, Portugal); Helena G. Ramos (Instituto de Telecomunicacoes, Instituto Superior Tecnico, Portugal)

Detection Method for Metal Impurities and Interlayer Moisture in Power Insulation Equipment by Terahertz Technology

Shushan Wang (Tsinghua Shenzhen International Graduate School, Tsinghua University, China); Hongwei Mei (Graduate School at Shenzhen, Tsinghua University, China); Jianjun Liu (China Electric Power Research Institut, China); Dabing Chen (State Grid Jiangsu Electric Power CO., LTD. Research Institute, China); Huaiyuan Jiang (Tsinghua Shenzhen International Graduate School, Tsinghua University, China); Liming Wang (Graduate School at Shenzhen, Tsinghua University, China)

Measurement of tube thickness using eddy current testing based on the modified integration range

Pu Huang, Hang Pu, Lijun Xu and Yuedong Xie (Beihang University, China)

Co-surface capacitive sensor structure design and its performance evaluation on single steel tendon positioning in grouting duct

Wenlong Tao (Northwestern Polytechnical University, China); Nan Li (Northwestern Polytechnical University & Beijing University of Technology, China)

Planar Electrical Capacitance Tomography with Hexagonal Sensor

Yu Sun and Ziqiang Cui (Tianjin University, China); Lifeng Zhang (North China Electric Power University, China); Huaxiang Wang (Tianjin University, China)

A Non-Invasive System for On-line Defect Detection on special-shaped steel towards real production lines

Yajiao Liu, Jiang Wang, Haitao Yu, Jiansheng Li, Fulong Li and Quanfa Zhao (Tianjin University, China)

17:30 - 19:00
Welcome Reception
Room: Penthouse

I²MTC 2022 Technical Schedule – Wednesday, May 18, 2022

8:00 - 10:00
Machine Learning and Big Data for Instrumentation and Measurement
Session Chairs: Consolatina Liguori (University of Salerno, Italy)
Bruce Stephen (University of Strathclyde, United Kingdom (Great Britain))
Room: Chaudiere

Convolutional Neural Network Aided Chemical Species Tomography for Dynamic Temperature Imaging
Yalei Fu, Rui Zhang and Godwin Enemali (University of Edinburgh, United Kingdom (Great Britain)); Abhishek Upadhyay and Michael Lengden (University of Strathclyde, United Kingdom (Great Britain)); Chang Liu (University of Edinburgh, United Kingdom (Great Britain))

Modified YOLOv4 Framework with Thermal Images for Pedestrian Detection
Saurav Kumar and P Sumathi (IIT Roorkee, India)

Development of a new speed measurement technique based on deep learning
Marco Carratù, Vincenzo Gallo, Consolatina Liguori and Vincenzo Paciello (University of Salerno, Italy)

A ML-based approach to enhance metrological performance of wearable Brain-Computer Interfaces
Leopoldo Angrisani, Andrea Apicella, Pasquale Arpaia and Egidio De Benedetto (University of Naples Federico II, Italy); Nicola Donato (University of Messina, Italy); Luigi Duraccio (Politecnico di Torino, Italy); Salvatore Giugliano (University of Naples Federico II, Italy); Roberto Prevete (Università degli Studi di Napoli Federico II, Italy)

Sensors fingerprints using Machine Learning: a case study on dam monitoring systems
Paulo Assumpção (Universidade Federal do Rio de Janeiro, Brazil); Carlos Augusto Ruviaro de Oliveira (Instituto Nacional de Metrologia, Qualidade e Tecnologia & Universidade Federal do Rio de Janeiro, Brazil); Wilson Melo, Jr. and Luiz Fernando Costa Carmo (National Institute of Metrology Quality and Technology, Brazil)

A Novel Method to Estimate Measurement Error in AI-Assisted Measurements
Ammar Rashed and Shervin Shirmohammadi (University of Ottawa, Canada)

8:00 – 10:00
Image Processing and Vision Based Measurement
Session Chairs: Mohamed A Abou-Khousa (Khalifa University of Science and Technology, United Arab Emirates)
Mohammad Tayeb Al Qaseer (Iowa State University, USA)
Room: Frontenac

Renal ultrasound image segmentation based on semantic segmentation deep neural network
Qimin Zhang and Qiang Wang (Harbin Institute of Technology, China)

Thermal Effects on Wave Structures of Falling Film Based on PLIF
Ting Xue, Fangjun Ruan and Yan Wu (Tianjin University, China)

Deep Feature Selection for Benign and Malignant Classification appearing as Ground Glass Nodules
ChenChen Ma and Yue (Tianjin University, China)

Fast Dynamic ISAR Imaging Method Based on Low-rank Tensor Decomposition with Alternating Minimization
Fei Yan, Shuliang Gui, Wei He, Jiamin Huang, Xiaodong Wu and Zengshan Tian (Chongqing University of Posts and Telecommunications, China)

Liquid Film Characteristics of Vertical Upward Annular Flow under Low Surface Tension
Ting Xue, Zhuping Li, Songlin Li and Zhuolin Li (Tianjin University, China)

Characteristics Measurement of Dense Bubbly Flow based on Laser Scanning
Ting Xue, Songlin Li and Zhuping Li (Tianjin University, China)

8:00 – 10:00
Instrumentation and Measurement for Non-Destructive Testing and Evaluation
Session Chairs: Matthew Dvorsky (Iowa State University, USA)
Sabrina Grassini (Politecnico di Torino, Italy)
Room: Joliet

Evaluating the impact of spectral estimators on frequency domain feature classification applications for pipe leakage detection
Kostas Angelopoulos and George-Othon Glentis (University of Peloponnese, Greece); Kristina Georgoulaki (University of West Attica, Greece)

Tunable Chipless RFID Pressure Sensor Utilizing Additive Manufacturing
Katelyn R Brinker (Iowa State University & Center for Nondestructive Evaluation, USA); Reza Zoughi (Iowa State University, USA)

Dielectric Characterization of Curved Structures Using Flangeless Open-Ended Waveguide Measurement
Marshall Vaccaro, Mohammad Tayeb Al Qaseer and Reza Zoughi (Iowa State University, USA)

An Electromagnetic Acoustic Transducer for Generating Acoustic Waves in Lithium-Ion Pouch Cells
Alexander Siegl, Bernhard Schweighofer, Hannes Wegleiter and Alexander Bergmann (Graz University of Technology, Austria)

Pulsed-Active Microwave Thermography
Logan M Wilcox (Missouri University of Science and Technology, USA); Mathias Bonmarin (Zurich University of Applied Sciences, Switzerland); Kristen M Donnell (Missouri University of Science and Technology, USA)

Metrological validation of a photogrammetry-based technique
Leila Es Sebar, Luca Lombardo, Marco Parvis and Emma Paola Angelini (Politecnico di Torino, Italy); Alessandro Re (University of Torino, Italy); Sabrina Grassini (Politecnico di Torino, Italy); Alessandro Bovero (Centro Conservazione e Restauro La Venaria Reale, Italy); Alessandro Lo Giudice (University of Torino & INFN Sezione di Torino, Italy)

Flow State Characterization of Horizontal Oil-gas-water Three-phase flow Using Independent Slow and Steady Feature Analysis

Linghan Li, Shumei Zhang and Feng Dong (Tianjin University, China)

Velocity Profile Reconstruction Method for Electromagnetic Flow Tomography: A Simulation Study

Pengyu Yang, Ziqiang Cui, Kai Gao and Huaxiang Wang (Tianjin University, China)

Influence of Operation Conditions on Condensation and Aerodynamic Shockwave in Supersonic Nozzle

Shiwei Wang and Chao Wang (Tianjin University, China); Hongbing Ding (Tianjin Uinversity, China); Zhengqi Chen (Tianjin University, China); Jiamin Ye (School of Electrical and Information Engineering, Tianjin University, China)

Using Three-axis Acceleration Sensor to Measure the Frequency of the Precession Vortex Signal

Ying Xu, Chuanshun Wei, Chao Yuan and Linfei Cao (Tianjin University, China); Rongji Zuo (Hebei University, China); Ye Liu and Xili Ba (Petrochina Planning&Engineering Institute, China)

A water cut measurement method based on TM010 mode microwave cavity sensor

Ying Xu (Tianjin University, China); Rongji Zuo (Hebei University, China); Chao Yuan, Chuanshun Wei, Linfei Cao and Cenwei Sun (Tianjin University, China)

A Comparative Study of Two Kinds of Modified Venturi Over-reading Models

Ying Xu, Linfei Cao and Chao Yuan (Tianjin University, China); Rongji Zuo (Hebei University, China); Chuanshun Wei (Tianjin University, China); Nianrong Wang (PetroChina Planning&Engineering Institute, China); Ye Liu (Petrochina Planning&Engineering Institute, China)

10:00 - 10:30
Wednesday AM Break
Room: International Ballroom ABC

10:30 - 11:00
Award Ceremony
Room: International Ballroom ABC

SI Second and UTC – Today and Tomorrow

The second still remains the best realised unit in SI (it has the smallest uncertainties), but this is no longer enough for frequency and time (F&T) metrologists and they are preparing for the redefinition of the second in the next few years. International F&T community is working hard nowadays to prepare all stakeholders for the new optical second that will have the realisation uncertainties at 1E-18 level, compared to 1E-16 level of the microwave Caesium standards.

In addition to new frequency standards, the attention to the accessibility and stability of UTC is high priority; modern technologies require high accuracy and secure time synchronization and F&T metrology is developing systems and methods that allow the transition of nanosecond accuracy from the National Labs to the client's systems.

I will present NRC F&T work that covers a wide range of activities – Caesium fountain NRC primary frequency standard realizing the SI second for Canada, portable single trapped Strontium Ion optical clock that will provide NRC with access to new optical SI second, and nanosecond accuracy time dissemination for the most demanding applications.

12:00 - 13:00
Wednesday Lunch Break
Room: International Ballroom ABC

13:00 - 14:00
Diversity and Inclusion in I&M
Room: Richelieu

13:00 – 14:00
Wednesday Poster Session
Session Chairs: Katelyn R Brinker (Iowa State University & Center for Nondestructive Evaluation, USA)
Grazia Iadarola (Polytechnic University of Marche, Italy)
Room: International Ballroom ABC

1: An Experimental Evaluation of a Quasicrystal-based Thermal-Conductive Absorber for Energy Harvesting
Maria Paula Medeiros Gomes Miguel and Mariana Marques Ferreira (Federal University of Paraíba, Brazil); Cleonilson Protasio de Souza (Federal University of Paraiba, Brazil); Bruno Alessandro Silva Guedes de Lima (UFPB, Brazil); Orlando Baiocchi (University of Washington, USA)

2: Photovoltaic Energy Prediction for New-Generation Cells with Limited Data: A Transfer Learning Approach
Angelo Genovese, Vera Bernardoni and Vincenzo Piuri (Università degli Studi di Milano, Italy); Fabio Scotti (Universita' degli Studi di Milano, Italy); Francesca Tessore (Università degli Studi di Milano, Italy)

3: A Self-diagnostic Flame Monitoring System Incorporating Acoustic, Optical, and Electrostatic Sensors

Yanchao Zhang (North China Electric Power University, China); Yong Yan (University of Kent, United Kingdom (Great Britain)); Xiaojing Bai and Jiali Wu (North China Electric Power University, China)

4: Measurement of cross-sectional velocity distribution of pneumatically conveyed particles in a square-shaped pipe through electrostatic sensing and Gaussian process regression

Yongyue Wang (North China Electric Power University, China); Lijuan Wang (University of Kent, United Kingdom (Great Britain)); Xiangchen Qian (North China Electric Power University, China); Yong Yan (University of Kent, United Kingdom (Great Britain))

5: Instrumentation for Assessing DC Electrical Distribution Systems in Buildings

Moazzam Nazir, Omkar A Ghatpande and Willy G Bernal Heredia (National Renewable Energy Laboratory, USA); Dusan Brhlik (Direct Energy Partners, USA)

6: Measurement of Wet Gas for Fuel Cell Recycling Loop Based on Ultrasonic and Capacitive Sensors

Chao Tan, Ziqi Cui, Hanrui Zhang, Yong Bao, Shangjie Ren and Feng Dong (Tianjin University, China)

7: Study on the channel weight of ultrasonic flow meter in wet gas measurement

Dandan Zheng and Zhai Mengxu (Tianjin University, China)

8: Gas Holdup Measurement of Gas-water Flow Using Microwave Transmission Line Method

Huimin Ma, Ying Xu, Chao Yuan, Jinghan Wang and Yi-Guang Yang (Tianjin University, China); Tao Zhang (TianJin University, China); Ziqiang Cui (Tianjin University, China)

9: Wet gas vortex metering based on tri-axis acceleration measurement

Hongjun Sun and Yuhang Liu (Tianjin University, China); Hongbing Ding (Tianjin Uinversity, China); Jinxia Li (Civil Aviation University of China, China); Jiamin Ye (Tianjin University, China)

10: Modeling a Virtual Flow Sensor in a Sugar-Energy Plant using Artificial Neural Network

Jayne dos Santos Lima (Universidade Federal da Paraíba, Brazil); Juan Moises Mauricio Villanueva (Federal University of Paraiba & UFPB, Brazil); Sebastian Yuri Cavalcanti Catunda (Federal University of Rio Grande do Norte, Brazil)

11: Wheat spikes counting using object-level data augmentation

Amirhossein Zaji (University of British Columbia, Canada); Zheng Liu (University of British Columbia Okanagan, Canada); Gaozhi (George) Xiao and Pankaj Bhowmik (National Research Council Canada, Canada); Jatinder Sangha and Yuefeng Ruan (Agriculture and Agri-Food, Canada)

12: What is my heart rate right now? Comparing data from different devices

Gloria Cosoli (Università Politecnica delle Marche, Italy); Angelica Poli (Universita' Politecnica delle Marche, Italy); Luca Antognoli and Susanna Spinsante (Università Politecnica Delle Marche, Italy); Lorenzo Scalise (Università Politecnica delle Marche, Italy)

13: Wearable Bio-Inspired Pulsating Flow Cooling for Live Garments

Patrick C.K. Luk (Centre of Power Engineering & Cranfield University, United Kingdom (Great Britain)); Jiawei Tang (Cranfield University, United Kingdom (Great Britain))

14: Wearable Big Data Pertinence Learning with Deep Spatiotemporal co-Mining
Qingxue Zhang (Purdue University School of Engineering and Technology, Indianapolis, USA)

15: Online Skin-Electrode Contact Quality Monitoring in Wearable Devices: An EEG Application
Valentina Casadei and Roberto Ferrero (University of Liverpool, United Kingdom (Great Britain))

16: Metrological foundations of emotional valence measurement through an EEG-based system
Andrea Apicella and Pasquale Arpaia (University of Naples Federico II, Italy); Antonio Esposito (Università degli Studi di Napoli Federico II, Italy & Augmented Reality for Health Monitoring Laboratory (ARHEMlab), Italy); Giovanna Mastrati and Nicola Moccaldi (University of Naples Federico II, Italy)

17: Network Effects on Dual Machine Learning Models Predicting Smart Home Sensor Measurements
Saif Almhairat (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Julien Larivière-Chartier (Bruyère Research Institute, Canada); Ali El-haraki (Telus, Canada); Rafik Goubran (Carleton University, Canada); Frank Knoefel (Bruyere Continuing Care, Canada)

18: Evaluation of interpolation methods for EMG arrays
Emma Farago and Adrian D.C. Chan (Carleton University, Canada)

19: Impedance spectroscopy for monitoring sound teeth and carious lesions
Isabella Sannino (Polytechnic of Turin, Italy); Emma Paola Angelini and Marco Parvis (Politecnico di Torino, Italy); Pasquale Arpaia (University of Naples Federico II, Italy); Sabrina Grassini (Politecnico di Torino, Italy)

20: Blink and saccade detection from forehead EEG
Emma Farago (Carleton University, Canada); Sujoy Ghosh Hajra (National Research Council & Simon Fraser University, Canada); Andrew Law (National Research Council, Canada); Adrian D.C. Chan (Carleton University, Canada)

21: Validation of an inertial odometry system for tracking upper limb kinematics
Ilaria Mileti (University Niccolò Cusano, Italy); Juri Taborri (University of Tuscia, Viterbo, Italy); Marco Germanotta and Irene Aprile (Don Carlo Gnocchi Onlus Foundation, Milan, Italy); Eduardo Palermo (Sapienza University of Rome, Italy); Fabrizio Patanè (Niccolò Cusano University, Italy); Stefano Rossi (University of Tuscia, Italy)

22: Fiducial point estimation solution for impedance cardiography measurements
Olev Martens, Margus Metshein and Anar Abdullayev (Tallinn University of Technology, Estonia); Antoine Frappé (IEMN - ISEN, France); Antoine Gautier (University of Lille, Junia, France); Maryam Saeed, Deepu John and Barry G Cardiff (University College Dublin, Ireland); Andrei Krivošei, Paul Annus and Marek Rist (Tallinn University of Technology, Estonia)

23: Hierarchical Spectral-Temporal Feature Learning for Motor Task Recognition in Brain Computer Interfaces
Hamidreza Sadreazami (McGill University, Canada); Yaser Mohammad Taheri (Concordia University, Canada); Marzieh Amini (Carleton University, Canada)

24: An Emergency Message and Call System for People with Epilepsy
Krishnu R S and Rahul Shukla (IIT Ropar, India); Hemant Kumar Chattar (Indian Institute of Technology Ropar, India); Birinder Paul, Ranjit Kaur and Arun Khokhar (Dayanand Medical College and Hospital, India); Gagandeep Singh (DMC&H Ludhiana, India); Ashish Kumar Sahani (Indian Institute of Technology Ropar, India)

25: Plug-and-Play Oxygen Auto-flow Regulator for Low Flow Oxygen Therapy: A Prototype Development
Balasubramanian Malayappan (BITS-Pilani, Hyderabad Campus, India); Avinash Pattaje, Arumalla Mohit Krishna and Bandi Jai Krishna (Birla Institute of Technology and Science (BITS)-Pilani, Hyderabad Campus, India); Pratyush Chakraborty (BITS Pilani, Hyderabad Campus, Jawaharnagar, India); Alivelu Manga Parimi (BITS Pilani Hyderabad Campus, India)

26: A Real-time Electromagnetic Localization System
Harald Gietler (University of Klagenfurt, Austria); Hubert Zangl (Alpen-Adria Universität, Austria)

27: Evolving Fuzzy and Tensor Product-based Models for Tower Crane Systems
Radu-Emil Precup (Politehnica University of Timisoara, Romania); Lorena Hedrea and Raul-Cristian Roman (Politehnica University Timisoara, Romania); Emil M. Petriu (University of Ottawa, Canada); Claudia-Adina Bojan-Dragos (Bd. V. Parvan 2 & Polithenica University Timisoara, Romania); Ciprian Hedrea (Politehnica University Timisoara, Romania)

28: Simultaneous decoupling control of translation and rotation for a 6-DOF vibration isolator based on the Stewart platform
Xunchao Chu and Zhenxing Li (Tsinghua University, China); Kang Wu (Tutor, China)

29: Towards a Multi-Pixel Time-of-Flight Indoor Navigation System for Nano-Drone Applications
Vlad Niculescu (ETH Zurich, Switzerland); Hanna Müller (ETH Zürich, Switzerland); Iman Ostovar, Tommaso Polonelli, Michele Magno and Luca Benini (ETH Zurich, Switzerland)

30: RFID-based robot localisation: an unconstrained optimisation problem by exploiting RSSI
Farhad Shamsfakhr, David Macii and Daniele Fontanelli (University of Trento, Italy); Luigi Palopoli (Universita` di Trento, Italy); Andrea Motroni, Paolo Nepa and Alice Buffi (University of Pisa, Italy)

31: Additively Manufactured Capacitive Proximity and Tactile Sensors for Soft Robotic Systems
Mohammad Alshawabkeh (Carinthia University of Applied Sciences, Austria); Hosam Alagi (Researcher, Germany); Stefan Escaida Navarro and Christian Duriez (Inria, France); Björn Hein (Hochschule Karlsruhe, Germany); Lisa-Marie Faller (Carinthia University of Applied Sciences, Austria)

32: A Study on the Magnetic Polarizability Tensors of Minimum Metal Anti-Personnel Landmines
Toykan Ozdeger (University of Manchester, United Kingdom (Great Britain)); Paul Ledger (Keele University, United Kingdom (Great Britain)); Anthony Peyton (University of Manchester, United Kingdom (Great Britain))

33: Permittivity Measurement of Low-Loss Materials using Embedded Resonance
Phil Bartley (Innovative Measurement Solutions, Inc, USA)

34: A Metrology-grade Digitizer for Power Converters in the High Luminosity Large Hadron Collider
Nikolai Beev, Michele Martino, Miguel Cerqueira Bastos and Daniel Valuch (CERN, Switzerland)

35: Microwave Surface Conductivity Measurement Using an Open-Ended Circular Waveguide Probe
Matthew Dvorsky and Mohammad Tayeb Al Qaseer (Iowa State University, USA); Reza Zoughi (Missouri University of Science and Technoogy, USA)

36: Spike-frequency adaptation improves the coding accuracy by a deep learning algorithm from the biophysical perspective
Jixuan Wang, Bin Deng, Tianshi Gao, Jiang Wang and Guosheng Yi (Tianjin University, China)

37: Anomaly Detection in Spacecraft Telemetry Data using Graph Convolution Networks
Yue Song, Jinsong Yu, Diyin Tang, Jie Yang and Lingkun Kong (Beihang University, China); Xin Li (China Academy of Launch Vehicle Technology, China)

38: A Mixed Gas Composition Identification Method Based on Sample Augmentation
Yinsheng Chen and Wanyu Xia (Harbin University of Science and Technology, China); Deyun Chen (Harbin University of Science and Technology(HUST), China); Tian yu Zhang (Harbin University of Science and Technology, China); Kai Song (Harbin Institute of Technology, China)

39: Neural Network-Based Prediction and Monitoring of Blood Glucose Response to Nutritional Factors in Type-1 Diabetes
Leopoldo Angrisani (University of Naples Federico II, Italy); Giovanni Annuzzi (Università Federico II, Italy); Pasquale Arpaia and Lutgarda Bozzetto (University of Naples Federico II, Italy); Andrea Cataldo (University of Salento, Italy); Alessandra Corrado and Egidio De Benedetto (University of Naples Federico II, Italy); Vincenzo Di Capua (University of Naples Federico II & CERN, European Organization for Nuclear Research, Switzerland); Roberto Prevete (Università degli Studi di Napoli Federico II, Italy); Ersilia Vallefuoco (University of Naples Federico II, Italy)

40: Infrared Image Super-Resolution via Generative Adversarial Network with Gradient Penalty Loss
Jianqiang Mei (Tianjin University of Technology and Education, China)

41: An Efficient Model Fusion Method for Bearing Fault Diagnosis
Honghao Ren, Xinshan Zhu and Jiayu Wang (Tianjin University, China)

42: Arbitrary frequency magnetic particle spectrometer for viscosity measuring of magnetic nanoparticles
Haoran Zhang, Bo Zhang, Yanjun Liu and Jie He (Beihang University, China); Hui Hui (Institute of Automation, Chinese Academy of Sciences, China); Jie Tian (Beihang University, China)

43: Mechatronic Demodulation for Dynamic Atomic Force Microscopy Measurement Modes
Mathias Poik, Mario Mayr and Thomas Hackl (TU Wien, Austria); Georg Schitter (Vienna University of Technology, Austria)

44: Ferrofluid-Based Shape-Controllable and Fast-Responsive Micro-Pumping and Valving Actuation
Jiawei Tang (Cranfield University, United Kingdom (Great Britain)); Patrick C.K. Luk (Centre of Power Engineering & Cranfield University, United Kingdom (Great Britain))

45: DC-Bias-free Surface Potential Measurements by Heterodyne AC Kelvin Probe Force Microscopy
Thomas Hackl and Mathias Poik (TU Wien, Austria); Georg Schitter (Vienna University of Technology, Austria)

46: Detection of interfacial shear stress and droplet detachment using PLIF&PIV methods in horizontal liquid-liquid flows
Lusheng Zhai, Wenhao Wang, Xinyu Meng and Ningde Jin (Tianjin University, China)

47: Remote Operation Status Tracking for Manufacturing Machines via Sound Recognition using IoT
Boon Yaik Ooi and Jason Jing Wei Lim (UTAR, Malaysia); Soung Yue Liew (Universiti Tunku Abdul Rahman, Malaysia); Shervin Shirmohammadi (University of Ottawa, Canada)

48: Multiple correlation analysis for finite-time delay estimation in Soft Sensors design
Salvatore Graziani (University of Catania, Italy); Maria Gabriella Xibilia (University of Messina, Italy)

49: Real-Time Measurement of Viscosity Using Coplanar Capacitive Sensor
Anas Al Shaghouri, Imad H Elhajj and Daniel Asmar (American University of Beirut, Lebanon)

14:00 - 14:30
Wednesday PM Break
Room: International Ballroom ABC

14:00 - 15:30
Wednesday Industry Session
Room: International Ballroom ABC

15:30 - 17:30
Data Acquisition Systems
Session Chairs: Luca De Vito (University of Sannio, Italy)
Angelo Perkusich (Federal University of Campina Grande, Brazil)
Room: Chaudiere

Multi-parameter Wearable Band for Wireless Data Collection from People with Epilepsy
Hemant Kumar Chattar, Bijit Basumatary and Rahul Shukla (Indian Institute of Technology Ropar, India); Birinder Paul, Ranjit Kaur and Arun Khokhar (Dayanand Medical College and Hospital, India); Gagandeep Singh (Dayanand Medical College & Hospital, India); Ashish Kumar Sahani (Indian Institute of Technology Ropar, India)

Hybrid Successive Subtraction Method of Analog to Digital Converter
Suchitra Padidala (Indian Institute of Technology Madras, India); Nimal Kumar (University of Sussex, England); Jagadeesh Kumar V (Indian Institute of Technology Madras, India)

Use of Electrical Resistance to Modeling the Phase Transformation of Shape Memory Alloy
Wislayne Silva, Jaidilson Jo Silva and Angelo Perkusich (Federal University of Campina Grande, Brazil)

A CS-based acquisition method of acoustic emission signals from distributed SHM systems

Domenico Luca Carnì (University of Calabria, Italy); Luca De Vito (University of Sannio, Italy); Francesco Lamonaca (University of Calabria, Italy); Francesco Picariello and Ioan Tudosa (University of Sannio, Italy)

On the Use of an Hyperspectral Imaging Vision Based Measurement System and Machine Learning for Iris Pigmentation Grading

Tommaso Fedullo (University of Padua, Italy); Ettore Masetti, Giovanni Gibertoni, Federico Tramarin and Luigi Rovati (University of Modena and Reggio Emilia, Italy)

Oxygen Uptake Rate Measurement Using Sigma Delta Modulator in the Biological Domain in Activated Sludge Systems

Paulo R. C. Silva, Sebastian Yuri Cavalcanti Catunda and Antonio Soares (Federal University of Rio Grande do Norte, Brazil); Adrianus Van Haandel (Federal University of Campina Grande, Brazil)

Shape Reconstruction for Electrical Impedance Tomography with V2D-Net Deep Convolutional Neural Network

Zichen Wang, Xinyu Zhang, Rong Fu, Di Wang and Chen Xiao Yan (Tianjin University of Science and Technology, China); Huaxiang Wang (Tianjin University, China)

Optimization of 3-D Sensor Design for Electrical Capacitance Tomography

Ying Wang, Shijie Sun, Xupeng Lu, Jiangtao Sun and Lijun Xu (Beihang University, China)

Acoustoelectric signal measurement system based on FPGA

Zhaoyang Zhang and Yanbin Xu (Tianjin University, China); Zhicheng Yan (School of Electrical and Information Engineering, Tianjin University, China); Feng Dong (Tianjin University, China)

Comparison of dredging pipe velocity measurement methods based on ERT

Yuwei Zhao (Tianjin University, China)

Repeatability and Reproducibility of Electrical Measurements of Spark-Plasma-Sintered Alumina-SiCw Composites

Miriam Rath and Rosario Gerhardt (Georgia Institute of Technology, USA)

Circuits and Embedded Systems for Instrumentation and Measurement
Session Chairs: Niccolo Gallice (Università degli Studi di Milano & INFN Milano, Italy)
Salvatore Graziani (University of Catania, Italy)
Room: Joliet

Timing Deviations in Wireless Networks using Bluetooth Periodic Advertising

Timo Maiwald and Qing Zhang (Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany); Max Bartunik (Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany); Kilin Shi (Friedrich-Alexander University Erlangen-Nuremberg, Germany); Fabian Lurz (Hamburg University of Technology, Germany); Georg Fischer (Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany); Thomas Ackermann (University of Erlangen-Nuremberg, Germany)

Development of a cryogenic DC-DC Boost Converter: devices characterization and first prototype measurements

Niccolo Gallice (Università degli Studi di Milano & INFN Milano, Italy); Danilo Santoro and Paolo Cova (University of Parma, Italy); Nicola Delmonte (Università di Parma, Italy); Massimo Lazzaroni (Università degli Studi di Milano, Italy); Paola Sala and Andrea Zani (INFN Milano, Italy)

A new Measurement technique to determine the Amplitude and Phase shift of a sinusoidal voltage signal using a charge balanced digitizer

Kartheek A Sai Bandi (Indian Institute of Technology and Engineering, Tirupati, India); Prashanth Vooka (Indian Institute of Technology Tirupati, India)

Hardware prototype blind calibration of MWC based on BGPC

Yinuo Su, Jingchao Zhang, Siyi Jiang, Xiaodong Li and Liyan Qiao (Harbin Institute of Technology, China)

An FPGA-based real-time radar coordinate transformation by jointly exploiting MicroBlaze and Programmable Logic

Jingchao Zhang and Peiwen Gao (Harbin Institute of Technology, China)

Teaching Instrumentation and Measurement in Local and Remote Laboratories

Christian Schuss (University of Oulu & Faculty of Information Technology and Electrical Engineering, Finland); Aleksi Maanselkä, Mikko Kaikkonen and Tapio Fabritius (University of Oulu, Finland)

Instrumentation and Measurement in Aerospace and Space Systems
Session Chairs: Bruce Stephen (University of Strathclyde, United Kingdom (Great Britain))
Marco Grassi (University of Pavia, Italy)
Room: Richelieu

Investigation of Sensor Bias and Signal Quality on Target Tracking with Multiple Radars

Peter Carniglia (Defence Research and Development Canada, Canada); Anthony Damini (DRDC Ottawa, Canada); Bhashyam Balaji (DRDC-Ottawa, Canada

Experimental Characterization of the ORION ASIC: The Read-Out Circuit for X-γ-Ray Detection of the THESEUS Mission Spectrometer

Marco Grassi, Alessandro Gemelli and Piero Malcovati (University of Pavia, Italy); Filippo Mele, Irisa Dedolli, Massimo Gandola and Giuseppe Bertuccio (Politecnico di Milano, Italy); Ezequiel Marchesini and Enrico Virgilli (INAF Bologna, Italy); Riccardo Campana, Fabio Fuschino and Claudio Labanti (INAF-OAS Bologna, Italy); Lorenzo Amati (INAF Bologna, Italy)

Sensor Data Prediction for Fixed-wing Drone Based on OR-RELM

Jingyi Dong and Datong Liu (Harbin Institute of Technology, China)

L1/2-norm Regularization for Detecting Aero-engine Fan Acoustic Mode

Zhendong Li, Baijie Qiao and Zepeng Li (Xi'an Jiaotong University, China); Bi Wen (Science and Technology on Altitude Simulation Laboratory, China); Xuefeng Chen (Xian Jiaotong University, China)

FPGA-based large-scale remote sensing image ROI extraction for on-orbit ship detection

Peng Yu, Yutong Li and Bowen Yao (Harbin Institute of Technology, China)

Drone Micro-Doppler Identification with Radar Calibration

Ian WK Lam and Andy Huang (Carleton University, Canada); Shashank Pant (National Research Council Canada, Canada); Sreeraman Rajan (Carleton University, Canada); Prakash Patnaik (NRC, Canada); Bhashyam Balaji (DRDC-Ottawa, Canada)

17:30 - 21:00
Gala Dinner
Location: Canadian Museum of History

Automatic and Fast Extraction of 3D Hand Measurements using a Deep Neural Network

Nastaran Nourbakhsh Kaashki and Xinxin Dai (Vrije Universiteit Brussel, Belgium); Timea Gyarmathy (Technical University of Cluj-Napoca, Romania); Pengpeng Hu (Vrije Universiteit Brussel, Belgium); Bogdan Iancu (Technical University Cluj-Napoca, Romania); Adrian Munteanu (Vrije Universiteit Brussel, Belgium)

Comparison of Blind Source Separation Techniques for Respiration Rate Estimation from Depth Video

Mohsen Mozafari, James R Green and Rafik Goubran (Carleton University, Canada); Andrew Law (National Research Council, Canada)

Respiration Rate Estimation from Thermal Video of Masked and Unmasked Individuals Using Tensor Decomposition

Mohsen Mozafari (Carleton University, Canada); Andrew Law (National Research Council, Canada); James R Green and Rafik Goubran (Carleton University, Canada)

Instantaneous Rotational Speed Measurement of Wind Turbine Blades using Marker Tracking Method

Yi-Hsiang Liao, Lijuan Wang and Yong Yan (University of Kent, United Kingdom (Great Britain))

Uncertainty mitigation in drone-based 3D scanning of defects in concrete structures

Daniele Marchisotti and Emanuale Zappa (Politecnico di Milano, Italy)

An Automated Tool to Assess Air Space Size in Histopathology Images of Lung Tissue

Diego A Politis, Sina Salsabili and Adrian D.C. Chan (Carleton University, Canada)

Improvement of Flame Complex Permittivity Model Considering Positive Ions and Electrons

Chao Wang, Shuo Jin, Xiaoning Cao and Jiamin Ye (Tianjin University, China)

Optimization of the Measuring Tubes for High Pressure Coriolis Flowmeters

Lijun Sun, Jingyu Gao and Yue Liu (Tianjin University, China)

Design Optimization of Micro Coriolis Flowmeters

Lijun Sun, Wei Wu and Jinpeng Lian (Tianjin University, China)

Analysis of Parameters Influence in a MOX Gas Sensor Model

Graziella Bedenik (Federal University of Sergipe, São Cristóvão, Brazil); Matheus Souza (Federal University of Rio Grande do Sul, Porto Alegre, Brazil); Elyson A N Carvalho, Lucas Molina and Jugurta Montalvao (Federal University of Sergipe, São Cristóvão, Brazil); Raimundo Freire (Federal University of Campina Grande, Campina Grande, Brazil)

An Optimization Design of the Iron-core Coil Sensor for High-frequency Current Signals

Lei Zhou and Yang Jiao (Huazhong University of Science and Technology, China); Hui Gong (China Electrical Power Research Institute, China); Hongbin Li, Chaojun Ma and Chuanji Zhang (Huazhong University of Science and Technology, China)

Simulation and Design of Double-Winding Thermal Flow Sensor Based on COMSOL

Qinhui Wang, Xiangyu Hu, Peng Wang, Wuyu Cui and Yi Wang (Lanzhou Institute of Physics, China)

8:00 – 10:00
Instrumentation and Measurement in Agriculture, Food Production and Food Safety and in Environmental Monitoring
Session Chairs: Pisana Placidi (University of Perugia, Italy)
Maurizio Spadavecchia (Polytechnic University of Bari, Italy)
Room: Joliet

Capacitive Low-Cost System for Soil Water Content Measurement in the IoT Precision Agriculture

Pisana Placidi, Nicola Papini, Carmine Villani Delle Vergini, Paolo Mezzanotte and Andrea Scorzoni (University of Perugia, Italy)

Monitoring of Seagrass Meadows Using Satellite Images and U-Net Convolutional Neural Network

Marco Scarpetta (Polytechnic University of Bari, Italy); Paolo Affuso (Politecnico di Bari, Italy); Maddalena de Virgilio (National Research Council, Italy); Maurizio Spadavecchia (Polytechnic University of Bari, Italy); Gregorio Andria and Nicola Giaquinto (Politecnico di Bari, Italy)

Dust accumulation sensing system with a screen-printed interdigitated sensor

Pauliina Vilmi (University of Oulu, Finland); Christian Schuss (University of Oulu & Faculty of Information Technology and Electrical Engineering, Finland); Esa Hannila (Optoelectronics and Measurement Techniques Research Unit, Finland); Rafal Sliz and Tapio Fabritius (University of Oulu, Finland)

Performance Comparison of Omni and Cardioid Directional Microphones for Indoor Angle of Arrival Sound Source Localization

Meng Jiang, Chibuzo J Nnonyelu, Jan Lundgren, Goran Thungstrom and Mårten Sjöström (Mid Sweden University, Sweden); Shan Gao (Beijing Jiaotong University, Sweden)

Accuracy Evaluation of a Weeding Robot in Organic Farming

Vitali Czymmek, Leif Ole Harders and Stephan Hussmann (West Coast University of Applied Sciences, Germany); Florian Johannes Knoll (West Coast University, Germany)

Development of Compact Laser Ion Source for Field-Deployable Mass Spectrometer for Nuclear Security

Ankur Chaudhuri, Liqian Li, James Johnston and Martin-Lee Cusick (Canadian Nuclear Laboratories, Canada)

8:00 – 10:00
Instrumentation and Measurement in Medical, Biomedical and Healthcare Systems
Session Chairs: Joseph Cortner (Retired, USA)
Baki Karaböce (TÜBİTAK UME & National Metrology Institute of Turkey, Turkey)
Room: Richelieu

Biometric Classification of Frequency Following Responses to English Vowels

Rui Sun, Martin Bouchard and Hilmi R Dajani (University of Ottawa, Canada)

A Bootstrapping Technique to Boost Input Impedance of ECG Recording Amplifiers

Soumyajyoti Maji (Harvard University, USA); Martin Burke (Trinity College, Ireland)

EMG-Based Continuous Motion Decoding of Upper Limb with Spiking Neural Network

Yuwei Du (Harbin Institute of Technology, China); Jing Jin (Harbin institute of Technology, China); Qiang Wang and Jianyin Fan (Harbin Institute of Technology, China)

SABiNN: FPGA Implementation of Shift Accumulate Binary Neural Network Model for Real -Time Automatic Detection of Sleep Apnea

Omiya Hassan (University of Missouri-Columbia, USA); Rushil Thakker, Tanmoy Paul and Dilruba Parvin (University of Missouri, USA); Abu S Mosa and Syed Islam (University of Missouri-Columbia, USA)

An Accelerometer-based Wearable Multi-node Motion Detection System of Freezing of Gait in Parkinson's Disease

Chen Liu, Lingmin Han, Siyuan Chang and Jiang Wang (Tianjin University, China)

Towards a Temperature Compensated Model for a Blood-pH Sensor in Extracorporeal Circulation

Daniele Goldoni, Alberto Ferrari and Mattia Piccini (University of Modena and Reggio Emilia, Italy); Stefano Cattini (University of Modena and Reggio Emilia & Science & Technology Park for Medicine, Mirandola, Modena, Italy); Luigi Rovati (University of Modena and Reggio Emilia, Italy)

10:00 - 10:30
Thursday AM Break
Room: International Ballroom ABC

Optically Generated Magnetic Fields

based on a joint work of
P. B. Corkum1, K. Jana1, S. Möller1, Y. Mi1, S. Sederberg1, M. Mountney2 and A. Emmanouilidou2
1Joint Attosecond Science Laboratory, University of Ottawa, and National Research Council of
Canada
2University College London

Isolated magnetic fields are used extensively in solid state physics, medical physics, and chemistry. These magnetic fields are often generated in wire loops with Biot-Savart law relating the time-dependent current flowing to a dynamic magnetic field. However, physical wires constrain the magnitude, the time-dependence, and the dimensions of the fields.

Controlled currents can be optically injected into semiconductors, dielectrics, gases, or plasmas using coherent control – the perturbative or non-perturbative interference of quantum pathways from an initial state to a final state in the material itself. Like their wire counterparts, these material currents create fields, but with different constraints than those generated by physical wires.

Optical injection allows the spatial dimensions to be confined to the focal volume of a vacuum ultraviolet (VUV) pulse (~100 nm) while the rise time of the current is determined by the femtosecond pulse duration of the exciting beams. Furthermore, since the magnitude and direction of these currents are controlled by interference, the motion of the charge carriers can be controlled with a spatial-light modulator. I will describe how we measure current in GaAs and the dynamic near-field magnetic structure that Maxwell's equations imply. I will also describe the space-time coupled field that is radiated (sometimes called a "flying doughnut") and measured by electro-optic sampling. I will conclude with a space-time measurement of the linear electronic spectrum of water vapor in the THz spectral region.

11:30 - 12:30
Thursday Lunch Break
Room: International Ballroom ABC

12:30 - 14:00
Thursday Industry Session
Room: International Ballroom ABC

SPS 8: Metrological performance of Low-cost platforms for measurement applications and SPS 9: Measurement Systems for Harsh Operating Conditions
Session Chairs: Markus Neumayer (Graz University of Technology, Austria)
Stefano Rinaldi (University of Brescia, Italy)
Room: Chaudiere

An Experimental Characterization of Chain of PLLs for Wired Clock Synchronization of UWB Anchors for Indoor Location

Stefano Rinaldi, Alessandro Musatti, Alessandro Depari, Paolo Ferrari, Alessandra Flammini and Emiliano Sisinni (University of Brescia, Italy)

Synchronization solutions for Power Quality functionalities in low cost smart meters

Paolo Castello, Carlo Muscas, Paolo Attilio Pegoraro and Sara Sulis (University of Cagliari, Italy)

Torque measurement with tunable metamaterial and a modified Doppler radar

Alexander Schossmann and Alexander Bergmann (Graz University of Technology, Austria); Christof Michenthaler and Dirk Hammerschmidt (Infineon Technologies AG, Austria)

Analysis of Sensor Effects for a Position Measurement System in Harsh Environments

Gabriel Gruber, Markus Neumayer, Bernhard Schweighofer and Hannes Wegleiter (Graz University of Technology, Austria); Gerald Klösch, Thomas Leitner and Matthias Berger (Voestalpine, Austria)

Acoustic Condition Monitoring: Signal Analysis for Large Machinery Halls

Christof Pichler, Markus Neumayer, Hannes Wegleiter and Bernhard Schweighofer (Graz University of Technology, Austria); Stefan Schuster (Voestalpine Stahl Gmbh & Institute for Communications and Information Engineering, Austria); Christoph Feilmayr (Voestalpine Stahl GmbH, Austria); Stefan Puttinger (Johannes Kepler University Linz, Austria)

14:00 – 16:00
SPS 7: Laser Sensing and Imaging Techniques and System
Session Chairs: Chang Liu (University of Edinburgh, United Kingdom (Great Britain))
Gaozhi (George) Xiao (National Research Council Canada, Canada)
Room: Frontenac

Two-Step TDLAS Tomographic Reconstruction for Temperature Imaging

Jingjing Si and Xin Liu (Yanshan University, China); Yinbo Cheng (Hebei Agricultural University, China); Chang Liu (University of Edinburgh, United Kingdom (Great Britain))

Laser wavelength self-diagnosis in TDLAS/WMS system

Zihuai Liu and Yonggang Li (Central South University, China); Qiwu Luo (School of Automation, Central South University, Changsha, China); Chunhua Yang, Weihua Gui and Lijuan Lan (Central South University, China)

Temperature Telemetry with Synchronous Distance Detection System based on CM-TDLAS

Rende Wang, Lijun Xu, Ang Huang, Wanpeng Zhang and Zhang Cao (Beihang University, China)

A portable laser absorption sensor for quantitative measurement of ambient temperature and humidity
Liuhao Ma (Wuhan University of Technology, China)

An Interferometer modulated TDLAS Temperature Sensor by using Coherent Demodulation
Guangyu Hou, Lijun Xu, Wenbin Zhou, Ang Huang and Zhang Cao (Beihang University, China)

Simulation Study on Influencing Factors of Image Reconstruction Quality Based on UT System
Jingyi Hu (Northwestern Polytechnical University, China); Nan Li (Northwestern Polytechnical University & Beijing University of Technology, China); Lina Wang (Northwestern Polytechnical University, China)

14:00 – 16:00
Instrumentation and Measurement in Medical, Biomedical and Healthcare Systems
Session Chairs: Ruth A Dyer (Kansas State University, USA)
Marco Parvis (Politecnico di Torino, Italy)
Room: Joliet

Convolutional Neural Network Based Heart Sounds Recognition on Edge Computing Platform
Venkatesh Vakamullu and Sudipto Trivedy (Indian Institute of Technology Kharagpur, India); Madhusudhan Mishra (North Eastern Regional Institute of Science and Technology(NERIST), Arunachal Pradesh, India); Anirban Mukherjee (Indian Institute of Technology Kharagpur, India)

Real-Time Heart Murmur Classification using Attention Based Deep Learning Approach
Venkatesh Vakamullu (Indian Institute of Technology Kharagpur, India); Madhusudhan Mishra (North Eastern Regional Institute of Science and Technology(NERIST), Arunachal Pradesh, India); Anirban Mukherjee (Indian Institute of Technology Kharagpur, India)

Sensor fusion hardware platform for robust electromagnetic navigation
Kilian O'Donoghue and Herman Alexander Jaeger (Tyndall National Institute, Ireland); Padraig J Cantillon-Murphy (Tyndall National Institute & Quadrant Scientific, Ireland)

Pulse Compression Favourable Thermal Wave Imaging Approach for Estimation of Osteoporosis: A numerical study
Vanita Arora (Indian Institute of Information Technology Una, India); Ravibabu Mulaveesala (Indian Institute of Technology Ropar, India); Sreeraman Rajan (Carleton University, Canada); Bhashyam Balaji (DRDC-Ottawa, Canada); Carlos Rossa (Carleton University, Canada)

Modality-Independent Placebo Device for Electrostimulation
Graziella Bedenik (Federal University of Sergipe, São Cristóvão, Brazil); Matheus Souza (Federal University of Rio Grande do Sul, Porto Alegre, Brazil); Elyson A N Carvalho, Josimari DeSantana and José Carvalho-Filho (Federal University of Sergipe, São Cristóvão, Brazil); Raimundo Freire (Federal University of Campina Grande, Campina Grande, Brazil)

The Effect of Noise on Contactless Heart Rate Measurement using Video Magnification
Leen Yassin Kassab (Carleton University, Canada); Andrew Law (National Research Council, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Julien Larivière-Chartier (Bruyère Research Institute, Canada); Rafik Goubran (Carleton University, Canada); Frank Knoefel (Bruyere Continuing Care, Canada)

sEMG Signal based Hand Gesture Recognition by using Selective Subbands Coefficients and Machine Learning

Saeed Mian Qaisar (Effat University, Saudi Arabia); Dominique Dallet (IMS Laboratory - Bordeaux INP - University Bordeaux, France); Alberto López Martínez and Francisco Ferrero Martín (University of Oviedo, Spain)

Direction of Arrival Estimation of Moving Sound Sources using Deep Learning

Jana Rusrus (Universty of Ottawa, Canada); Martin Bouchard and Shervin Shirmohammadi (University of Ottawa, Canada)

Extension of Signal Model for Super Resolution Phase Retrieval in Continuous Domain

Xiaodong Li, Ning Fu and Liyan Qiao (Harbin Institute of Technology, China)

Improved Amplitude Extraction Method for Attenuation Reconstruction of Transmissive Ultrasonic Tomography

Hao Liu, Chao Tan and Feng Dong (Tianjin University, China)

Multi-task learning: A solution of small sample size problem in floor-based gait recognition

Bin Deng, Jiangtao Luo, Tianshi Gao, Zijian Cui and Jiang Wang (Tianjin University, China)

Cascade integrator comb filter-aided calibration-free Wavelength Modulation Spectroscopy Tomography

Jiangnan Xia, Godwin Enemali, Rui Zhang and Chang Liu (University of Edinburgh, United Kingdom (Great Britain))

16:00 – 17:00
Thursday PM Break
Room: International Ballroom ABC

16:00 - 17:00
Late Results Poster Session
Session Chairs: Harald Gietler (University of Klagenfurt, Austria)
Salvatore Graziani (University of Catania, Italy)
Room: International Ballroom ABC

1: An Automaton for the Characterization of Low-Cost Gas Sensor Systems in Air Quality Monitoring

Georgi Tancev and Céline Pascale (Swiss Federal Institute of Metrology, Switzerland)

2: New simplified simulation method for predicting impedance behavior of multiple circuits

Yifan Jin and Rosario Gerhardt (Georgia Institute of Technology, USA)

3: Distributed Optical Strain Sensing measurements down to cryogenic temperatures
Keziban Kandemir (CERN, Switzerland); Michael Guinchard (CERN (European Organization for Nuclear Research), Switzerland)

4: Pulse: An unobtrusive vitals monitoring system based on innovative high sensitivity sensors
Adrien Thirion (LAAS-CNRS Institut National Polytechnique de Toulouse & Nanomade Lab, France); Estelle Mazaleyrat (Nanomade LAB, France); Blaise Mulliez (Université de Toulouse, France); Francis Bony (LAAS-CNRS Institut National Polytechnique de Toulouse); Hélène Tap (LAAS-CNRS, Institut National Polytechnique de Toulouse, Université de Toulouse, France)

5: Quality Control Testing of Interdigitated Circuits with Impedance Spectroscopy
Roshaun Titus and Rosario Gerhardt (Georgia Institute of Technology, USA); J. Elliott Fowler (Sandia National Laboratories, USA)

16:00 – 17:00
Presentations of IM Patents @ I²MTC
Session Chairs: Harald Gietler (University of Klagenfurt, Austria)
Salvatore Graziani (University of Catania, Italy)
Room: International Ballroom ABC

6: Electrocardiogram (ECG) Biometric Authentication
Inventors: Abdulmotaleb El Saddik, Juan Sebastian Arteaga Falconi, Hussein Al Osman

7: Method and Device for Broadband Analysis of Systems and Substances
Inventors: Raul Land, Paul Annus, Mart Min, Olev Märtens, Jaan Ojarand

8: Remote Sensing of Human Breathing at a Distance
Inventors: Mohamed Mabrouk, Izmail Batkin, Sreeraman Rajan, Miodrag Bolic, Voicu Groza, Hilmi Dajani

9: System and Method for In-situ Measurement of Viscoelastic Material Properties Using Continuous-Wave Ultrasound
Inventors: Jinglu Tan, Nilesh Salvi

10: Methods and Apparatus for Network Delay and Distance Estimation, Computing Resource Selection, and Related Techniques
Inventors: Karthigesu Vijayasuganthan, Sorin Stoian, Shervin Shirmohammadi, Shady Mohammed, Alaa Eddin Alchalabi

11: Action Recommendation Engine of a Closed-loop Machine Learning System for Controlling a Network
Inventors: David Côté, Thomas Triplet, Shelley Bhalla, Emil Janulewicz, Ayse Rumeysa Mohammed, Shady A Mohammed, Shervin Shirmohammadi

12: A Measurement Approach to Validate the Predicted Behavior of a Nonlinear Mechanical Energy Harvester

Bruno Ando and Salvatore Baglio (University of Catania, Italy); Adi R. Bulsara (Space and Naval Warfare Center (San Diego), USA); Vincenzo Marletta and Bruno Vaccaro (University of Catania, Italy)

13: Wideband Microwave Dielectric Properties of Martian and Lunar Regolith Simulants

Theodore W Mathews IV, Joseph Filbert, Mohammad Tayeb Al Qaseer and Reza Zoughi (Iowa State University, USA)

14: Beamformer-based Multi-source Acoustic DOA Detection System for Hearing Aids

Hala As'ad and Martin Bouchard (University of Ottawa, Canada); Homayoun Kamkar-Parsi (WS Audiology, Germany)

15: Recognition of complex surfaces based on multiscale temporal networks

Tianshi Gao, Bin Deng, Jiangtao Luo, Jixuan Wang, Jiang Wang and Guosheng Yi (Tianjin University, China)

16: 3-D Targets Reconstruction Based on Stepped Frequency Continuous Wave GPR System

Yuxuan Wu, Feng Shen, Minghao Zhang, Tong Wan, Yongfei Miao and Dingjie Xu (Harbin Institute of Technology, China)

17: A Fast Analytical Solution to the Filtered Canonical Polyadic Decomposition Problem

Balázs Renczes (Budapest University of Technology and Economics & Faculty of Electrical Engineering and Informatics, Hungary); Jan Decuyper and Mark Runacres (Vrije Universiteit Brussel, Belgium)

18: Parameter Matching Method for the Measurement of Two-dimensional Pulse Streams Signal

Shuangxing Yun, Ning Fu and Liyan Qiao (Harbin Institute of Technology, China)

19: Using Generalized Cross-Correlation estimators for leak signal velocity estimation and spectral region of operation selection

Kostas Angelopoulos and George-Othon Glentis (University of Peloponnese, Greece)

20: Opti2: A reconstruction approach for periodic signals using compressive sensing

Dailys Arronde Perez (University of Klagenfurt, Austria); Christian Stetco and Hubert Zangl (University of Klagenfurt)

21: Frequency Identification of a Memory Polynomial Model for PA Modeling

Stanislas Dubois (University of Bordeaux, France); Bruno Lelong (Thales DMS, France); Jean-Michel Hodé (Thales DMS); Guillaume Ferré (University of Bordeaux, France); Dominique Dallet (IMS Laboratory - Bordeaux INP - University Bordeaux, France)

22: Gas-water Two-phase Flow Status Monitoring based on Multi-sensor Signals and CA-PCA Strategy
Wentao Wu, Shumei Zhang and Feng Dong (Tianjin University, China)

23: Observer-based discrete Gabor transform
Bence Ország and László Sujbert (Budapest University of Technology and Economics, Hungary)

24: A RP image-based health indicator construction method for wind turbine RUL prediction
Danyang Han, Jinsong Yu, Diyin Tang and Lingkun Kong (Beihang University, China); Xin Li (China Academy of Launch Vehicle Technology, China)

25: Evaluation of the measurement uncertainty for improving quality and reliability in the automated inspection of composite materials
Emanuela Natale and Giulio D'Emilia (University of L'Aquila, Italy); Antonella Gaspari (Politecnico di Bari, Italy); Luciano Chiominto (University of L'Aquila, Italy)

26: Effective and Fast Estimation for Multi-Source Navigation Sensor Reliability
Wenqiang Li, Feng Shen, Zhongxuan Zhang, Yi Liang, Dingjie Xu and Wei Gao (Harbin Institute of Technology, China)

27: High precision and contactless dielectric loaded resonator for room temperature surface resistance measurements at microwave frequencies
Andrea Alimenti, Kostiantyn Torokhtii, Nicola Pompeo and Enrico Silva (Università Roma Tre, Italy)

28: A λ-level partition-based linear back projection algorithm to electrical resistance tomography
XueZhen Liu, Yue and Huaxiang Wang (Tianjin University, China)

29: Fault Diagnosis of ERT Data Acquisition System in Dredging Project
Changhao Xin and Yue (Tianjin University, China)

30: Accuracy Improvement of High-Frequency Transmission Line Model of Induction Motor Through Multilayer Perceptron
Zhenyu Zhao, Fei Fan, Quqin Sun, Pengfei Tu, Huamin Jie and Kye Yak See (Nanyang Technological University, Singapore)

31: Intelligent Cross-domain Fault Diagnosis For Rotating Machinery Using Multiscale Adversarial Convolutional Neural Network
Ke Yue, Jipu Li, Junbin Chen and Weihua Li (South China University of Technology, China)

32: Hybrid Machine Learning for Anomaly Detection in Industrial Time-Series Measurement Data
Anika Terbuch and Paul O'Leary (University of Leoben, Austria); Peter Auer (Montanuniversität Leoben, Austria)

33: Superposition Johnson Noise Thermometer with a Fully Differential Structure
Qina Han (Harbin Institute of Technology, China); Kunli Zhou (NIM, Beijing, China); Jifeng Qu (National Institute of Metrology, China)

34: Distance Measurement Characterization for Ultra Wide Band Indoor Localization Systems
Salvatore Dello Iacono, Vincenzo Paciello and Paolo Sommella (University of Salerno, Italy)

35: Investigation into the Applicability of Software Requirements from Legal Metrology to Sensor Networks

Marko Esche and Martin Nischwitz (Physikalisch-Technische Bundesanstalt, Germany); Federico Grasso Toro (Swiss Federal Institute of Metrology, Switzerland)

36: BLE Fingerprinting Automatic Calibration using an Ultrasonic IPS

Felipe Parralejo (University of Extremadura & Sensory Systems Research Group, Spain); Fernando J. Aranda (Universidad de Extremadura & Sensory Systems Research Group, Spain); Teodoro Aguilera, Fernando J. Álvarez Franco and José Moreno (University of Extremadura, Spain)

37: Exploitation of a Spider Silk based Sensing Element

Carlo Trigona (University of Catania, Italy); Caterina Cunsolo, Giuseppe Di Luca and Michael Rizza (DIEEI, Italy); Salvatore Baglio (University of Catania, Italy)

17:00 - 18:00
Closing Ceremony & 2023 Announcement
Room: International Ballroom ABC