I2MTC 2023

22-25 May 2023 || Kuala Lumpur Convention Centre || Malaysia
Instrumentation and Measurement: Rising Above Covid-19

I2MTC 2023 CONFERENCE PROGRAM

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Welcome Message from the General Co-Chairs

Ladies and gentlemen, esteemed colleagues, and distinguished guests,

On behalf of the IEEE International Instrumentation and Measurement Technology Conference (I2MTC) 2023 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 2023 in Kuala Lumpur, Malaysia. 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, "Instrumentation and Measurement: Rising Above Civd-19." as we moved from the Pandemic to the Endemic the world cautiously start to get back on its feet.

This year will be the first time the conference is organized fully face-to-face. We hope the meeting in Kuala Lumpur will provide an interesting venue for all the participants to confidently engage, discuss and exchange the latest findings in the area of instrumentation and measurement in the most vibrant environment.

Over the next 5 days, we will have the honor of hearing from some of the leading minds in instrumentation and measurement research. They will share their findings, thoughts, and perspectives on the latest advancements, challenges, and opportunities in this field. On Tuesday morning, our local Malaysian researcher Prof Sevia Mahdaliza Idrus Sutan Nameh will deliver the talk "Calibration and Standardisation of High Precision Foreign Object Debris Detection Radar Sensor for Airport Runway Safety and Surveillance" from Universiti Teknologi Malaysia. On the same day in the afternoon, Prof Eros Pasero, Professor of Electronics at the Politecnico of Turin will give a talk on "Artificial Intelligence and Medicine 4.0: the new frontier". On Wednesday, we will listen to the winner of J. Barry Oaks Advancement Award Prof Shibin Wang School of Mechanical Engineering, Xi'an Jiaotong University, Xi'an, China with his presentation "Sparsity-assisted machinery fault diagnosis". Finally, on Thursday, we will listen to Mr Sharul A Rashid Group Technical Authority & Custodian Engineer, Instrument & Control in Petronas a Malaysian National Petroleum Company will share his thought on the industrial application of instrumentation and measurement technology with a talk " Remote Operation of Regasification Terminal Sg Udang, Melaka".

I would like to extend my gratitude to the organizing committee, volunteers, and sponsors who have dedicated countless hours to make this conference possible. Their hard work and support are invaluable and have played a crucial role in ensuring the success of this event.

I encourage you all to take full advantage of the various networking opportunities, including panel discussions, workshops, and poster sessions, to meet and collaborate with your peers and foster new connections and partnerships.

Finally, I wish you all a fruitful and productive conference. Let us all engage in thought-provoking discussions and exchange valuable insights and knowledge that will help shape the future of instrumentation and measurement research.

Sincerely,
Dr. Kushsairy Abdul Kadir and Robiah Ahmad (I2MTC 2023 General Co-Chairs)

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- Applied AI for measurement uncertainty and decision making in machine intelligent diagnosis
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- Artificial Intelligence in Instrumentation and Measurement: from the metrological characterization to the application in real scenarios
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  - Antonio Pietrosanto
- Edge Computing for Smart and Low Power Sensing in emerging applications
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- Electrochemical Measurements for Sensors and Energy Applications
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  - Francesco Di Franco
  - Andrea Zaffora
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- Innovative Measurement and methodologies for future communication systems and applications
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  - Giulio D'Emilia
- Interpretable, efficient deep learning for intelligent monitoring of industrial equipment
  - Weihua Li
  - Shibin Wang
- Metrological performance of Low cost platforms for measurement applications
  - Paolo Castello
  - Stefano Rinaldi

I²MTC 2023 Special Session Organizers (continued)

- Sensors, Instrumentation, and Artificial Intelligence technologies for Environmental Measurement and Modeling
  - Tuan Guo
  - Der-Chen Huang
  - Chi-Hung Hwang
  - Huan Liu
- Smart textile-based instruments for industrial applications
  - Stefano Rossi
  - Juri Taborri

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I²MTC 2023 Keynote Speakers

Professor Ir. Dr. Sevia Mahdaliza Idrus Sutan Nameh
Faculty Of Electrical Engineering, Universiti Teknologi Malaysia

Professor Ir Dr Sevia Mahdaliza Idrus received her Bachelor in Electrical Engineering in 1998 and Master in Engineering Management in 1999, both from UTM. She obtained her Ph.D in 2004 from the University of Warwick, United Kingdom in optical communication engineering. She has served UTM since 1998 as an academic and administrative staff. Her main research interests are optical communication system and network, optoelectronic design, and engineering management. Her research output have been translated into a number of publications (H-index-17) and IPR including a high-end reference books, 'Optical Wireless Communication: IR Connectivity' published by Taylor and Francis, 49 book chapters and monographs, over 200 refereed research papers, 8 patents granted, 36 patent filings and holds 31 UTM copyrights. To date, she has secured and been involved in 84 research and consultation projects with a total value of USD25M. She is the founder and Director of a UTM spin-off company, iSmartUrus Sdn Bhd (1057063A) successfully commercialized her invention, a novel airtime based mobile micropayment solution and application-centric IoT based mobile enforcement device for smart city. She is actively involved in a number industrial and international research collaboration projects, delivered keynote and invited speeches to many international conferences and seminars. Based on her active contribution with industry for smart city solution, she has been awarded 'The Top Research Scientists Malaysia 2021' by Academy Science Malaysia, Ministry of Science, Technology and Innovation and '51 Most Impactful Smart Cities Leaders 2019 Award' in conjunction with World CSR Day & World Sustainability Congress 2019, Mumbai, India on March 2019. She led a four years G2G project on 'Radar over Fiber Foreign Object Debris Detection System' field trial at Kuala Lumpur International Airport (KLIA) a collaboration project between UTM, Hitachi Kokusai Electric Japan and Malaysia Airport (Sepang) under financial support from Ministry of Internal Affairs and Communication Japan. The project has made KLIA and Malaysia as world focal point for development of high precision millimetre wave radar at 90-100GHz range. She is Senior Member of IEEE and member of Editorial Board of few refereed international journals. She has been appointed as Guest Professor at Osaka Prefecture University and Tokai University, Japan in 2011 and 2014, respectively.

Calibration and Standardisation Of High Precision Foreign Object Debris Detection Radar Sensor For Airport Runway Safety and Surveillance

Foreign object debris (FOD) on airport runways can cause problems (e.g., runway closure, accidents) to airplanes and airport operators if not removed immediately. Hence, airport operators need to remove any FODs that are detected via a manual or automated FOD detection system. Manual detection implies that airport operators carry out periodical manual inspection while automated FOD detection is able to perform rapid detection continuously without any airport personnel on-site. Automated detection system also avoids unnecessary runway closure due to manual inspection, which is inefficient for busy airport operation. Millimeter-wave radar sensor proof to be an efficient method on detecting small FOD automatically, due to its high-sensitivity, high-range resolution and weather robustness. In this talk, successful collaborative Malaysia and Japan research project on Foreign Object Debris Detection System (FODDS) field trial at Kuala Lumpur International Airport will be presented.

The system currently under field trial in accordance to the International Civil Aviation Organization (ICAO), Aerodrome Design and Operation. The field trial and operation of FODDS was established in collaboration with National Institute of Information and Communication (NICT), Japan, Hitachi Kokusai Electric Inc (HiKE), Japan and Malaysia Airport (Sepang) Sdn Bhd, Malaysia Airports Holding Berhad (MAHB) supported by Ministry of Internal Affairs and Communication Japan. Through more than three year field trial at KLIA, the system demonstrated highly accurate and fast, the system is able to detect 3cm FOD within the range of 500 meters in 10 seconds by using the millimeter wave radar sensor. The FOD detection systems is able to spot FOD the moment it is deposited on the runway by radar sensing, identifying, and locating at a previously unprecedented level of speed and accuracy for objects as small as an aircraft rivet. This is extremely valuable when aircraft take-offs are only minutes apart. Finally improved airport management by not only increases efficiency, enhances safety and improves security, but also saves airports and airlines operational cost. This FODDS will be a promising candidate to enhance security against intruders or attack drones in important facilities and to enhance safety to avoid critical incident in the airport runways.

I²MTC 2023 Keynote Speakers (continued)

Sharul A Rashid

Sharul is Group Technical Authority & Custodian Engineer, Instrument & Control in PETRONAS. He is currently the President, International Society of Automation (SA) Malaysia. He has more than 30 years of experience in instrumentation & control for oil refinery & petrochemical, gas liquefaction plants including pipeline transmission facilities and advises PETRONAS-group wide plants and facilities on instrument, control, process safety and cybersecurity issues

At national level, he is permanent member for IEC SC TC65 WG Industrial Networks and Smart Manufacturing NSC 19 and Vice-Chair Digital Connected Society (Malaysia) Globally, he holds various key positions:

- Co-Chair Certification Working Group (OPAF)
- Vice-Chair Instrument Automation Standards Steering Committee, IOGP (International Oil & Gas Producers)
- Co-Steering Committee of JIP33 (Joint Industry Program), IOGP
- Voting member for ISA 75 (Valve Actuator)

Sharul is an “Expert” ISA IEC 62443 Certification in Cybersecurity. He also is a certified Functional Safety Engineer since 2011

Remote Operation of Regasification Terminal Sg Udang, Melaka

Abstract: Situated 3 kms offshore Sungai Udang, Melaka, the Regasification Terminal (RGT) is considered an engineering feat by the industry. Developed based on a revolutionary design, it comprises the world’s first-of-its-kind re-gasification unit on an island jetty (JRU), two floating storage units (FSU) and a three-km sub-sea pipeline connecting to a new 30-km onshore pipeline that links to PGB’s existing Peninsular Gas Utilisation (PGU) pipeline network. RGT Sg Udang (RGTSU) was designed-in with remotely operated and controlled in 2022. It was initially designed to be operated locally since its commissioning back in 2017 when the 1st LNG Cargo was first loaded into the terminal. After June 2022, RGTSU has been normally unmanned, and remote-controlled from an onshore operations centre at Segamat Operation Centre, Johor more than 100 km away. The presentation will give an introduction to the design of the automation and industrial 5G private network-based telecom systems for remote operation of RGTSU from shore, and the experience from the recently commissioned as normally unmanned as Remote operation.

I²MTC 2023 Keynote Speakers (continued)

Prof. Eros Pasero
Past SIREN President
IEEE I&M Society Distinguished Lecturer

Eros G. Pasero is Professor of Electronics at the Politecnico of Turin since 1991 after a four year appointment as Professor at the University of Roma, Electronics Engineering. He was also Visiting Professor at ICSI, UC Berkeley, CA in 1991, Professor of digital electronics and electronic systems at Tongji University, Shanghai, China in 2011, 2015 and 2017, and Professor of digital electronics and electronic systems at TTPU (Turin Tashkent Politechnic University), Tashkent, Uzbekistan since 2012 to 2014 where he was also vice rector in the first period of 2014.
Prof. Pasero established in 1990 the Neuronica Lab where hardware and software neurons and synapses are studied practical applications; innovative wired and wireless sensors are also developed for biomedical, environmental, and automotive applications. Data coming from sensors are post processed by means of artificial neural networks.

Prof. Pasero is now the President of SIREN, the Italian Society for Neural Networks; he was v. General Chairman of IJCNN2000 in Como, General Chairman of SIRWEC2006 in Turin, general Chairman of WIRN2015, WIRN2016 and WIRN2017, WIRN 2018, WIRN 2019 and WIRN 2020 in Vietri. He holds 7 international patents (the first silicon European neurons and synapse together Texas Instruments). He was supervisor of tenths of international Ph.D and hundredths of Master students and
he is author of more than 130 international publications.
Together his group he was awarded with the 1982 CILEA-Sperry award for "complex application systems and local distributed architecture", with the ASSIPE Design-In- Award in 2003 and 2004, with premio "Innova S@alute2017" at the "forum dell'innovazione per la salute" on September 2017; he was IEEE key note speaker at 2014 Symposium series on Computational Intelligence in Orlando, FI, USA; Distinguished Lecturer of the 2016 IEEE Medical Information Summer School, Distinguished Lecturer of the 2017 IEEE school "Smarter Engineering for Industry 4.0".

Now he is IEEE I&M society Distinguished Lecturer for the three year period 2021- 2023

Artificial Intelligence and Medicine 4.0: the new frontier

Industry 4.0 is considered the great revolution of the past few years. New technologies, the Internet of things, the possibility to monitor everything from everywhere changed both plants and the approaches to the industrial production. Medicine is considered a slowly changing discipline. The human body model is a difficult concept to develop. But we can identify some passages in which medicine can be compared to industry. Four major changes revolutionized medicine:

Medicine 1.0: James Watson and Francis Crick described the structure of DNA. This was the beginning of research in the field of molecular and cellular biology

Medicine 2.0: Sequencing the Human genome. This discovery made it possible to find the origin of the diseases. Medicine 3.0: The convergence of biology and engineering. Now the biologist's experience can be combined with the technology of the engineers. New approaches to new forms of analysis can be used.

Medicine 4.0: Digitalization of Medicine: IOT devices and techniques, AI to perform analyses, Machine Learning for diagnoses, Brain Computer Interface, Smart wearable sensors.

Medicine 4.0 is definitely a great revolution in the patient care. New horizons are possible today. Covid 19 has highlighted problems that have existed for a long time. Relocation of services, which means remote monitoring, remote diagnoses without direct contact between the doctor and the patient. Hospitals are freed from routine tests that could be performed by patients at home and reported by doctors on the internet. Potential dangerous conditions can be prevented. During the Covid emergency everybody can check his condition and ask for a medical visit (swab) only when really necessary. This is true telemedicine. This is not a whatsapp where an elder tries to chat with a doctor. This is a smart device able to measure objective vital parameters and send to a health care center. Of course Medicine 4.0 requires new technologies for smart sensors. These devices need to be very easy to use, fast, reliable and low cost. They must be accepted by both people and doctors.

In this talk we'll see together the meaning of telemedicine and E-Health. E-health is the key to allowing people to self monitor their vital signals. Some devices already exist but a new approach will allow to everybody (especially older people with cognitive difficulties) to use these systems with a friendly approach. Telemedicine will be the new approach to the concept of hospital. A virtual hospital, without any physical contact but with an objective measurement of every parameter. A final remote discussion between the doctor and the patient is still required to feel comfortable. But the doctor will have all the vital signal recorded to allow him to make a diagnosis based on reliable data.

Another important aspect of medicine 4.0 is the possibility of using AI both to perform parameter measurement and to manage the monitoring of multiple patients. The new image processing based on Artificial Neural Networks allows doctors to have a better and faster analysis. But AI algorithms are also able to manage intensive care rooms with several patients reducing the number of doctors involved in the global monitoring of the situation.

J. Barry Oaks Advancement Award Presentation

Shibin Wang

Shibin Wang (M'15) is a Professor in the School of Mechanical Engineering, Xi'an Jiaotong University, Xi'an, China, where he received the Ph.D. degree in mechanical engineering in 2015. His research interests include time-frequency analysis, sparsity-assisted signal processing, interpretable neural networks for machine condition monitoring and fault diagnosis. In 2017, he was a Visiting Scholar with the Tandon School of Engineering, New York University, NY, USA. Previously, he received the B.S. and M.S. degrees in electrical engineering from Soochow University, Suzhou, China, in 2008 and 2011, respectively. Dr. Wang's honors and awards include the Excellent Young Scholars of NSFC (2021), the First Prize of Natural Science of the Ministry of Education, China (2020), Hiwin Doctoral Dissertation Award (Silver Award, 2016), etc. He currently serves as Associate Editor for IEEE Transactions on Instrumentation and Measurement.

Sparsity-assisted machinery fault diagnosis

Sparsity-assisted machinery fault diagnosis uses sparsity-assisted signal processing techniques to improve the performance of fault feature extraction and thus to promote the ability of diagnosis, which is realized by exploring sparsity priors in a certain domain of fault-related condition information. In recent years, sparsity-assisted signal processing techniques have been widely studied for machinery fault diagnosis. In this representation, fault-induced sparsity prior is introduced to model the vibration signal to enhance the fault information for fault feature extraction, and moreover the optimization algorithm to solve the sparsity-assisted signal model is unrolled to construct a fault-information-aware interpretable neural network for mechanical fault diagnosis. More specifically, this presentation introduces a new sparsity-assisted model under the assumption that the noise in the signal obeys a mixture of generalized Gaussian (MoGG) distribution. Also, the Lp norm ($0 < p \leq 1$) is adopted as the regularization to keep the model sufficiently sparse and adjustable. Thus, this sparsity-assisted model is named a MoGG noise distribution enabled sparse representation (MoGG-SR) model. The mixed distribution characteristic can make this model more adaptive, and the use of the generalized Gaussian function as the basis function makes it more robust to outliers. Furthermore, the presentation introduces an interpretable neural network to provide high-performance and credible mechanical fault diagnosis results. The sparsity-assisted interpretable network is mainly generated by unrolling the nested iterative soft thresholding algorithm (NISTA) for a sparse coding model and it is named NISTA-Net. Therefore, the network architecture of NISTA-Net has a clear theoretical basis, and users know how it is designed. Additionally, a visualization method is introduced for NISTA-Net to examine whether the network has learned meaningful features. This method helps users better understand how NISTA-Net performs classifications. These two aspects of transparency/interpretability allow NISTA-Net to be more credible when applied for mechanical fault diagnosis. We carried out simulation and experiment study to verify the performance of sparsity-assisted machinery fault diagnosis. The results reveal that sparsity-assisted methods can well extract the fault features of the concerned bearings and gears. As a consequence, it achieves the best performance compared with other advanced networks.

I²MTC 2023 Tutorial Speakers

- Detection and Forecasting of Micro-Scale Variability in Electric Power Profiles
  - Grigore Stamatescu
  - Mihaela M. Albu

- Material State Determination For Process State Awareness 2023
  - James A. Smith

- Non-Contact In-Circuit Impedance Measurement Technology
  - Kye Yak See
  - Zhenyu Zhao
  - Fei Fan

- Revisiting Sensor Characterization and Measurement Chain Optimization under Information Theory
  - Marco Tartagni

- TECHNICAL PAPER PUBLISHING REVIEW PROCESS GUIDELINES AND TIPS FOR AUTHORS, EDITORS AND REVIEWERS
  - R. Zoughi

- Microwave Instrumentation and Measurement for Nanotechnology Materials and Devices
  - Dr Kamel HADDADI

- Predictive Maintenance with Digital Twin
  - Dr. Zheng Liu

- Electrochemical Measurements for Biosensing Applications: A Tutorial
  - Dr. Anis Nurashikin Nordin

Diversity and Inclusion in I&M

Speak with Presence in Person, on Audio and Video: An Interactive Workshop on Communicating Authentically in the 21st Century

J.G. Vellenga and J. Rettele-Thomas
Voice First World LLC, Lenexa, KS 66219

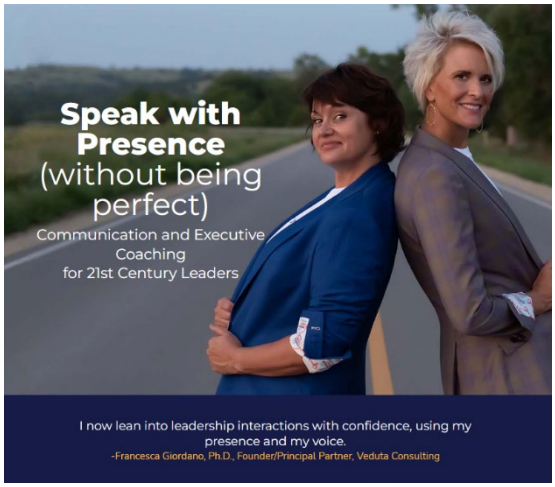
Abstract: Global teams, a diverse workforce, and virtual offices are on the rise. Clear, confident, and emotionally intelligent communications are necessary for career advancement and inclusive leadership. Workshop attendees will explore identity in the context of workplace power dynamics, learn how to read an audience, and craft thought leadership for podcast interviews, video conferences, and stage presentations. Utilizing some of the tools that actors use to develop characters for new plays, this interactive workshop provides training on delivering a clear, consistent, authentic message to multiple audiences with confidence and ease. Actors embody character and speak with presence to affect audiences and inspire belief. Similarly, when professionals use non-verbal communication and speaking presence, they influence change in the workplace. Effective communication skills provide a breadth of knowledge that subject area competency alone cannot offer.

Learn More: https://youtu.be/asSF2KEAKPM

Author Details: Jen Vellenga is a stage director and former university professor/department chair. She uses actor training skills to direct speakers and leaders across industries to speak with confidence and presence. Jennifer Rettele-Thomas spent her career in university development where she crafted her skills in stewardship and operations.

Jen V. & JRT are the co-founders of Voice First World and the co-hosts of the Speak with Presence podcast, available on all platforms. They have interviewed IEEE past president, Susan K. (Kathy) Land (Ep. 12: "Invert the Org Chart"), Georgette MacDonald, Director General of the National Research Council's Metrology Research Centre, Canada's National Metrology Institute (Ep. 32: "Find Your Ally"), and VP of Engineering at Octane Wireless, Dalma Novak, an IEEE Fellow and member of the Board of Directors (Ep. 61: "Cultivate Confidence" which releases on April 11, 2023).

Learn More: https://www.voicefirstworld.com/



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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
2023 - Kuala Lumpur, Malaysia, Instrumentation and Measurement: Rising Above Covid-19

Awards and Distinctions

2022 IEEE Transactions on I&M Outstanding Associate Editors

Rosenda Valdes Arencibia
Yang Bai
Fabricio Guimaraes Baptista
Valentina Bianchi
Bruno Albuquerque de Castro
Damodar Reddy Edla
Isaac Fan
Mohamad Forouzanfar
Rajarshi Gupta
Hamed Hamzehbahmani
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2022 IEEE Open Journal of I&M Outstanding Associate Editors

Amitava Chatterjee
Alessandro Ferrero
Subhas Mukhopadhyay
Samir Trabelsi

2022 I&M Society Awards

IEEE Instrumentation and Measurement Society Andy Chi Best Paper Award

Zhiqin Zhu, Hongyan Wei, Gang Hu, Yuanyuan Li , Guanqiu Qi , and Neal Mazur, "A Novel Fast Single Image Dehazing Algorithm Based on Artificial Multiexposure Image Fusion," *IEEE Transactions on Instrumentation and Measurement*, vol. 70, Article No. 5001523, 2021.

IEEE Instrumentation and Measurement Society Best Application Award

Tuan Guo, Jinan University, China

"For outstanding contributions to energy storage monitoring using optical fiber sensing technologies."

IEEE Instrumentation and Measurement Society Outstanding Young Engineer Award

Xingwu Zhang, Xi'an Jiaotong University, China

"For outstanding contributions to health monitoring and active vibration control for industrial applications in the field of mechanical equipment."

IEEE Instrumentation and Measurement Society Technical Award

Olfa Kanoun, Chemnitz University of Technology, Germany

"For pioneering the evolution of impedance spectroscopy from laboratory scale to field sensors."

IEEE Instrumentation and Measurement Society Distinguished Service Award

Ruqiang Yan, Xi'an Jiaotong University, China

"For outstanding service to the I&M society, and significant contribution to revitalizing the Technical and Standards Activities Committee of the society."

IEEE J. Barry Oakes Advancement Award

Shibin Wang, Xi'an Jiaotong University, China

"For contributions to the advancement of signal processing methods for machine fault diagnosis."

2023 Instrumentation and Measurement Society Fellows

Elevated by IMS:

Zhigang Liu

for contributions to fault detection and protection in high-speed railway power systems

Lijun Xu

for contributions to multiphase flow measurement and combustion process monitoring

IMS Members Elevated by other IEEE Entities:

Yihong Qi (elevated by the IEEE Electromagnetic Compatibility Society)

for contributions to over-the-air testing of massive MIMO systems and development of over-the-air measurement systems

Shilong Pan (elevated by the IEEE Microwave Theory and Techniques Society)

for contributions to high-performance microwave-photonic imaging radar

Paul C.-p. Chao (elevated by the IEEE Sensors Council)

for contributions to optical bio-imaging and sensing technologies

2022 Instrumentation and Measurement Society Senior Member Elevations

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David Armstrong
Zhang Cao
Joseph Castagna
Radu Ciorap
Peter Elg
Matthias Engels
Angelo Genovese
Arunangshu Ghosh
Detlev Gross
Hamida Hallil
Abhishek Jha
Baki Karaboce
Pamela Leatherwood
Fan Li
Nan Li
Shiyong Li
Chang Liu
F Liu
Fabian Lurz
Sabarimalai Manikandan
Zhu Mao
Mirko Marracci
Dan Milici
Biswarup Mukherjee
Kang No
Jayashree Prasad
Fei Qin
Thee Quk
Vidhyalavanya Ramachandran
Brindha Saminathan
Hongming Shan
Prasad Shrawane
Ranjana Sodhi
Selim Solmaz
Shilpa Sondkar
Pedro Villegas
Peng Wang
Christoph Wasserzier
Jun Wu
Min Xia
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Emrah Zerdali
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IEEE Instrumentation and Measurement Society: Administrative Committee

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Young Professionals Representative, Judy Amanor-Boadu, Intel Corporation, USA

I²MTC 2023 General Information

Venue:

The Kuala Lumpur Convention Centre (Malay: Pusat Konvensyen Kuala Lumpur), also known as the KL Convention Centre, is a convention and exhibition centre located in the Kuala Lumpur City Centre (KLCC) development in Kuala Lumpur, Malaysia.

- Address: Jalan Pinang, Kuala Lumpur City Centre, 50088 Kuala Lumpur, Wilayah Persekutuan Kuala Lumpur, Malaysia
- Phone: +60 3-2333 2888

Registration & Information Desk:

The Registration & Information desk is located at the registration counter outside the Plenary Theatre room. Name Badges can be picked up at registration and are required for access to all conference events.

Registration Hours:

Monday, May 22	9:30 – 17:00
Tuesday, May 23	7:30 – 17:00
Wednesday, May 24	8:00 – 17:00
Thursday, May 25	7:30 – 17:00

Exhibit Hall Hours:

Monday, May 22	13:30 – 17:00 (Exhibitor Set Up)
Tuesday, May 23	10:00 – 19:00 (Exhibit Hall Open)
Wednesday, May 24	10:00 – 16:00 (Exhibit Hall Open)
Thursday, May 25	10:30 – 16:00 (Exhibit Hall Open)
	16:00 – 17:00 (Exhibitor Clean Up)

Electronic Proceedings:

A download link for the conference proceedings will be emailed to registered attendees. The proceedings download link will be available from May 22 - June 22, 2023.

Conference Attire:

Attire during the duration of the conference is business casual.

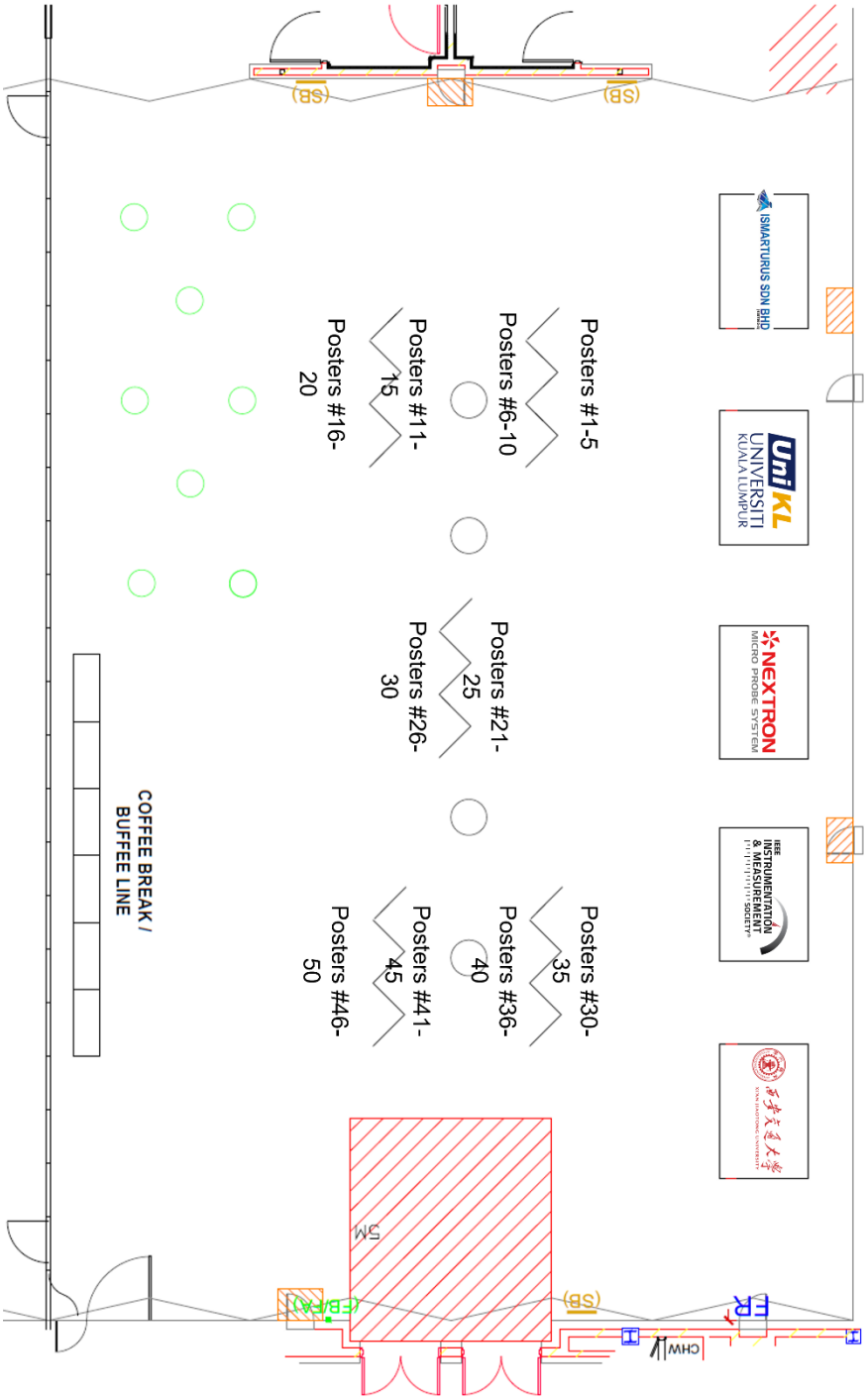
Cellular Phones:

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.

I²MTC 2023 Exhibit and Poster Hall Layout



I²MTC 2023 Program Grid – Tutorials – Monday

	Meeting Room 304	Meeting Room 305	Meeting Room 306	Meeting Room 302/303
10:30 – 12:00	Microwave Instrumentation and Measurement for Nanotechnology Materials and Devices	TECHNICAL PAPER PUBLISHING REVIEW PROCESS GUIDELINES AND TIPS FOR AUTHORS, EDITORS AND REVIEWERS	Revisiting Sensor Characterization and Measurement Chain Optimization under Information Theory	Electrochemical Measurements for Biosensing Applications: A Tutorial
12:00 – 13:30	Lunch *(Conference Hall 2)*		YP Meeting *(Meeting Room 307)*	
13:30 – 15:00	Material State Determination For Process State Awareness	Non-Contact In-Circuit Impedance Measurement Technology - Part 1	Detection and Forecasting of Micro-Scale Variability in Electric Power Profiles - Part 1	
15:00 – 15:30	Coffee Break *(Conference Hall Foyer)*			
15:30 – 17:00	Predictive Maintenance with Digital Twin	Non-Contact In-Circuit Impedance Measurement Technology - Part 2	Detection and Forecasting of Micro-Scale Variability in Electric Power Profiles - Part 2	
17:00 – 18:30	Tutorial / Young Professional Reception *(Conference Hall 2-3 Foyer)*			

I²MTC 2023 Program Grid – Tuesday

	Meeting Room 302/303	Meeting Room 304	Meeting Room 305	Meeting Room 306
8:30 – 9:00	Opening Ceremony *(Auditorium)*			
9:00 – 10:00	Keynote Speaker: Professor Ir. Dr. Sevia Mahdaliza Idrus Sutan Nameh *(Auditorium)*			
10:00 – 10:30	Coffee Break *(Conference Hall 3)*			
10:30 – 12:30	SPS: Innovative Measurement and methodologies for future communication systems and applications	SPS: Instrumentation and measurement for improving quality, reliability and safety: new perspectives for research and industry	Instrumentation and Measurement for Energy and Renewable Energy and Power Industry and for Physical and Electromagnetic Quantities	Instrumentation and Measurement in Medical, Biomedical and Healthcare Systems
12:30 – 13:30	Lunch *(Conference Hall 2)*		TC-1 Lunch *(Meeting Room 307)*	
13:30 – 14:30	Keynote Speaker: Prof. Eros Pasero *(Auditorium)*			
14:30 – 15:30	Poster Session / Best Student Paper Finalists TIM & OJIM Poster Session Coffee Break *(Conference Hall 3)*			
15:30 – 17:30	Optical and Fiber Optic Instrumentation and Measurement	Instrumentation and Measurement for Advanced Manufacturing	Artificial Intelligence, Machine Learning and Big Data for Instrumentation and Measurement	Instrumentation and Measurement in Medical, Biomedical and Healthcare System
17:30 – 19:00	Welcome Reception *(Conference Hall 3)*			

I²MTC 2023 Program Grid – Wednesday

	Meeting Room 302/303	Meeting Room 304	Meeting Room 305	Meeting Room 306
9:00 – 11:00	Image Processing and Vision Based Measurement	Instrumentation and Measurement for Non-Destructive Testing and Evaluation (IMNDE)	Instrumentation and Measurement for Communications, IoT, and Industry 4.0	Instrumentation and Measurement Systems for Robotics
11:00 – 11:30	Coffee Break *(Conference Hall 3)*			
11:30 – 12:30	J. Barry Oaks Advancement Award Presentation *(Auditorium)*			
12:30 – 13:00	Award Ceremony *(Auditorium)*			
13:00 – 14:30	Lunch *(Conference Hall 2)*			
14:30 – 15:30	Diversity and Inclusion in I&M *(Auditorium)*		Poster Session *(Conference Hall 3)*	
15:30 – 16:00			Coffee Break *(Conference Hall 3)*	
16:00 – 18:00	SPS: Applied AI for measurement uncertainty and decision making in machine intelligent diagnosis	Instrumentation and Measurement for Non-Destructive Testing and Evaluation (IMNDE)	Sensors and Transducers	Instrumentation and Measurement for the Automotive, Transportation Industry, and Robotics
19:00 – 22:00	Gala Dinner *(Grand Hyatt – Grand Ballroom)*			

I²MTC 2023 Program Grid – Thursday

	Meeting Room 302/303	Meeting Room 304	Meeting Room 305	Meeting Room 306
8:30 – 10:30	Signal Processing for Instrumentation and Measurement	Advances in Measurement Theory and Metrology; and Circuits and Embedded Systems for Instrumentation and Measurement	Instrumentation and Measurement for Oil and Gas Industry, Chemical and Biological Quantities, and Agriculture, Food Production and Food Safety	Machine Learning and Big Data for Instrumentation and Measurement
10:30 – 11:00	Coffee Break *(Conference Hall 3)*			
11:00 – 12:00	Keynote Speaker: Sharul A Rashid *(Auditorium)*			
12:00 – 13:00	Lunch *(Conference Hall 2)*			
13:00 – 15:00	Signal Processing for Instrumentation and Measurement; and SPS: Edge Computing for Smart and Low Power Sensing in Emerging Applications	Instrumentation and Measurement in Environmental Monitoring and in Medical, Biomedical and Healthcare Systems	Data Acquisition and Real-time Measurement Systems; and Instrumentation and Measurement for Physical and Electromagnetic Quantities	Instrumentation and Measurement for Physical and Electromagnetic Quantities
15:00 – 16:00	Coffee Break Poster Session Late Result Poster Session *(Conference Hall 3)*			
16:00 – 16:30	Closing Ceremony & 2024 Announcement *(Auditorium)*			

I²MTC 2023 Technical Schedule – Tutorials – Monday

10:30 - 12:00
Microwave Instrumentation and Measurement for Nanotechnology Materials and Devices
Meeting Room 304

Abstract: Non-destructive Testing (NDT) NDTE is the process of inspecting, testing and evaluating materials, components or systems without altering their properties. Leading industries use NDT techniques to ensure the quality of products. Among established NDT techniques (visual testing, eddy-current, magnetic-particle, liquid penetrant, radiographic and ultrasonic), microwave (300MHz-30GHz) and mm-Wave (30GHz-300GHz) electromagnetic waves present advantages such as penetration inside dielectric materials, low power, high electrical sensitivity to both physical and geometric properties, non-contact and non-ionizing characterization. Despite advantages of Microwave NDT techniques over established methods, their penetration at industrial scale is still limited and confined to niche markets or academic laboratories. The inadequate commercial availability of microwave systems for NDT purposes has limited its more extensive implementation. Indeed, quantitative evaluation of materials requires dedicated calibration algorithms, protocols, standard reference materials, and essential training in GHz technologies not available at the industry level. Introduction of nanotechnology has a great potential to enhance material properties but deeper understanding of local interactions between nanoparticles and host materials, interfaces effects, correlation between nano- and macroscale responses, require innovative industrial characterization methods and tools to enhance final materials or/and products, and to screen new material properties. State of the art multi-scale microwave & mm-Wave instrumentation will be discussed with probing of electromagnetic properties from nano- to macroscale. Rather than a usual and restricted laboratory equipment approach, the scientific investigation, hardware development and applicability to industrial challenges (including development of multi-scale references and standards, fully automated and real-time operations) are thought as a whole.

Syllabus: 1) Fundamentals of Wave to Material interaction, 2) RF and Microwave instrumentation for NDT applications, 3) From Radar to Nano-Radar concept, 4) Metrology – Traceability aspects

- Dr Kamel HADDADI

10:30 - 12:00
TECHNICAL PAPER PUBLISHING REVIEW PROCESS GUIDELINES AND TIPS FOR AUTHORS, EDITORS AND REVIEWERS
Meeting Room 305

Abstract: There has been an astronomical increase in the number of technical paper submissions in the past decade. Some of the reasons include:

pressure to publish, as the success indicator, for promotion and professional advancement,
universities moving away from the traditional M.S. Theses and Ph.D. Dissertations to instead a compilation of several peer-reviewed journal papers,
creation of new journals, and
the open-access publishing "economy".
Journals are ranked according to certain "indicators" that may or may not be objective. Everyone wants to publish in the highest-ranking journals exasperating the situation for some. However, we wish to think that "Quality" is the number one "indicator" of a journal. "Quality" is not a "measurable" and is difficult to define. However, there are ways by which to positively influence the "Quality" of a journal beyond those indicators.

REVIEW PROCESS – This is the most crucial aspect of the publishing process. It involves the authors, the editors, and the reviewers, and how each performs detrimentally impacts the outcome and the "Quality". Without proper training, knowledge, experience and established guidelines, this entire process is destined to achieve mediocrity or fail all together.

This educational tutorial aims to provide basic guidelines and critical tips for everyone involved in this process.

- R. Zoughi

10:30 - 12:00
Revisiting Sensor Characterization and Measurement Chain Optimization under Information Theory
Meeting Room 306

Abstract: Sensor characterization and metrology have always been complex issues due to the different design approaches and application tasks. Therefore, concepts such as resolution, precision, accuracy, and minimum detectable signal are sometimes characterized by misleading and fuzzy definitions. In the first part of this tutorial, I will review the basic concept of resolution under the Information Theory framework showing its strong relationship with mutual information. Then, I will analyze a signal measurement chain as a communication channel where, differently from the telecommunication approach, the optimization is performed on the channel configuration instead of the coding process.

Additionally, to the above viewpoint, I will show how electronic measurement acquisition design could be reduced to three constraints: information, time, and power consumption, and how they could be used to enhance the overall performance in terms of resolution, bandwidth, and power efficiency reducing the design time. Finally, I will illustrate how the single gains in a measurement chain could be optimized concerning the above constraints by examples.

Part1: Concept of information in measurement and sensing. This part will frame some concepts of information theory under the sensor design viewpoint showing the difference compared to the typical telecommunication applications. The concept of resolution will be revisited under the mutual information paradigm.

Part 2: The three-node constraints scheme. This section will show how any sensing design could be simplified using the trade-offs between information, time, and power. The first is the information node, where resolution, operating range, and input-referred noise are put together to define the information conveyed by the system. Then, the power consumption node will be treated, showing the most common sensor figure of merit (FoM) factors. Finally, the time node will address the bandwidth relationships.

Part 3: Optimization of measurement and sensors acquisition chains. One of the most challenging problems in most sensor acquisition chains is understanding how to balance the gain of stages to optimize the overall system. Therefore, a complete system of equations is set for this task, including the resolution rules of acquisition chains (RRC). Finally, examples of design optimization will be shown.

- Marco Tartagni

10:30 - 12:00
Electrochemical Measurements for Biosensing Applications: A Tutorial
Meeting Room 302/303

Abstract: Electrochemical sensors have been widely used to detect different types of disease pathogens such as bacteria and viruses. The sensitivities of the these sensors depend on the design of the sensors, the transduction elements. its biorecognition elements and the type of electrochemical techniques used. Different electrochemical measurement methods such as amperometry, voltammetry and impedance spectroscopy can be used to detect these pathogens in body fluids and aerosols. In this tutorial, the usage of these different electrochemical methods for different biosensing applications will be explained. The tutorial begins with an introduction to bio-sensing, the different types of analytes (virus, bacteria), biorecognition elements (antibody-antigen, DNA-based assays), transducers (polymers, nanostructures, wires) and signal readouts (potentiometry, amperometry, impedance). Next, explanation on the transduction elements of an electrochemical cell such as the working, reference and counter electrodes will be detailed. The tutorial will continue by describing the experimental setup for an electrochemical measurements and the different measurement settings needed for each technique, voltammetry and impedance spectroscopy. Next, explanation will be given on the different waveforms generated by each measurement technique (cyclic voltammetry, differential pulse voltammetry and impedance spectroscopy (EIS)). Details on peak separation and its relationship with electron transfer processes will be given. For EIS, the Warburg electrical equivalent circuit will be described and methods to simulate the circuit values from the Nyquist plot will be explained. Finally, the tutorial will describe on how the use of novel methods such as nanostructures and aptamers can improve the sensitivity and specificity of the sensor.

- Professor Dr. Anis Nurashikin Nordin

12:00 - 13:30
Lunch
Conference Hall 2

13:30 - 15:00
Material State Determination For Process State Awareness
Meeting Room 304

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 project 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 with an emphasis on continuous processes. 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.

- James A. Smith

13:30 - 15:00
Non-Contact In-Circuit Impedance Measurement Technology - Part 1
Meeting Room 305

Abstract: In-circuit impedance measurement extracts impedance information of an energized electrical system. The extracted impedance serves as a key parameter in many practical industrial applications, such as optimal electromagnetic interference (EMI) filter design, condition monitoring of critical electrical assets, and state-of-charge and state-of-health of battery, etc. Therefore, the research and development of a simple, safe, and accurate in-circuit impedance measurement methodology serves to fulfil this role. This tutorial presents the past and existing research work from the instructors. They have developed a series of novel in-circuit impedance measurement setups that do not require direct electrical contact with the energized electrical system under test, and thus simplifying on-site implementation and eliminating potential electrical safety hazards. Firstly, the significance of in-circuit impedance will be introduced, followed an overview of common measurement setups, and then the proposed in-circuit impedance measurement setups will be elaborated. The application aspects of the proposed technology will be presented, such as EMI filter design in power converters, stator winding fault detection of induction motors, power rail condition monitoring of mass rapid transit (MRT), current collector health monitoring of light rail transit (LRT), and voltage-dependent capacitances extraction of power semiconductors, etc.

- Kye Yak See
- Zhenyu Zhao
- Fei Fan

13:30 - 15:00
Detection and Forecasting of Micro-Scale Variability in Electric Power Profiles - Part 1
Meeting Room 306

Abstract: The development of advanced metering infrastructures (AMI) for low-voltage (LV) networks enables the fine-grained collection of rich and diverse datasets for in situ power quality assessment. Resulting datasets, collected at high reporting rates, support detection and labelling of micro-scale events that are affecting the correct operation of LV networks and have been so far overseen through window-based averaging using typical approaches and measurement equipment. The tutorial focuses on methods and techniques to first detect and label such events as anomalies in a data processing and learning pipeline. Subsequently, the labeled datasets are used in a forecasting framework as early-warning system for potential imbalances in the local energy network. One key novelty is the combination of extracted features using time series data mining methods, such as the matrix profile, with state-of-the-art machine learning algorithms, including automated machine learning to optimize classification metrics in real time, across various model/algorithm structures and hyper-parametrisation options. Hands-on activities will highlight the practical use of the Python matrixprofile, scikit-learn and auto-sklearn open-source packages on publicly available residential power measurements collected in the context of two active research projects.

- Grigore Stamatescu
- Mihaela M. Albu

15:00 - 15:30
Coffee Break
Conference Hall Foyer

15:30 - 17:00
Predictive Maintenance with Digital Twin
Meeting Room 304

Abstract: The industry is migrating from reactive to predictive maintenance to increase operational availability and efficiency. An exciting chance to facilitate this transformation is coming with the 4th industrial revolution enabled by new information and communication technology (ICT) and data-intensive methodologies. The digital twin is a disruptive technology that creates a living model of industrial assets. The digital twin living model will continually adapt to changes in the environment or operations using real-time sensory data and forecast the future of the physical target. A digital twin can be used to proactively identify potential issues with its real physical counterpart. It allows the prediction of the remaining useful life of the physical twin by leveraging a combination of physics-based models and data-driven analytics. The digital twin ecosystem comprises sensor and measurement technologies, industrial Internet of Things, simulation and modeling, machine learning, artificial intelligence, and data/information fusion. This tutorial will give an overview of the opportunity offered by the digital twin technology for predictive maintenance and identify the potential challenges for digital twin research and development from the industrial asset life cycle management perspective.

- Dr. Zheng Liu

15:30 - 17:00
Non-Contact In-Circuit Impedance Measurement Technology - Part 2
Meeting Room 305

15:30 - 17:00
Detection and Forecasting of Micro-Scale Variability in Electric Power Profiles - Part 2
Meeting Room 306

17:00 - 18:30
Tutorial / Young Professional Reception
Conference Hall 2-3 Foyer

At the Young Professional event, we will learn some basics about how to easily network across cultures, in social settings, professional settings, etc.. In addition, we will play a fun BINGO game for prizes, and create new connections. There is an opportunity to win a grand prize - 30 minutes communication coaching session.

I²MTC 2023 Technical Schedule – Tuesday

8:30 - 9:00
Opening Ceremony
Auditorium

9:00 - 10:00
Keynote Speaker: Professor Ir. Dr. Sevia Mahdaliza Idrus Sutan Nameh
Auditorium

10:00 - 10:30
Coffee Break
Conference Hall 3

10:30 - 12:30
SPS: Innovative Measurement and methodologies for future communication systems and applications
Meeting Room 302/303
Session Chairs: Gianfranco Miele and Mihaela Albu

IEC 61850 on 5G Communication Infrastructure: Feasibility Analysis and Practical Considerations
Guglielmo Frigo (Federal Institute of Metrology METAS, Switzerland); Tommaso Fedullo (University of Modena and Reggio Emilia, Italy & University of Padova, Italy); Alberto Morato (IEIIT-CNR, Italy); Federico Tramarin (University of Modena and Reggio Emilia, Italy)

Performance analysis of SCHC compression for IPv6 in a real world LoRaWAN deployment
Emiliano Sisinni, Paolo Bellagente, Alessandro Depari, Paolo Ferrari and Stefano Rinaldi (University of Brescia, Italy); Dhiego F. Carvalho and Eduardo P Godoy (São Paulo State University at Sorocaba, Brazil)

Human exposure to 5G systems: experimental analysis and measurement issues in FR1 and FR2 operating bands
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); Sangin Qhatan (Kualampur & University Putra Malaysia, Malaysia); Manfred Ruttner (A1 Telekom Austria, Austria); Aduwati Sali (UPM, Malaysia); Darko Suka (University of East Sarajevo, Bosnia and Herzegovina)

Characterization of Reconfigurable Reflectarray Elements using Scattering Measurement Technique
Mohamed A Abou-Khousa and Ademola Akeem Mustapha (Khalifa University of Science and Technology, United Arab Emirates); Omar S. Hassan (Khalifa University, United Arab Emirates)

Exploiting Hybrid Medium Access Control and Relaying Strategies to Overcome Duty-Cycle Limitations in LoRa-Based Sensor Networks
Tommaso Fedullo (University of Modena and Reggio Emilia, Italy & University of Padova, Italy); Aamir Mahmood (Mid Sweden University, Sweden); Federico Tramarin (University of Modena and Reggio Emilia, Italy); Alberto Morato (IEIIT-CNR, Italy); Mikael Gidlund (Mid Sweden University, Sweden); Luigi Rovati (University of Modena and Reggio Emilia, Italy)

Measurement method for end-to-end Time synchronization of wired and wireless TSN
Susruth Sudhakaran, Dave A Cavalcanti and Christopher Hall (Intel Corporation, USA); Alberto Morato (IEIIT-CNR, Italy); Claudio Zunino (National Research Council of Italy, Italy); Federico Tramarin (University of Modena and Reggio Emilia, Italy)

10:30 - 12:30
SPS: Instrumentation and measurement for improving quality, reliability and safety: new perspectives for research and industry
Meeting Room 304
Session Chairs: Lorenzo Ciani and Antonio Pietrosanto

Capacitive Droplet Sensing for Milk Quality Analysis
Uzma Salmaz (JAMIA MILLIA ISLAMIA NEW DELHI, India); Tarikul Islam (Jamia Millia Islamia University, India); Suriani Ibrahim (University of Malaya, Malaysia)

An experimental setup for characterization of Inertial measurement unit under dynamic conditions
Marco Carratù (University of Salerno, Italy); Antonio Pietrosanto (University of Salerno & CEO of Metering Research srl, Italy); Paolo Sommella (University of Salerno, Italy); Marcantonio Catelani, Lorenzo Ciani, Gabriele Patrizi and Roberto Singuaroli (University of Florence, Italy)

Experimental analysis for the estimation of the Arrhenius's activation energy of lithium batteries
Gianluca Caposciutti, Gabriele Bandini, Mirko Marracci and Bernardo Tellini (University of Pisa, Italy); Gabriele Patrizi, Marcantonio Catelani and Lorenzo Ciani (University of Florence, Italy)

A simulation tool for sensor selection in AMB rotor supported systems
Giovanni Donati (University of Florence, Italy); Marco Mugnaini (University of Siena, Italy); MIchele Basso (University of Florence, Italy)

After earthquake survey of the structural state of a building by a Robotic Total Station: metrological aspects
Antonella Gaspari (Politecnico di Bari, Italy); Giulio D'Emilia, Emanuela Natale and Luciano Chiominto (University of L'Aquila, Italy)

Performance of reinforced epoxy resin embedded MEMS accelerometers for IoT condition monitoring
Elia Landi, Ada Fort, Marco Mugnaini and Valerio Vignoli (University of Siena, Italy)

10:30 – 12:30
Instrumentation and Measurement in Medical, Biomedical and Healthcare Systems
Meeting Room 306
Session Chairs: Sabrina Grassini and Marco Parvis

Multi-illumination Imaging System with CNN Machine Learning Applied to Optical Inspection of Highly Complex Specimen
Cheng-Ru Li and Ching-Ching Yang (Taiwan Instrument Research Institute, National Applied Research Laboratories, Taiwan); Yin-Ting Su (Taiwan Instrument Research Institute National Applied Research Laboratories, Taiwan); Hsin-Yi Tsai (Taiwan Instrument Research Institute, National Applied Research Laboratories, Taiwan); Kuo-Cheng Huang (Taiwan Instrument Research Institute National Applied Research Laboratories, Taiwan); Yu-Hsuan Lin (Taiwan Instrument Research Institute, National Applied Research Laboratories, Taiwan)

Semi supervised segmentation of thyroid based on ultrasound images with wavelet and boundaries features
Dandan Li and Liu Fei (Harbin Institute of Technology, China); Meng Fangang and Du Yang (Harbin Medical University, China); Jing Jin (Harbin institute of Technology, China)

Time- and spectrally-resolved mesoscopic Raman and fluorescence imaging of carious enamel by a CMOS SPAD-based spectrometer
Jere Kekkonen, Tuomo Talala and Ilkka Nissinen (University of Oulu, Finland)

A New Method to Determine the Shear Wave Speed and Attenuation Coefficient in Phantoms for Ultrasound Shear Wave Elastography
Zuyuan Wang (University of Electronic Science and Technology of China, China); Christian Kargel (University of the Bundeswehr Munich, Germany)

Estimating range of pelvic motion during gait by using in-shoe motion sensor
Zhenwei Wang, Chenhui Huang, Kazuki Ihara, Fumiyuki Nihey, Kenichiro Fukushi, Hiroshi Kajitani, Yoshitaka Nozaki and Kentaro Nakahara (NEC Corporation, Japan)

A nodal array solver for Robot Assisted Electrical Impedance Sensing
Zhuoqi Cheng (University of Southern Denmark, Denmark)

10:30 – 12:30
Instrumentation and Measurement for Energy and Renewable Energy and Power Industry and for Physical and Electromagnetic Quantities
Meeting Room 305
Session Chairs: Carlo Muscas and Grzegorz Fusiek

A High Integrative Frequency Measurement Method Based on TDC
Ziqi Wang, Zhongtao Shen, Junchen Wang, Wenhao Dong, Changqing Feng and Shubin Liu (University of Science and Technology of China, China)

Adaptively Determination of Model Order of SVD-based Harmonics and Interharmonics Estimation
Jian Song (Hunan University & College of Electrical and Information Engineering, China); Zhu Liang (Jiangxi Power Grid Corporation, China); Alessandro Mingotti and Lorenzo Peretto (University of Bologna, Italy); He Wen (Hunan University & College of Electrical and Information Engineering, China)

Stability Impact of Frequency Measurement Accuracy on Decoupling Control of GCI under Weak Grids
Xianfu Lin (Hunan university); Zhu Liang (Jiangxi Power Grid Corporation, China); Chang Huang (University of Hunan, China); He Wen (Hunan University & College of Electrical and Information Engineering, China)

Impedance Measurement of Three-Phase Common-Mode Chokes in Power Electronic Applications
Huamin Jie, Zhenyu Zhao and Fei Fan (Nanyang Technological University, Singapore); Guangchao Zhao (School of Electrical and Electronic Engineering, Nanyang Technological University, Singapore); Zhenning Yang (NTU, Singapore); Yu Zeng (Nanyang Technological University, Singapore); Firman Sasongko (Rolls-Royce Electrical, Rolls-Royce Singapore Pte. Ltd, Singapore); Kye Yak See (Nanyang Technological University, Singapore)

Measurement of Moisture Distribution in a Biomass Silo Based on Electrical Capacitance Tomography
Yong Yan (University of Kent, United Kingdom (Great Britain)); Ge Guo (North China Electric Power University, China & University of Kent, unknown); Wenbiao Zhang (Tianjin University, China); Yonghui Hu and Guimei Fu (North China Electric Power University, China)

A Statistical Investigation of PMU Errors in Current Measurements
Paolo Castello, Giacomo Gallus, Carlo Muscas, Paolo Attilio Pegoraro, Davide Sitzia and Sara Sulis (University of Cagliari, Italy)

12:30 - 13:30
Lunch
Conference Hall 2

12:30 – 13:30
TC-1 Lunch
Meeting Room 307

TC-01: Nondestructive Evaluation and Industrial Inspection (NDE&II)
Anyone with interest in NDE&II is welcome to attend.

13:30 - 14:30
Keynote Speaker: Prof. Eros Pasero
Auditorium

14:30 - 15:30
Coffee Break
Conference Hall 3

14:30 - 15:30
Poster Session / Best Student Paper Finalists
Conference Hall 3
Session Chairs: Logan Wilcox and Alex Hook

1: Face Detection in Thermal Images with Improved Spatial Precision and Temporal Stability
Mohsen Mozafari (Carleton University, Canada); Andrew Law (National Research Council, Canada); James R Green and Rafik Goubran (Carleton University, Canada)

2: Simultaneous imaging defect and measuring lift-off using a double layer parallel-cable-based probe
Shenghan Wang, Chun Jiang, Yu Hu, Zhaoqi Duan, Yihua Kang and Bo Feng (Huazhong University of Science and Technology, China)

3: Pulse-Echo and Pitch-Catch: Ultrasonic C-Scan of Adhesively Bonded Single Lap-joints
Mohsen Barzegar (Instituto de Telecomunicações & Instituto Superior Técnico, Portugal); Dario J. Pasadas (Instituto 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)

4: The effect of surface roughness variations to eddy current displacement measurement
Kalle Kinnunen, Tuomas Tiainen and Raine Viitala (Aalto University, Finland)

5: Global Sensitivity Analysis of State Estimation for Power Distribution Systems
Mirko Ginocchi (RWTH Aachen University, Germany); Riccardo Scalabrin, Gianmarco Cocchi and Sergio Toscani (Politecnico di Milano, Italy); Ferdinanda Ponci (RWTH Aachen University, Germany); Antonello Monti (RWTH Aachen University & Institute for Automation of Complex Power Systems, Germany)

6: PMU-Based Estimation of Inertia Variation: Proposed Metric and Feasibility Analysis
Federica Costa and Lorenzo Peretto (University of Bologna, Italy); Guglielmo Frigo (Federal Institute of Metrology METAS, Switzerland)

7: Modelling droplet size in annular flow based on fiber optical reflectometer
Maosen Wang (School of Electrical and Information Engineering, Tianjin University, China); Dandan Zheng and Ying Xu (Tianjin University, China)

8: Observation of the Ultrasonic Vibrational Potential with an Instrumented Coaxial Needle Probe
Conor McDermott, Hossein Asilian Bidgoli and Carlos Rossa (Carleton University, Canada)

9: Tiny Machine Learning for Damage Classification in Concrete Using Acoustic Emission Signals
Veysi Adin, Yuxuan Zhang, Bengt Oelmann and Sebastian Bader (Mid Sweden University, Sweden)

10: Development of a bearing test-bed for acquiring data for robust and transferable machine learning
Christopher Schnur, Yannick Robin, Payman Goodarzi, Tanja Dorst and Andreas Schütze (Saarland University, Germany); Tizian Schneider (Saarland University & Center for Mechatronics and Automation Technology (ZeMA), Germany)

11: Analysis of Cross-Talk Induced Measurement Errors in Model-Based RF Voltage Sensing
Mathias Poik and Thomas Hackl (TU Wien, Austria); Stefano Di Martino (Infineon Technologies AG, Austria); Martin Schober (TU Wien, Austria); Jin Dang (Infineon Technologies AG, Austria); Georg Schitter (Vienna University of Technology, Austria)

12: Fast Plastic Detection with a Time-Resolved Raman Spectrometer
Tuomo Talala and Ilkka Nissinen (University of Oulu, Finland)

14:30 – 15:30
TIM & OJIM Poster Session
Conference Hall 3
Session Chair: Ruqiang Yan

13: On the Orientation of Signal Excitation for Magnetically Coupled Human Body Communication
Yicely K. Hernández-Gómez (Grupo Cideinnova, Colombia)

Human body communication (HBC) technologies have vast potential in the health care landscape. This work focuses on Magnetic HBC (MHBC), supporting for the first time that this technique is more efficient when planar inductors are used as transceivers. A systematic study was performed to establish the most appropriate way to excite the signal into the human body to improve the channel usability and provide a design criterium for transceiver designers. Furthermore, a physical-based model is proposed and tested against channel measurements, obtaining excellent experiment-model correlation at frequencies up to 20 MHz.
https://ieeexplore.ieee.org/document/9866806

14: Open-Source Pressure Controller Based on Compact Electro-Pneumatic Regulators for Droplet Microfluidics Applications
Anton Bukatin (Alferov Saint Petersburg National Research Academic University & Institute for Analytical Instrumentation, Russia); Nikita Filatov (Alferov Saint Petersburg National Research Academic University, Russia); Ivan Denisov (Siberian Federal University, Russia); Anatoly Evstrapov (Institute for Analytical Instrumentation of the RAS, Russia)

Microfluidics is a rapidly growing area that provides innovations in biotechnology, medical diagnostics, and life science. Along with the commercial solutions, there are open-source projects aimed to make such technologies more affordable and flexible for end users. In this article, we developed an open-source, low-cost, and easy-to-use microfluidic pressure controller with a modular design based on electropneumatic regulators to introduce liquids into microfluidic devices under constant pressures. For implementation of complex experimental protocols, the controller contains a vacuum pump, relay outputs, analog inputs, and digital inputs/outputs to connect external equipment. It can be operated using five displays and an encoder or from a personal computer in a manual or automatic regime through the custom open-source software. In this study, we applied this pressure controller for the generation of water-in-oil droplets in microfluidic flow-focusing droplet generators. Droplets' diameters linearly depended on the dispersed and continuous phases' ratio in the range 5- 65μm . In all the cases, the generation regimes were stable for at least 4 h. Direct comparison of the droplet generation obtained with the developed pressure controller and precise syringe pumps showed that it will suit the needs of the microfluidic community for different flow-based lab-on-a-chip applications, as a more affordable and flexible solution for introducing liquids and controlling flow sensors, heaters, valves, light sources, and so on during experiments. The work was supported by the Russian Science Foundation, project No 20-74-10117.
10.1109/TIM.2022.3158383

15: Distributed State Estimation for Multi-Feeder Distribution Grids
Marco Pau (Fraunhofer Institute for Energy Economics and Energy System Technology, Germany); Ferdinanda Ponci (RWTH Aachen University, Germany); Antonello Monti (RWTH Aachen University & Institute for Automation of Complex Power Systems, Germany); Carlo Muscas and Paolo Attilio Pegoraro (University of Cagliari, Italy)

The real-time monitoring of electric distribution grids via state estimation is a fundamental requirement to deploy smart automation and control in the distribution system. Due to the large size of distribution networks and the poor coverage of measurement instrumentation on the field, designing fast state estimation algorithms and achieving accurate results are two major challenges associated to distribution system state estimation. In this paper, an efficient and accurate solution for performing state estimation in multi-feeder radial distribution grids is presented. The proposed algorithm is based on a two-step approach. In the first step, state estimation is performed in parallel on the different feeders suitably processing the available measurements and pseudo-measurements and taking into account their uncertainty characteristics. In the second step, the results on each feeder are post-processed to refine the estimations and to improve the accuracy performance. To this purpose, the second step considers how measurement uncertainties propagate towards the final estimates and how measurements shared among the feeders could adversely affect the final estimation. Performed tests show that the conceived design leads to accuracy performance very close to those achievable by running state estimation on the full grid. At the same time, the parallelization of the estimation process on the different feeders allows decentralizing the state estimation problem, with the associated benefits in terms of computation time and distribution of the communication and storage requirements.
https://ieeexplore.ieee.org/document/9855829

16: Impedance Parameters Estimation of Transmission Lines by an Extended Kalman Filter-Based Algorithm
Eduardo Costa (Universidade de Sao Paulo, Brazil); Ronaldo Pereira (University of São Paulo, Brazil); Luisa H. B. Liboni (Institute of Education, Science, and Technology of São Paulo, Brazil); Felipe Albuquerque (USP, Brazil); Maurício de Oliveira (University of California, San Diego, USA)

The accurate knowledge of the electrical parameters of transmission lines is an important issue for, e.g., fault detection and location, stability analysis. In this sense, the reliability in which such parameters are determined shows to be crucial to the entire system operation. In this article, we propose the estimation of both phasors and parameters through a nonlinear approach by using the Kronecker product, in order to determine the Jacobian terms, and thereafter the extended Kalman filter (EKF). The parameters estimation is carried out recursively in the d-q domain, based on the phasor rotation dynamics for a given frequency. The results presented a reliable and accurate estimation compared to another approach based on Kalman Filtering method. The nonlinear approach, applying the Kronecker product and EKF, represents the original contribution of the proposed estimation method. Besides, this method is applicable to large systems, since the transmission line have to be modeled by the equivalent π model using the hyperbolic corrections.
10.1109/TIM.2022.3169562

17: Active search of subsurface lymph nodes using robot-assisted electrical impedance scanning

Zhuoqi Cheng (University of Southern Denmark, Denmark); Andreas Sørensen Zeltner, Alex Tinggaard Årsvold and Kim Lindberg Schwaner (SDU, Denmark); Pernille Tine Jensen (Aarhus University Hospital, Denmark); Thiusius Rajeeth Savarimuthu (University of Southern Denmark, Denmark)

Lymphadenectomy is frequently performed for cancer treatment. Since lymph nodes are surrounded by fatty tissues, they are often difficult to detect. In robotic-assisted minimally invasive surgery (RMIS), the difficulty increases because haptic feedback is unavailable. This article presents a novel sensing system to assist surgeons with subsurface lymph node detection. The proposed system uses already existing instruments for measuring tissues' electrical properties. A machine-learning-based classifier is developed to estimate the likelihood of a lymph node being present at the measuring site. In addition, an optimized area search algorithm is integrated to make the sensing procedure autonomous and efficient. The proposed system is built and evaluated through experiments using water tank setups, finite element simulation, and ex vivo tissue phantoms. The results demonstrate the efficacy of the proposed method including high detection precision, recall, and Matthews correlation coefficient (MCC). Besides, the proposed method can greatly reduce the number of sampling points compared with a grid-based search method, leading to a quarter faster for the acquisition time. Given the promising performance and easy implementation, the proposed system can potentially improve the quality of related surgical procedures significantly in the future.
https://ieeexplore.ieee.org/abstract/document/9698135

18: A radio frequency tagging continuous-wave optical spectrometer with megahertz refreshing rate

Xiaojing Ren (Chinese Academy of Sciences, China)

Optical spectrometers capable of fast spectral measurements are useful in many fields spanning from industrial manufacturing to scientific research. However, conventional spectrometers, especially those applicable to continuous-wave light measurements, are limited in speed due to the need of taking multiple measurements sequentially and/or direct current (dc) detection that are subject to noise influence. We report a new radio frequency (RF) tagging spectrometer, which breaks these limitations and dramatically accelerates measurements. In this new spectrometer, an acousto-optic deflector (AOD) is used to encode the intensity at each wavelength to the amplitude of a different beat RF signal. As a result, all RF signals can be summed up and detected simultaneously by a fast single-channel detector. The spectrum is obtained by taking the Fourier transform of the summed RF signal. The spectrometer is evaluated by measuring both multiline and broadband light sources with a speed up to 1 MHz as well as light scattering spectra with a speed of 64 kHz. With the ability to select wavelengths by programming the driving RF signal, the spectrometer offers great flexibility to detect part of a spectrum that contains most useful information with an unprecedented speed limit up to multiple megahertz.https://ieeexplore.ieee.org/document/9978913

19: Palm-Sized Quadcopter for Three-Dimensional Chemical Plume Tracking

Shunsuke Shigaki (Osaka University, Japan); Yuki Yoshimura (SoftBank Corporation, Japan); Daisuke Kurabayashi (Tokyo Institute of Technology, Japan)

In this study, we designed and experimentally verified the placement of odor sensors and an algorithm using the aero-olfactory effect of a palm-sized quadcopter to solve the 3-D chemical plume tracking (3-D-CPT) problem. Solving 3-D-CPT is important in engineering as it helps perform rescue operations during disasters and identify sources of harmful substances. Moreover, the odor sensors must be properly located and a CPT algorithm be applied to improve the tracking performance of a chemical. However, studies regarding the use of quadcopters for solving the 3-D-CPT problem are scarce, and the relationship between the odor sensor location and algorithm is debatable. Hence, we utilized particle image velocimetry (PIV), an airflow visualization technology, to evaluate the arrival direction of chemicals at different heights. The results showed that odor sensors must be placed on the upper and front surfaces of a quadcopter to monitor the chemicals three-dimensionally. Additionally, we designed a 3-D surge-casting algorithm, which is an extension of the CPT strategy of a flying moth, that is, surge casting, to accommodate the proposed odor sensor placement. By conducting 3-D-CPT experiments based on different heights of odor sources using the proposed system, we discovered that even in an environment with significant changes in the wind direction the CPT performance is better than that of the conventional 3-D-CPT algorithm. Thus, 3-D-CPT should be further improved to enable its application in unknown and cluttered environments. In this study, we improved the 3-D-CPT performance of a palm-sized quadcopter by designing an appropriate sensor arrangement and algorithm balance.

https://ieeexplore.ieee.org/document/9933476

20: Normal Inverse Gaussian Features for EEG-Based Automatic Emotion Recognition
Anurag Singh (IIIT Naya Raipur, India); Nalini Pusarla (DSPM IIIT NAYA RAIPUR, India); Shrivishal Tripathi (DSPM IIIT Nayaraipur, India)

Electroencephalography (EEG)-based emotion recognition is crucial in the domain of human-computer interaction (HCI), which gained significant attention in recent years. However, the nonstationarity and chaotic nature of the EEG signals pose challenges and restrict the state-of-the-art techniques from precisely identifying distinct emotional states from the EEG data and hence offer limited emotion recognition performance. To capture the underlying nonlinear characteristics of EEG, this study employed a novel local mean decomposition (LMD) algorithm, which decomposes EEG signals into product functions (PFs). Further PFs are modeled by normal inverse Gaussian (NIG) probability density function (pdf) parameters. Thus, these pdf features are fed to an optimized Adaboost classifier developed with the help of a cross-validation (CV) approach. The novelty of the work lies in the NIG modeling of LMD-domain PFs to identify specific emotions from the EEG signals. The significance of the NIG parameters is illustrated by qualitative, pictorial, and statistical analyses. To assess the efficiency of the proposed approach, intensive experiments are conducted on open-source datasets, Shanghai Jiao Tong University (SJTU) Emotion EEG Dataset (SEED), SEED-IV, and Database for Emotion Analysis of Physiological Signals (DEAP). The emotion recognition performance is evaluated in terms of heat maps, receiver operating characteristics (ROCs), and accuracy. The proposed emotion recognition system outperformed the state-of-art methods and achieved a maximum accuracy of 97.3%, 98%, and 98.6% with the CV approach and 93.23%, 94.87%, and 95.58% for the cross-subject validation (CSV) approach using DEAP, SEED, and SEED-IV datasets, respectively.
IEEE Xplore Link: https://ieeexplore.ieee.org/document/9887984

21: A Two-step Calibration Method for Vision Measurement with Large Field of View
Hao Hu (Northwestern Polytechnical University, China)

Nowadays, the commonly used large view calibration methods usually have the problems of low measurement accuracy, big on-site operation limitation, or high tolerance requirement for target preparation. In order to resolve the previous mentioned issues, a two-step calibration method for the interior and exterior parameter of multi cameras is proposed based on the principle of industrial close range photogrammetry. First step, by using a small-scale cross target at the closer range, the interior parameter of the front section of the camera is calibrated based on the pyramid method. Second step, by setting a proper number of serialized targets at the further range of the measured area, the exterior parameter is calibrated based on space resection with multi-image. Finally, the interior and exterior parameters are all optimized by using the bundle adjustment method to get the accurate measurement results. A numbers of experiments are performed to verify the feasibility and accuracy of this proposed method. As per the experiment results, with a camera resolution of 2448×2048 pixels, the reprojection error is less than 0.11 pixels. For the measuring volume of 10.0×8.4×3.6 m, the maximum absolute error of threedimensional measurement is 0.42 mm. The measurement error for the flapping angle of rotor which diameter is 10 meter, is less than 4.5%. By using this method, the interior parameter can be collected in the laboratory, while the exterior parameter can be collected in the open field separately. This method has high practicality under the actual engineering working environment.

22: Distributed State Estimation in Digital Distribution Networks Based on Proximal Atomic Coordination

Zhelin Liu, Shiyuan Gao, Peng Li and Haoran Ji (Tianjin University, China); Wei Xi (China Southern Power Grid Company Limited, China); Hao Yu (Tianjin University, China); Jianzhong Wu (Cardiff University, United Kingdom (Great Britain)); Chengshan Wang (Tianjin University, China)

With the emerging digitalization technologies represented by edge computing, distribution networks are gradually transforming into digital distribution networks (DDNs). The realization of edge computing drives the distributed operation of DDNs, where multiple areas exchange boundary information through edge computing devices. Benefitting from the data acquisition and computing capacity of edge computing devices, it is feasible to perform accurate and real-time state estimation on the edge side. Aiming at the state perception with edge computing devices in DDNs, this article proposes a distributed state estimation (DSE) method based on the proximal atomic coordination (PAC) algorithm. First, based on convex relaxation optimization, the state estimation model is converted into a positive semidefinite programming (SDP) model to solve the nonconvexity caused by nonlinear measurements, which ensures the accuracy and convergence of state estimation. Then, a DSE method based on the PAC algorithm is proposed to exchange information of each area, which reduces the computation time and realizes the efficient state estimation on the edge side. The model and the effectiveness of the proposed method are numerically demonstrated on the modified PG&E 69-node system and the test case from a practical pilot in Guangzhou, China.

23: Logit Inducing With Abnormality Capturing for Semi-Supervised Image Anomaly Detection

Qian Wan (Huazhong University of Science and Technology, China); Liang Gao (Huazhong University of Sciencen and Technology & School of Mechanical Science and Technology, China); Xinyu Li (Huazhong University of Science and Technology, China)

Image Anomaly Detection is a significant stage for visual quality inspection in intelligent manufacturing systems. According to the assumption that only normal images are available during the training stage, unsupervised methods have been studied recently for image anomaly detection. But anomalous images of small scale can be collected for training in many real-world industrial scenarios, and the unsupervised methods make no use of them to improve the detection accuracy. This leads to a semi-supervised image anomaly detection with an unbalanced detection challenge. In this paper, a Logit Inducing with Abnormality Capturing (LIAC) method is proposed to address semi-supervised image anomaly detection. Firstly, a Logit Inducing Loss is proposed to train a classifier for dealing with unbalanced detection. And secondly, an Abnormality Capturing Module is proposed to address anomaly detection. With labeling only 40 anomalous images for training, the proposed LIAC method achieves a 98.8% f1-score on the image anomaly detection of the printed circuit board, compared with the state-of-the-art methods. More, the proposed LIAC method is experimentally compared with the state-of-the-art methods on MTD, ROCT, and ELPV three open-source datasets, respectively achieves f1-score of 85.2%, 96.8%, and 66.6% with given 40 anomalous images for training.
https://ieeexplore.ieee.org/document/9885240

24: Homography-Based PnP Solution to Reject Outliers
Cuicui Jiang (Beihang University, Beijing)

In this article, a homography-based perspective-n-point (PnP) solution is proposed to reject the outliers and estimate the relative pose. The point correspondences for the 3-D point coordinates and the 2-D image projections are first obtained by the image processing, and the homography is applied to derive the PnP solution into a linear system. Then, considering the outlier correspondences, a determinant error function is proposed to predict the image projections. These image projection predictions are compared with the measurement projections to obtain the error distributions, which are analyzed to decrease the percentage of outliers. Given the decreased percentage of outliers, an iterative null space reweighting method is applied by a homography matrix to reject all the remaining outliers. Finally, the plane norm direction constraint is coupled with the direct linear transformation (DLT) method to refine the final pose. Numerical simulations are conducted to evaluate the performance of the proposed method.
10.1109/TIM.2022.3216085

25: Local Sensitivity Analysis and Monte Carlo Simulation to Examine the Effects of Chipless RFID Measurement Uncertainties-Part II: Consideration of Multiple Measurement Uncertainties
Katelyn R Brinker (Iowa State University & Center for Nondestructive Evaluation, USA)

Measurement and response decoding is an ongoing challenge in the chipless radio-frequency identification (RFID) field. Measurement uncertainties, including tag/reader misalignment, S-parameter error, and clutter, can cause response distortions, such as magnitude changes and resonant frequency shifts, that can lead to the improper assignment of a binary code or sensing parameter (i.e., decoding). This work aims to use local sensitivity analysis and Monte Carlo simulation to fully characterize the effects of misalignment, response parameter measurement error (e.g., VNA S-parameter error), and clutter on chipless RFID responses that are measured in the near-field with a monostatic setup. From this type of comprehensive characterization, conclusions are drawn about the identification (ID) and sensing capabilities of the tags. While the effect of misalignment-based uncertainty was examined in Part I, here in Part II, S11 uncertainty and clutter-based uncertainty are examined both individually and in combination with misalignment-based uncertainty. An example, demonstrating the application of the proposed tag performance assessment framework is also provided.
https://ieeexplore.ieee.org/abstract/document/9951061

26: A New Contrastive GAN With Data Augmentation for Surface Defect Recognition Under Limited Data

Zongwei Du (Huazhong University of Science and Technology, China); Liang Gao (Huazhong University of Sciencen and Technology & School of Mechanical Science and Technology, China); Xinyu Li (Huazhong University of Science and Technology, China)

Surface defect recognition (SDC) is essential in intelligent manufacturing. Deep learning (DL) is a research hotspot in SDC. Limited defective samples are available in most real-world cases, which poses challenges for DL methods. Given such circumstances, generating defective samples by generative adversarial networks (GANs) is applied. However, insufficient samples and high-frequency texture details in defects make GANs very hard to train, yield mode collapse, and poor image quality, which can further impact SDC. To solve these problems, this article proposes a new GAN called contrastive GAN, which can be trained to generate diverse defects with only extremely limited samples. Specifically, a shared data augmentation (SDA) module is proposed for avoiding overfitting. Then, a feature attention matching (FAM) module is proposed to align features for improving the quality of generated images. Finally, a contrastive loss based on hypersphere is employed to constrain GANs to generate images that differ from the traditional transform. Experiments show that the proposed GAN generates defective images with higher quality and lower variance between real defects compared to other GANs. Synthetic images contribute to pretrained DL networks with accuracies of up to 95.00%-99.56% for Northeastern University (NEU) datasets of different sizes and 91.84% for printed circuit board (PCB) cases, which proves the effectiveness of the proposed method.

27: Realization of Tensile-Bending Mechanical-Thermal Coupling Fatigue Based on a Uniaxial Tensile-Fatigue Testing Device

Chaofan Li, Zhichao Ma, Wei Zhang, Shuai Tong, Shenghui Wang, Hongwei Zhao and Luquan Ren (Jilin University, China)

Lack of advanced testing technology and instrument restricted the development and application of material subjected to multiaxial mechanical-thermal coupling fatigue load. This article developed the mechanical-thermal coupling tensile-bending combined fatigue testing instrument by modifying the existing uniaxial tensile testing device and the shape of specimens. The thermal loading unit, the thermal insulation unit, and the temperature monitoring unit were integrated into the tensile testing device to obtain fatigue properties of different temperatures. A single v-notch used to adjust the ratio of bending component to tensile component was prepared on the symmetric specimen to establish the tensile-bending coupling stress state of the minimum cross section of specimens. The v-notch specimens and conventional symmetrical specimens were used on the modified instrument to test at room temperature to 600 °C. The performance of the modified instrument was verified through the stability of load response, the consistency of fatigue fracture process and displacement response, and the softening trend of material with the increase in temperature. The tensile-bending stress state caused by v-notch was proven through the finite-element analysis and the stress analysis based on the crack growth morphology. A deep neural network model was established by connecting the testing parameters and the tensile-bending combined stress state, and the feasibility of the model was verified by small enough training error and testing error. https://ieeexplore.ieee.org/document/9853611

28: PCBNet: A Lightweight Convolutional Neural Network for Defect Inspection in Surface Mount Technology

Hongjin Wu, Ruoshan Lei and Yibing Peng (Huazhong University of Science and Technology, China)

Prereflow automatic optical inspection (AOI) has been widely used to ensure product quality in surface mount technology (SMT). When confronted with a complex industrial environment, traditional hand-designed visual inspection algorithms may lack robustness and generalizability. In this article, PCBNet, a convolutional neural network (CNN) method that combines data preprocessing, detection network, and visualization, is proposed to localize electronic components and recognize defects. In the data preprocessing stage, raw images are segmented into several regions of interest (ROIs). The ROI patches are inspected by a CNN-based detection system, which is capable of classifying defects and positioning components. After inspection, the reporting system visualizes the results via the human-computer interface. In comparative studies, the effectiveness of the proposed PCBNet was validated on a large-scale PCB component defect dataset. The PCBNet backbone outperforms other well-known lightweight CNN backbones in terms of accuracy and latency on 4× ARM Cortex A72 CPU @ 1.5 GHz. Compared to other learning-based methods on the small-scale benchmark dataset, the PCBNet also achieves the best balance between inference speed and accuracy. In addition, extensive experiments demonstrate the superior efficiency of PCBNet in comparison to some famous traditional object detectors and novel oriented object detection algorithms.
https://ieeexplore.ieee.org/document/9837457

29: Development of Lightweight RBF-DRNN and Automated Framework for CNC Tool-Wear Prediction

Chee Hoe Loh (National Yunlin University of Science and Technology, Taiwan); Sheng-Min Chiu (Feng Chia University, Taiwan); Yi-Chung Chen (National Yunlin University of Science and Technology, Taiwan); Cheng-Ju Kuo (Shanghai Woodman-AI Company, Taiwan); Li-Chun Hung (Precision Machinery Research and Development Center, Taiwan); Min-Hsiung Hung (Chinses Culture University, Taiwan); Chao-Chun Chen (National Cheng Kung University, Taiwan); Chiang Lee (National Cheng-Kung University, Taiwan)

CNC tool-wear prediction (TWpred) is an important issue in the industry. Recently, researchers have demonstrated that deep-learning models (DLMs) are effective in TWpred. However, DLMs are ill-suited to small- and medium-scale manufacturers due to high computational costs. Methods exist to reduce the computational costs of DLMs, but most depend on overly-complex pruning processes which are not appropriate for the low-end computers used by the above manufacturers. We therefore developed a lightweight DLM and an automated framework for TWpred. The framework is based on two concepts: (1) the DLM was pruned by reducing the number of input data fields so the model itself remains unchanged and (2) we designed a framework that enables the automatic establishment of a lightweight DLM. These two concepts make the overall framework applicable to small- and medium-scale manufacturers. Finally, we used real-world data set PHM 2010 to verify that the lightweight DLM can achieve almost the same RULA accuracy as the DLM (DLM: 95.55%, lightweight DLM: 95.51%) using only 0.88% of DLM parameters, which verifies the low cost and high precision of the proposed model.
https://ieeexplore.ieee.org/document/9748893

30: Force sensing resistors used as plantar impedance plethysmography electrodes
Isabel Morales (Universidad de la República & Núcelo de Ingeniería Biomédica, Uruguay); Rafael González-Landaeta (Universidad Autónoma de Ciudad Juárez, Mexico); Franco Simini (Universidad de La Republica, Uruguay)

Diabetic Foot Ulcers are an ominous consequence of Diabetic Foot. To develop a multidimensional lesion warning device, several variables must be considered, among which vascular parameters. To minimize the number of sensors, we investigate the use of standard flexible Force Sensing Resistors, FSR402 and FSR406, to detect not only plantar pressure, but also bioimpedance plethysmography. Since FSRs include conductive electrodes covered by polymer film, the interface with the subject can be considered a capacitive electrode. We present a special impedance plethysmography circuit to inject current using FSRs and measuring the resulting voltage from other FSRs contacts. Impedance plethysmography simulations with two modeled FSRs, two contacts each, was not successful but using four FSRs, one capacitive contact each, shows a precision within 4% of the expected FSR resistor value. Impedance plethysmography system was verified with simultaneously matching ECG-lead I, Ag-AgCl and capacitive electrodes signals alongside power spectra. For the first time, four sole pressure sensors are used also as bioimpedance electrodes to detect cardiac activity with standard components at frequencies up to 50 kHz, simulated as well as experimentally verified on one healthy subject. Link_IEEE XPLORE: https://ieeexplore.ieee.org/document/9785883

31: Complex Dielectric Constant Extraction of Substrate Materials Using Cross-Resonator Method
Amir Zahedi (K. N. Toosi University of Technology, Iran)

This article presents a novel resonance method by using a cross-resonator (CR) for the complex permittivity measurement of planar dielectric substrate materials with its full theoretical and analytical transmission line (TL) model. Due to its symmetrical structure, it offers two main advantages over its conventional counterpart. First, the unwanted asymmetricity mode is eliminated due to the centric magnetic wall. Second, the electric field at the junction of the open-ended stub is uniform.
The propagation constant of the structure in this method is directly extracted from the S-parameters. The total losses without approximation are computed by using a robust theoretical and analytical TL modeling. The proposed resonator is implemented on RO4003C and FR4 substrate materials, and S-parameters are measured in the frequency range of 1 MHz to 8 GHz. Then the complex dielectric constant of the substrate is extracted at each resonant frequency. A full-wave simulation also confirms the accuracy of the proposed resonator. The comparison between the simulated and the measured S-parameters demonstrate a relative error less than 1% over the frequency range.

32: TRANS-Net: Transformer-Enhanced Residual-Error AlterNative Suppression Network for MRI Reconstruction
Dianlin Hu (Southeast University & KUMC, USA)

Since deep priors could exploit more intrinsic features than handcrafted prior knowledge, unrolled reconstruction methods significantly improve image quality for fast magnetic resonance imaging (MRI) reconstruction with the combination of iterative optimization and deep neural network-based regularization terms. One popular way for unrolled methods is to employ the regularization penalty on the reconstructed result within the image space. Dissimilarly, in this article, we innovatively propose a reconstruction framework termed Transformer-enhanced Residual-error AlterNative Suppression Network (TRANS-Net) for MRI reconstruction to extend the unrolled methods. Unlike some existing model-based algorithms, TRANS-Net additionally deploys the regularization term on the error maps in the residual image domain, which greatly emphasizes the high-frequency information contained in the MR images. Besides, to further explore the global spatial correlation of the reconstructed image, the transformer module is adopted to enlarge the receptive field of deep priors regularized on the reconstructed images for better tissue recovery. The quantitative and qualitative results show that the proposed TRANS-Net method has superior performance to the state-of-the-art reconstruction algorithms in anatomical structure restoration and perceptual detail preservation.

33: VWR-SLAM: Tightly Coupled SLAM System Based on Visible Light Positioning Landmark, Wheel Odometer, and RGB-D Camera
Weipeng Guan (South China University of Technology, China)

Visible light positioning (VLP) is a promising technology since it can provide high-accuracy indoor localization based on the existing lighting infrastructure. Most VLP systems require a prior light-emitting diode (LED) location map, termed a VLP-landmark map in this article, for which manual surveys are costly in practical deployment at scale. What is more, the existing approaches also require dense LED deployments. In this work, we proposed a multisensor fusion framework, termed VWR-simultaneous localization and mapping (SLAM), which tightly fused the VLP, wheel odometer, and red green dlue-depth map (RGB-D) camera to achieve SLAM. Our VWR-SLAM can provide accurate and robust robot localization and navigation in LED shortage/outage situations, meanwhile, constructing the 3-D sparse environment map and the 3-D VLP-landmark map without tedious manual measurements. The experimental results show that our proposed scheme can provide an average robot positioning accuracy of 1.81 cm and an LED mapping accuracy of 3.01 cm.
IEEE Xplore link: https://ieeexplore.ieee.org/document/10003174

34: In Situ Measurement of Nonorthogonal Angles of a Three-Axis Vector Optically Pumped Magnetometer

Siran Li (Beihang University, China)

An in situ method has been proposed for measuring all nonorthogonal angles of the beams and triaxial coils in a three-axis vector optically pumped magnetometer (OPM). Based on the combination and alignment of two pump beams, each of which can achieve biaxial transverse measurement in a time-sharing regime under modulated magnetic fields, a 3-D orthogonal coordinate measurement system is obtained, and the measurement models for three categories (six types) of nonorthogonal angles are established theoretically. On this basis, we experimentally measured the nonorthogonal angles along with related uncertainties at different modulated frequencies and strengths of the magnetic fields. The nonorthogonal angles were (3.65° ± 0.52°) between the two pump beams before compensation. They were (7.05° ± 0.23°) between the X - and Y -axis coils, (8.89° ± 0.21°) between the Y - and Z -axis coils, (5.23° ± 0.27°) between the X - and Z -axis coils, (7.24° ± 0.24°) between the x -direction pump beam and X -axis coil, and (9.10° ± 0.22°) between the z -direction pump beam and the Z -axis coil. This study measures the magnitudes of six types of nonorthogonality, without making an assumption of ideal orthogonality or using auxiliary calibration equipment. Moreover, this method can be extended to several other kinds of OPMs with simple modifications. This study is critical for evaluating and reducing the misalignment error to improve the accuracy of three-axis vector OPMs. (https://ieeexplore.ieee.org/document/8868282)

35: Tunnel Magnetoresistance-Based Noncontact Current Sensing and Measurement

Jiaxian Li, Hao Liu and Tianshu Bi (North China Electric Power University, China)

The dynamic characteristics of power systems have become increasingly complex with the growing application of power electronics equipment. A high level of real-time monitoring is now required to provide a database for system stability and safety control. Therefore, flexible and accurate sensor technology is crucial. In this article, a noncontact current sensing method is proposed using tunnel magnetoresistance (TMR) technology. Based on the introduction of TMR chip characteristics, the sensing law of a TMR chip surrounding a current-carrying wire is revealed. An arrangement of four TMR chips is then proposed to reflect the magnetic field intensity around a current-carrying wire. A TMR chip array-based noncontact current sensing technique is presented for use as a real set-and-use current sensing method. The convenience of the proposed method is superior to traditional current sensors because the wire does not need to be surrounded by a magnetic ring or coil. A method for location detection is presented to avoid iterating for every sample, which significantly reduces the computation burden. Simulations are then carried out to demonstrate the effectiveness of the proposed method. A current sensor prototype based on a printed circuit board (PCB) is developed, and its practicality is proven by experiments. Test results show that the prototype can meet the requirements of phasor measurement unit (PMU) standards, indicating that the proposed current sensing method is practical and can be applied in M-class and P-class PMUs for current sensing.
https://ieeexplore-ieee-org-s/document/9717280

36: Mechanical Particle Filter-Based Active Vision System for Fast Wide-Area Multiobject Detection

Xianlei Long (Institute of Automation & Chinese Academy of Sciences, China); Liping Ma (Institute of Automation, China)

Sliding window searching is a common paradigm used for large field-of-view (FOV) multiobject detection. However, low target resolution and irregular distribution of objects make the traditional method inefficient and hard to meet the demands of fast object detection in a wide area. To address the above issues, in this article we design an ultrafast switching galvano-mirror-based active vision system that can simultaneously search and detect multiobject at 300 frames per second (fps) in a large FOV, without the guidance of a high-resolution (HR) panoramic camera. Specifically, a novel mechanical particle filter (MPF) framework is proposed to improve the efficiency of searching potential objects by constructing the probability distribution model and then iteratively locating target objects, where each particle is represented by an image of a single small FOV that is controlled and captured by a switching galvano-mirror. The object detector is used to determine whether the particle image contains target objects. Then, to reduce the total scanning cost for capturing all the particles, we introduce a center partitioned scanning algorithm that significantly speeds up the scanning process by 10× or more. Moreover, we optimize the processing pipeline for low latency sensing using a high-parallelism visual feedback scheme to improve efficiency. Finally, an efficient and fast active vision system is implemented, which is based on a two-axis galvano-mirror and a high-speed camera without multicamera fusion for active object searching. Abundant experimental results demonstrate the effectiveness of our proposed system in indoor environments and real-world scenarios. We also verify the performance in terms of scanning speed and detection accuracy.
https://ieeexplore.ieee.org/abstract/document/9868232/keywords#keywords

37: Region Probability Map-Guided Fast Wide-Area Multiobject Detection
Xianlei Long (Institute of Automation & Chinese Academy of Sciences, China)

Detecting multiobjects in a wide-area scenario efficiently is a critical technology for industry and security applications. The detection performance has benefited enormously from the probability estimation of the unknown environment. Representative methods, such as particle filter (PF), construct the probability distribution model and iteratively locate target objects. However, randomly sampling and detecting image patches in the large covering field-of-view (FOV) make these methods inefficient and computation costly. To address these issues, we propose a region probability map (RPM)-guided fast wide-area detection system that can simultaneously detect multiobjects from a large FOV at 300 frames per second (fps) through a coarse-to-fine-grained detection paradigm. Specifically, a segmentation-based RPM generation module is introduced to assign probability measurements to different regions of the panoramic image, which models how likely the desired objects will occur in these regions. Then, based on the generated probability map of the whole scene, a novel RPM-guided PF framework is proposed to speed up the detection process by concentrating the detection on high-probability areas. Finally, a rapid and low-latency active detection system based on a wide-angle camera, a high-speed camera, and an ultrafast galvano mirror is implemented, which gains a 15.38% efficiency improvement while achieving more accurate detection compared with existing methods. Extensive experimental results verify the robustness and effectiveness of our proposed system.
https://ieeexplore.ieee.org/document/9989405

38: An Automatic Tool for Partial Discharge De-Noising via Short-Time Fourier Transform and Matrix Factorization
Yuan Yan (West Xianning Road, Xi'an, Shaanxi & Xi'an Jiaotong University (XJTU), China)

This article develops a fully automatic tool for the de-noising of partial discharge (PD) signals occurring in electrical power networks and recorded in on-site measurements. The proposed method is based on the spectral decomposition of the PD measured signal via the joint application of the short-time Fourier transform (STFT) and the singular value decomposition (SVD). The estimated noiseless signal is reconstructed via a clever selection of the dominant contributions, which allows us to filter out the different spurious components, including the white noise and the discrete spectrum noise. The method offers a viable solution which can be easily integrated within the measurement apparatus, with unavoidable beneficial effects in the detection of important parameters of the signal for PD localization. The performance of the proposed tool is first demonstrated on a synthetic test signal and then it is applied to real measured data. A cross comparison of the proposed method and other state-of-the-art alternatives is included in the study. https://ieeexplore.ieee.org/document/9927494

39: Toward Online Removal of Cardiac Interference From Trunk Electromyography by Morphological Modeling of the Electrocardiography

Runwei Lin, Yichao Wu, Zuyu Du, Kaichen Wang, Yang Yao and Lin Xu (ShanghaiTech University, China)

Trunk electromyography (EMG) has been widely used in many biomedical applications, which is usually contaminated by electrocardiography (ECG) interference. Several methods have been proposed for ECG removal from trunk EMG. However, most of them are either inaccurate or unsuitable for online applications, e.g., prosthesis control. The aim of the present study is therefore to develop an accurate ECG removal algorithm suitable for online applications. Each ECG wave was modeled by Gaussian kernel functions and subtracted from the trunk measurement to obtain a clean EMG. Two synthetic datasets were generated by mixing a real EMG with a healthy ECG and a dysrhythmia ECG, respectively. Average rectified value (ARV) and mean frequency (MF) were calculated from the reconstructed EMG and the clean EMG for performance evaluation. Moreover, real trunk EMG was recorded under isometric contractions with different forces. Correlation coefficient (CC) between the amplitude of the reconstruct EMG and the contraction force was calculated as performance metric. Small root mean square errors were observed in ARV and MF between the clean EMG and reconstructed EMG, i.e., 2.5 ± 0.7 μv and 2.0±0.4 Hz for the synthetic dataset containing healthy ECG and 3.1±1.7 μv and 3.0±1.2 Hz for that containing dysrhythmia ECG. High CC (0.91 ± 0.12) between EMG amplitude and contraction force was observed for real trunk EMG. Our algorithm outperforms many of the state-of-the-art algorithms and is implemented in each cardiac cycle, enabling possible online applications such as prosthesis control.
https://ieeexplore.ieee.org/document/9845190

40: Optimal Parameter Design of DAC-Based Sinusoidal Signal Generators for Electrical Impedance Spectroscopy

Song-I Cheon and Minkyu Je (KAIST, Korea (South))

This article provides parameter optimization processes of sinusoidal signal generators (SSGs) based on a digital-to-analog converter (DAC) for electrical impedance spectroscopy (EIS) applications. The SSG, which is the most power-hungry building block in EIS systems, generates a sinusoidal signal by using a DAC. To achieve high accuracy for the overall EIS system, high linearity is required for the sinusoidal signal. Thus, the SSG's DAC is typically operated with a high oversampling ratio (OSR) and a large number of quantization levels (LDAC) at the expense of increased power consumption, large area, and high complexity. For efficient use of the power and area in the SSG, it is necessary to optimize the OSR, LDAC, and the order of the low-pass filter (LPF) (NLPF). In this article, optimal design parameters of SSGs, which can achieve highly accurate EIS systems with low complexity, are presented. First, the minimum OSR and NLPF for lowering the magnitude error to less than 0.1% are presented. Then, optimal quantization levels of finite-resolution DACs are found for sufficient accuracy and harmonic tones. In addition, the accuracy and harmonics of odd-number OSR cases are analyzed and compared with even-number OSR cases. According to the results, it is possible to design an SSG that only differs from the ideal sinusoidal signal by approximately 0.1% by using OSR ≤32, NLPF≤2, and LDAC≤256. https://ieeexplore.ieee.org/abstract/document/9968212

41: Optimal Design of Planar Coils With Reverse Current Distribution for Atomic Devices
Shuying Wang, Jixi Lu, Fei Lu, Chenning Lu and Xu Zhang (Beihang University, China)

The uniform magnetic field coil is an essential component for providing a controllable and uniform magnetic field in applications, such as scientific instruments, industrial equipment, and sensors. In recent years, the rapidly developing atomic devices are being miniaturized and have high requirements on the uniformity of the magnetic field. This study proposes an optimal design method for planar uniform magnetic field coils suitable for atomic devices, which can achieve high uniformity in a simple configuration and small volume. The proposed method combines the magnetic field relative errors of the target field points and innovatively introduces the reverse current distribution to compensate for the nonuniform magnetic field. Additionally, the genetic algorithm (GA) was used to calculate the structural parameters and the current direction under optimal uniformity. The simulation and experimental results demonstrated that the maximum magnetic field relative error of the designed planar coils on the two central axes improved by 89.7% and 31.9%, respectively, in contrast to the commonly used Helmholtz coils. Furthermore, the integration of the triaxial magnetic field was realized without increasing the overall volume of the coil. For the triaxial magnetic field coil, the proportion of the uniform magnetic field area of the designed coil can be increased by over 3× compared to the Helmholtz coil, which is conducive to the improvement of the performance of atomic devices. https://ieeexplore.ieee.org/document/9919171

42: Event-VPR: End-to-End Weakly Supervised Deep Network Architecture for Visual Place Recognition Using Event-Based Vision Sensor
Delei Kong (Northeastern University, China)

Traditional visual place recognition (VPR) methods generally use frame-based cameras, which will easily fail due to rapid illumination changes or fast motion. To overcome this, we propose an end-to-end visual place recognition network using event cameras, which can achieve good recognition performance in challenging environments (e.g., large-scale driving scenes). The key idea of the proposed algorithm is firstly to characterize the event streams with the EST voxel grid representation, then extract features using a deep residual network, and finally aggregate features using an improved VLAD network to realize end-to-end visual place recognition using event streams. To verify the effectiveness of the proposed algorithm, on the event-based driving datasets (MVSEC, DDD17, Brisbane-Event-VPR) and the synthetic event datasets (Oxford RobotCar, CARLA), we analyze the performance of our proposed method on large-scale driving sequences including cross-weather, cross-season and illumination changing scenes, and then we compare the proposed method with state-of-the-art event-based VPR method (Ensemble-Event-VPR) to prove its advantages. Experimental results show that the performance of the proposed method is better than that of event-based ensemble scheme in challenging scenarios. To our knowledge, for visual place recognition task, this is the first end-to-end weakly supervised deep network architecture that directly processes event stream data. https://ieeexplore.ieee.org/abstract/document/9760407/

43: Multiscale Convolution-Based Probabilistic Classification for Detecting Bare PCB Defects
Lei Lei (City University of Hong Kong, Hong Kong)

Defect detection is an essential part of quality management for bare printed circuit board (PCB) production. Existing vision-based methods are not effective in detecting PCB defects when uncertainty exists. This article proposes a multiscale convolution-based detection methodology to classify bare PCB defects under uncertainty. First, a novel window-based loss function is designed to tackle the inter-class imbalance and uncertainty. Then, a multiscale convolution network is constructed to process the defects with intra-class variance, and large scale extraction features are fused on the small scale to guide the extraction process. After that, the classification probability is extracted and assembled into a multiscale probability matrix, on which entropy-based probabilistic decisions are integrated for the final decision. Finally, experimental studies indicate that the proposed methodology can achieve satisfactory detection performance and demonstrate visual interpretability compared to baseline methods. https://ieeexplore.ieee.org/abstract/document/9989396

44: OVPD: Odor-Video Elicited Physiological Signal Database for Emotion Recognition
Jingyi Xue, Jinqin Wang, Shiang Hu, Ning Bi and Zhao Lv (Anhui University, China)

To explore the effects of different stimuli on human emotions, olfaction has been incorporated into stimulation materials that might trigger strong emotions. In this study, we designed a new stimulation experiment and established an odor-video physiological signal database (OVPD) of odor-video stimulation for emotion recognition. The database contained the electroencephalogram (EEG) data of ten subjects acquired when experimenting with video-odor stimuli and video-only stimuli. We selected 32 video clips and ten kinds of odors (i.e., orange, rose, alcohol, water, mint, vinegar, durian, foul, acetic, and myrtle) as elicitation materials. Each subject reported a self-assessment of arousal and valence levels after the experiment ended. By comparing the brain topographies associated with two types of stimuli, olfactory stimuli increased orbitofrontal cortex activity, which is consistent with the finding from the fMRI study. Simultaneously with three types of emotions, we presented the average classification accuracies of different features using the support vector machine (SVM) classifier. The optimal accuracies with or without olfactory stimuli were 99.03% and 97.92%, respectively. The superior results show that the olfactory stimulus can enhance emotional experiences.

45: A Novel Adaptive Bandpass Filter Based PLL for Grid Synchronization Under Distorted Grid Conditions
Sridharan K (Indian Institute of Information Technology, Design and Manufacturing Kancheepuram, India); B Chitti Babu (Indian Institute of Information Technology, Design and Manufacturing, India)

In the current scenario, the integration of a renewable energy sources (RESs) with variable power production into power grids requires a power converter with robust control techniques. In order to formulate the control strategy meticulously, a fast and accurate detection of grid phase angle is necessary. Hence, frequency and phase angle of the grid voltages are vital components to guarantee the synchronization for grid-connected converter. Additionally, a phase locked loop (PLL)-based control algorithm is needed to generate the accurate reference current for the grid-connected converter. The conventional adaptive low-pass filter (ALPF)-based PLL is used as a synchronization tool but requires more settling time during interharmonics and dc offset grid conditions in addition to higher THD of the grid currents/voltages. In this article, a novel adaptive bandpass filter (ABPF) is proposed and can be added as a prefilter of PLL structures without modifying the base design. To confirm the adaptive nature of the ABPF the gradient algorithm is used to maximize the normalized mean square output and self-adjust the center frequency of the filter during distorted grid conditions. The 3-D surface plot can be used to provide the system stability and dynamic response of the filter. For effectiveness of the proposed study, ABPF is added as prefilter to dq-frame cascaded delayed signal cancellation (dqCDSC) PLL and MAF PLL and detailed comparative study is made in this article. In addition to that, the proposed ABPF-based dqCDSC PLL and ABPF-based MAF PLL methods are analyzed using MATLAB/Simulink environment. Finally, performance is tested with real-time via dSPACE-1104 hardware-in-loop (HIL) simulation.

15:30 - 17:30
Optical and Fiber Optic Instrumentation and Measurement
Meeting Room 302/303
Session Chairs: James Smith and Tuan Guo

Safe Water Temperature Monitoring System using Optical Fibers
Mohamad Farhat (Australian University - Kuwait, Kuwait); Kevin Munisami (University of West London, United Kingdom (Great Britain)); Michel Nahas (Australian University - Kuwait, Kuwait)

Vortex detection in flow pattern control of horizontal liquid-liquid flows by PLIF&PIV methods
Lusheng Zhai, Xinyi Zhong, Wenhao Wang and Xinyu Meng (Tianjin University, China)

Development Of A Photonic Doppler Velocimeter To Verify A Fabry-Perot Velocimeter
James Smith (Idaho National Laboratory, USA); Bradley Benefiel (Experiment Design Idaho National Laboratory Idaho Falls, USA); Shaun P. Evans (Idaho Natiaonal Laboratory, USA); Katie Longfellow (INL, USA)

Implementation of NDIR technology for selective sensing of gases with common absorption spectra
Bakhram Gaynullin and Christine Hummelgård (Senseair AB, Sweden); Claes Mattsson and Goran Thungstrom (Mid Sweden University, Sweden); Henrik Rodjegard (SenseAir AB, Sweden)

Development of Fiber Bragg Grating Strain Amplification Sensor For Use in Nuclear Power Plants
Jack M Marston and Grzegorz Fusiek (University of Strathclyde, United Kingdom (Great Britain)); Pawel Niewczas (University of Strathclyde & Synaptec Ltd, United Kingdom (Great Britain)); Jiansong Guo (EDF Energy, United Kingdom (Great Britain))

15:30 – 17:30
Instrumentation and Measurement for Advanced Manufacturing
Meeting Room 304
Session Chairs: Eros Gian Alessandro Pasero and Olfa Kanoun

Corroborating Channel Gap Probe Measurements with an Optical Profiler
James Smith (Idaho National Laboratory, USA); Jon Quinn (Keyence, USA); Arvin B. Cunningham (Idaho National Laboratory, USA); Katie Longfellow (INL, USA)

3D Reconstruction Based on 2D ERT Slices in Dredging Engineering
Fanpeng Dong, Yue and Yuwei Zhao (Tianjin University, China)

Adaptive Grinding Planning of Robotic Arms with Self-optimization
Ningyuan Wang, Qiang Wang, Qimin Zhang and Jiulong Xie (Harbin Institute of Technology, China)

A Calibration Method for Light Screen-Based Speed Measurement Devices for Projectile
Lei Du, Qiao Sun and Jie Bai (National Institute of Metrology, China)

Frequency Scanning Interferometry and K-space Clocking with Dispersion Compensating Fibre
Michael A Campbell, Ben Hughes, James Blanchard and Jonathan Heaps (National Physical Laboratory, United Kingdom (Great Britain))

Millimeter Wave Near-Field Evaluation of Moisture Content of Polymeric Filaments Used in Additive Manufacturing
Farzaneh Ahmadi (CNDE, Iowa State University, USA); Mohammad Tayeb Al Qaseer and Reza Zoughi (Iowa State University, USA)

15:30 – 17:30
Instrumentation and Measurement in Medical, Biomedical and Healthcare System
Meeting Room 306
Session Chairs: Bruno Ando and Sabrina Grassini

Estimation of Blood Glucose Level of Human by Measuring Key Parameters in Electrocardiogram
Yu-Hsuan Lin, Cheng-Ru Li and Hsin-Yi Tsai (Taiwan Instrument Research Institute, National Applied Research Laboratories, Taiwan); Cheng-I Chen, Chang-Yuan Liu and Wei-Chung Lee (Singular Wings Medical Limited Company, Taiwan)

Assessing Confidence in Video Magnification Heart Rate Measurement using Multiple ROIs
Diane Geena Elhajjar (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Andrew Law (National Research Council, Canada); Rafik Goubran (Carleton University, Canada); Frank Knoefel (Bruyere Continuing Care, Canada)

An Improved Design of Detection Coil for Magnetic Particle Imaging
Rui Zhang, Shijie Sun and Shaoqi Sun (Beihang University, China); Jian Wei and Xingang Li (Beijing Friendship Hospital, China); Jing Zhong and Lijun Xu (Beihang University, China)

Electromagnetic Design of an Inductive Wireless Power Transfer System for Endoscopic Capsule
Gabriele Bandini, Alice Buffi, Mirko Marracci, Bernardo Tellini, Tommaso Rizzo, Massimo Macucci and Sebastiano Strangio (University of Pisa, Italy); Giuseppe Iannaccone (University of Pisa - Dipartimento di Ingegneria dell'Informazione, Italy)

A Closed-Loop Electrophysiological Hardware Prototype to Estimate and Control Neuronal States
Weitong Liu, Bin Deng and Jiawei Liang (Tianjin University, China); Bo Gong (Tianjin University & School of Electrical and Information Engineering, China); Jixuan Wang, Jiang Wang and Chen Liu (Tianjin University, China)

Analysis of Vibroarthrographic signals for classification of knee disorders using Empirical Wavelet Transform based on Statistical measures
Krishna Sundeep Basavaraju (National Institute of Technology Warangal, India); Kishore T (NIT Warangal, India); Komalla Ashoka Reddy (Kakatiya Institute of Technology & Science, India); RamKumarReddy K (Kakatiya Medical College, India)

15:30 – 17:30
Artificial Intelligence, Machine Learning and Big Data for Instrumentation and Measurement
Meeting Room 305
Session Chairs: Marco Carratù and Federico Tramarin

Development of Sorrow Analysis Dataset for Speech Depression Prediction
Muhammad F. Alghifari (International Islamic University Malaysia & Disruptometer, Malaysia); Teddy Surya Gunawan and Mira Kartiwi (International Islamic University Malaysia, Malaysia)

Classification and Clustering for predicting breathalyzer failures
Ana Gleice da Silva Santos (Inmetro, Brazil); Luiz Carmo (UFRJ, Brazil); Charles do Prado (Instituto Nacional de Metrologia, Brazil)

Calculation of Solid-Phase Fraction in Solid-Liquid Two-phase Flow by Convolutional Neural Network
Yibo Wang and Yue (Tianjin University, China); Tianyi Li (School of Electrical Engineering and Automation, Tianjin University, China)

A Grid-based Sensor Floor Platform for Robot Localization using Machine Learning
Anas Gouda (TU Dortmund University & Chair of Material Handlings and Warehousing, Germany); Danny Heinrich and Mirco Hünnefeld (TU Dortmund University, Germany); Irfan Fachrudin Priyanta (TU Dortmund University & Chair of Material Handlings and Warehousing, Germany); Christopher Reining and Moritz Roidl (TU Dortmund University, Germany)

From cloud AI to embedded AI in cardiac healthcare
Bárbara Nogueira da Costa (Iscte - Instituto Universitário de Lisboa, Portugal); Octavian Adrian Postolache (Instituto de Telecomunicações, Lisboa/IT & Instituto Universitario de Lisboa, ISCTE-IUL, Portugal); John Fontenele Araujo (CB UFRN, Brazil)

Metrological Characterization of a Clip Fastener assembly fault detection system based on Deep Learning
Vincenzo Gallo (University of Salerno, Italy); Irida Shallari (Mid Sweden University, Sweden); Marco Carratù (University of Salerno, Italy); Mattias O'Nils (Mid Sweden University, Sweden)

17:30 - 19:00
Welcome Reception
Conference Hall 3

I²MTC 2023 Technical Schedule – Wednesday

9:00 - 11:00
Image Processing and Vision Based Measurement
Meeting Room 302/303
Session Chairs: Marco Carratù and Chi Hung Hwang

Metrological issues in 3D reconstruction of an archaeological site with aerial photogrammetry
Andrea Gregorini, Nelly Cattaneo and Susanna Bortolotto (Politecnico di Milano, Italy); Serena Massa (Università Cattolica del Sacro Cuore, Italy); Marco Bocciolone and Emanuale Zappa (Politecnico di Milano, Italy)

Long-distance 2D positioning with diffractive large diameter laser beam and camera
Yinrui Su (Hitachi (China), Ltd., China)

Feature Driven Algebraic Reconstruction Technique Algorithm for Electrical Tomography
Ning Liu, Yue and Changhao Xin (Tianjin University, China)

DHA-Net: An encoder-decoder network fusing multi-scale features for optic disc segmentation
Yi He (School of Electrical and Information Engineering & Tianjin University, China); Xuan Zheng and Huaqing Yuan (Tianjin University, China); Yanglin Jiang (Tianjin Eye Hospital Optometry Center, China); Yanbin Xu (Tianjin University, China)

Investigation of Two-Dimensional Temperature Field of Falling Film Based on PLIF
Ting Xue (Tianjin University, China); Haoying Li (Tianjin Uinversity, China); Fangjun Ruan (Tianjin University, China)

Hyperspectral Microscope with Tunable Light Source
Chun-Jen Weng (Taiwan Instrument Research Institute & National Applied Research Laboratories, Taiwan); Chao-Feng Liu (Taiwan Instrument Research Institute, Taiwan); Guo-Hao Lu (Taiwan Instrument Research Institute, Taiwan & National Applied Research Laboratories, Taiwan); Sheng-Lung Huang (Graduate Institute of Photonics and Optoelectronics, National Taiwan University, Taiwan)

9:00 – 11:00
Instrumentation and Measurement for Non-Destructive Testing and Evaluation (IMNDE)
Meeting Room 304
Session Chairs: Chao Tan and James Smith

A novel liquid-level measurement method based on electromagnetic acoustic guided waves
Fulu Liu and Jiyao Li (Beihang University, China); Jun Long (Beijing Institute of Control Engineering, China); Lijun Xu and Yuedong Xie (Beihang University, China)

Quantification method of rail web buried defect using hybrid high-order guided waves
Hongyu Sun (Beijing Jiaotong University, China); Songling Huang, Lisha Peng and Shisong LI (Tsinghua University, China); Fajia Zheng and Qibo Feng (Beijing Jiaotong University, China)

Uncertainty in Material Characterization Using the Hessian and Filled Waveguide Method
Trent D Moritz, Matthew Dvorsky and Mohammad Tayeb Al Qaseer (Iowa State University, USA)

Normal Magnetizing-based Eddy Current Testing Method for Surface Crack and Internal Delamination of Steel Plate
Gongzhe Qiu, Yihua Kang, Jian Tang, Bo Feng, Xiang Cai and Hongbao Ma (Huazhong University of Science and Technology, China)

An electromagnetic decoupling method in eddy current testing
Pu Huang, Hang Pu, Xiaofei Huang, Li Zhiying, Lijun Xu and Yuedong Xie (Beihang University, China)

Extraction of Core Data in Electrical Impedance Tomography (EIT)
Hanyu Zhang and Nan Li (Northwestern Polytechnical University, China)

9:00 – 11:00
Instrumentation and Measurement Systems for Robotics
Meeting Room 306
Session Chairs: Ruqiang Yan and Tommaso Polonelli

Extrinsic Calibration of a Multiple Radar System for Proximity Perception in Robotics
Barnaba Ubezio (University of Klagenfurt, Austria); Hubert Zangl (Alpen-Adria Universität, Austria); Michael Hofbaur (University of Klagenfurt, Austria)

Model-Based Reinforcement Learning for Trajectory Tracking of Musculoskeletal Robots
Haoran Xu, Jianyin Fan and Qiang Wang (Harbin Institute of Technology, China)

Experimental Comparison of UWB and Magnetic Ranging Systems in Robotics Applications
Valerio Brunacci and Alessio De Angelis (University of Perugia, Italy)

Simultaneous AMCW ToF Camera and FMCW Radar Simulation
Harald Gietler and Barnaba Ubezio (University of Klagenfurt, Austria); Hubert Zangl (Alpen-Adria Universität, Austria)

Why Three Measurements are not Enough for Trilateration-based Localisation
Francesco Riz (University of Trento, Italy); Luigi Palopoli (Universita` di Trento, Italy); Daniele Fontanelli (University of Trento, Italy)

WhereAreYou: an UWB relative tracking system for pedestrian using only ranging information
Luca Santoro, Matteo Nardello, Davide Brunelli and Daniele Fontanelli (University of Trento, Italy)

9:00 – 11:00
Instrumentation and Measurement for Communications, IoT, and Industry 4.0
Meeting Room 305
Session Chairs: Gianfranco Miele and Shervin Shirmohammadi

A measurement method for intrusion detection in cyber IoT data stealing attacks
Andrea Amodei and Domenico Capriglione (University of Cassino and Southern Lazio, Italy); Luigi Ferrigno (University of Cassino, Italy); Gianfranco Miele (University of Cassino and Southern Lazio, Italy); Giuseppe Tomasso (University of Cassino, Italy); Gianni Cerro (University of Molise, Italy)

An accurate, CFO-free, phased-based ranging solution using the round-trip CSI
Xin Li, Zengshan Tian, Kaikai Liu and Ze Li (Chongqing University of Posts and Telecommunications, China)

On the Coexistence of LoRa and RF Power Transfer
Dimitrios Zorbas (Nazarbayev University, Kazakhstan); Deirdre Hackett (Tyndall National Institute, Ireland); Brendan O'Flynn (Tyndall National Institude, Ireland)

A MobileNet Neural Network Model for Fault Diagnosis in Roller Bearings
Matteo Intravaia (University of Florence, Italy); Ada Fort, Elia Landi and Marco Mugnaini (University of Siena, Italy); Monica Bianchini (Universita Siena, USA); Barbara T. Corradini, Franco Scarselli, Marco Tanfoni and Filippo Spinelli (University of Siena, Italy)

Finite time-delay estimation for soft sensors modelling Hammerstein Wiener structures
Salvatore Graziani (University of Catania, Italy); Maria Gabriella Xibilia (University of Messina, Italy)

Linear Variable Differential Transformer in Harsh Environments - A Displacement and Thermal Study
Gabriel Gruber, Markus Neumayer, Bernhard Schweighofer and Hannes Wegleiter (Graz University of Technology, Austria); Gerald Klösch, Thomas Leitner and Matthias Berger (Voestalpine, Austria)

11:00 - 11:30
Coffee Break
Conference Hall 3

11:30 - 12:30
J. Barry Oaks Advancement Award Presentation
Auditorium

12:30 - 13:00
Award Ceremony
Auditorium

13:00 - 14:30
Lunch
Conference Hall 2

14:30 - 16:00
Diversity and Inclusion in I&M
Auditorium

Speak with Presence in Person, on Audio and Video: An Interactive Workshop on Communicating Authentically in the 21st Century
J.G. Vellenga and J. Rettele-Thomas

14:30 - 15:30
Poster Session
Conference Hall 3
Session Chairs: Lorenzo Ciani and Reza Zoughi

1: Design and Comparison of Two Lock-In Amplifiers Using Demodulators AD630 and ADA2200
Te Liang (Beihang University, China); Xu Bai (School of Instrumentation and Optoelectronic Engineering Beihang University, China); Peng Suo (Beihang University, China); Wenbin Tian (China Agricultural University, China); Jiangtao Sun and Lijun Xu (Beihang University, China)

2: Light Driven Visual Inspection System for Human Vision
Mohammed Al-Rashdi, Sanush Abeysekera and Melanie Ooi (University of Waikato, New Zealand); Ye Chow Kuang (University of Waikato & Monash University, New Zealand); Vineetha Kalavally (Monash University, Malaysia); Chang Cheng (Monash University Malaysia, Malaysia)

3: Image-based Rail Surface Defect Detection of Line-Structured Light Data
Qingli Luo, Zhiyuan Chen and Shubin Zhang (Tianjin University, China)

4: Phase Segmentation Method of Slug Flow Based on a Convolutional Neural Network
Ting Xue, Bingmei Li and Haixia Wang (Tianjin University, China)

5: Kinect V2 Camera Based Vision System for Robotic Grinding
Qimin Zhang, Qiang Wang, Ningyuan Wang and Jiulong Xie (Harbin Institute of Technology, China)

6: Dynamic Image Reconstruction in Electrical Resistance Tomography Using LVB-KF Algorithm
Yundan Du, Guanghui Liang and Feng Dong (Tianjin University, China)

7: Fall Detection System for Elderly (FDS-E) Using Low-cost Camera Based on LSTM and Openpose
Herti Miawarni (Bhayangkara University, Indonesia); Wijayanti Wijayanti (Universitas Diponegoro, Indonesia); Tri Sardjono and Eko Setijadi (Institut Teknologi Sepuluh Nopember, Indonesia); Mauridhi Hery Purnomo (Institut of Technology Sepuluh Nopember, Indonesia)

8: Laplacian-Based Focus Measure Allows Rapid Focus Estimation of Annular Regions in Gray-scale Images
Ettore Masetti (University of Modena and Reggio Emilia, Italy); Mario Ettore Giardini (University of Strathclyde, United Kingdom (Great Britain)); Marco Ruggeri (University of Miami Miller School of Medicine, USA); Luigi Rovati (University of Modena and Reggio Emilia, Italy)

9: Automatic detection and measurement of white etching layers in deep drilled steels based on thresholding and deep learning algorithms
Simon Strodick (TU Dortmund University - Chair of Materials Test Engineering, Germany); Robert Schmidt, Andreas Zabel and Dirk Biermann (TU Dortmund University - Institute of Machining Technology, Germany); Frank Walther (TU Dortmund University - Chair of Materials Test Engineering, Germany)

10: Development of a low-cost and portable device for Reflectance Transformation Imaging
Amina Vietti and Marco Parvis (Politecnico di Torino, Italy); Nicola Donato (University of Messina, Italy); Sabrina Grassini and Luca Lombardo (Politecnico di Torino, Italy)

11: Automation of Seizure Diary Entry using Mobile-based Application
Nathasha Vp, Rahul Shukla and Sachin Yadav (Indian Institute of Technology Ropar, India); Krishnu R S (IIT Ropar, India); Amanpreet Chander (IIT ROPAR, India); Gagandeep Singh (DMC&H Ludhiana, India); Ashish Kumar Sahani (Indian Institute of Technology Ropar, India)

12: Markerless Visual Recognition of Brazilian Sign Language Alphabet
Silas Luiz Furtado (Military Institute of Engineering, Brazil); Jauvane C. Oliveira (National Laboratory for Scientific Computing, Brazil); Shervin Shirmohammadi (University of Ottawa, Canada)

13: Portable Data Acquisition and Fluidic System for Electrochemical Sensors
Nur Hanisah Azmi (IIUM, Malaysia); Anis Nurashikin Nordin (International Islamic University Malaysia, Malaysia); Muhammad Irsyad Suhaimi (Jabil Circuit Inc, Malaysia); Rosminazuin Ab Rahim (International Islamic University Malaysia, Malaysia); Lai Ming Lim (Jabil Circuit Inc, Malaysia); Mohd Saiful Riza Bashri (International Islamic University Malaysia, Malaysia); Zambri Samsudin (Jabil Circuit Inc, Malaysia)

14: A Study of Binary Excitation Sequences for use in Battery Impedance Spectroscopy
Ahmed Yahia Kallel and Amin Fischer (TU Chemnitz, Germany); Olfa Kanoun (Chemnitz University of Technology, Germany)

15: Thermal Diffusivity Materials Characterization via Active Microwave Thermography
Logan M Wilcox and Kristen M Donnell (Missouri University of Science and Technology, USA)

16: Real-time Automatic Thickness Recognition Using Pulse Eddy Current with Deep Learning
Tian Meng, Lei Xiong, Xinnan Zheng and Zihan Xia (University of Manchester, United Kingdom (Great Britain)); Xiaofei Liu, Yang Tao, Wuqiang Yang and Wuliang Yin (The University of Manchester, United Kingdom (Great Britain))

17: Research on Internal Damage Imaging Based on Laser Ultrasonic Wavenumber Domain Filtering
Hui Zhang, Wanting Wang, Lixin Xu, Jing Sun and Xiaobo Rui (Tianjin University, China)

18: Explainable Damage Models for Functional Ageing Effects in Abraded Copper Coated Textiles
Phillip Petz (University of Applied Sciences Upper Austria, Austria); Christian Biermaier (University Innsbruck, Austria); Josef Scharinger (Johannes Kepler University Linz, Austria); Josef Langer (University of Applied Sciences Upper Austria, Austria)

19: Flow Velocity Computation in Solid-liquid Two-phase Flow by Convolutional Neural Network
Ning Liu, Yue and Yibo Wang (Tianjin University, China)

20: Interoperability Issues in PQ and PMU Measurements for Reduced Inertia Power Systems
Federica Costa (University of Bologna, Italy); Guglielmo Frigo (Federal Institute of Metrology METAS, Switzerland)

21: Solid-Phase Fraction Calculation Based on ERT in Uneven Fields
Yibo Wang, Yue and Ning Liu (Tianjin University, China)

22: Particle swarm calibration for UKF-based vehicle speed estimation with unknown time-varying tire parameters
Bin Li, Jiaxing Lu, Lin Zhang and Hong Chen (Tongji University, China)

23: DELiB: Deep Extreme Learning-Based Health Estimation for Lithium-ion Battery
Murukuri S V S V Vasanth, Paul Akash Gunturu and Aparna Sinha (International Institute of Information Technology Naya Raipur, India); Debanjan Das (IIIT Naya Raipur, India)

24: Cooperative Positioning Algorithms for Estimating Inter-Vehicle Distance Using Multi-GNSS
Morteza Alijani (University of Ghent, Belgium); Andrea Steccanella (Centro Ricerche Fiat (CRF), Italy); Daniele Fontanelli (University of Trento, Italy)

25: IoT-Based Power Monitoring and Lifetime Estimation of a Distribution Transformer in Building Scale
Isa Hafidz (Institut Teknologi Sepuluh Nopember, Indonesia); Ardyono Priyadi and Rachmad Firdhaus Pujiantara (ITS, Indonesia); Nata Khakima Adhuna (Institut Teknologi Sepuluh Nopember, Indonesia); Mauridhi Hery Purnomo (Institut of Technology Sepuluh Nopember, Indonesia)

26: Signal Model Adequacy Indicator For Measurements In LV Grids
Anca Petruta Brincoveanu (University Politehnica of Bucharest, Romania); Efstathios Fiorentis (Polytechnic University of Bucharest Romania, Romania); Ana Maria Dumitrescu and Mihaela Albu (Politehnica University of Bucharest, Romania)

27: High-reporting rate smart metering framework using FIWARE technology
Radu Plamanescu (University Politehnica of Bucharest, Romania); Catalin Deaconescu (MicroDERLab Group, Romania); Grigore Stamatescu (University Politehnica of Bucharest, Romania); Mihaela Albu (Politehnica University of Bucharest, Romania)

28: A New Method For Identifying Harmonic Distortion Compensation Filters For Voltage Transformers
Marco Faifer, Christian Laurano, Roberto Ottoboni and Sergio Toscani (Politecnico di Milano, Italy)

29: Temperature and force characterization of an optical sag sensor for overhead line monitoring
Grzegorz Fusiek and Himanshi Singh (University of Strathclyde, United Kingdom (Great Britain)); Pawel Niewczas (University of Strathclyde & Synaptec Ltd, United Kingdom (Great Britain))

30: Research on the Pressure Drop Prediction Model of Wet Gas in Horizontal Pipe
Dandan Zheng, Simin Shao and Anna Liu (Tianjin University, China); Jianqiang Mei (Tianjin University of Technology and Education, China)

31: Gas holdup measurement for horizontal gas-liquid intermittent flow based on novel ultrasonic attenuation model
Lusheng Zhai, Yukun Huang, Bo Xu and Wenhao Wang (Tianjin University, China)

32: A Study of Downhole Gas Injection Flow Measurement Method
Ying Xu, Shijiao Jia, Chao Yuan and Yu-Meng Zhang (Tianjin University, China); Rongji Zuo (Hebei University, China); Dedong Xue and Chunfeng Zheng (China National Offshore Oil Corporation, China)

33: A Parametric Method for Pulp-Froth Interface Detection by Using ERT Linear Sensor
Ziqiang Cui, Hantao Qu, Ying Xu and Huaxiang Wang (Tianjin University, China)

34: Multilinear Subspace Analysis of State Ensembles in Gas-liquid Two Phase Flow via PWUD Signal
Zhao Li, Shumei Zhang and Feng Dong (Tianjin University, China)

35: Design and Development of Surface Based Air Pollution Measurement and Monitoring System for Climate Computing and Forecasting
Shafiqul Islam (Xavier University of Louisiana, New Orleans, LA USA, USA); David Brooks (IESRE, USA); Morewell Gasseller (Xavier University of Louisiana, USA); Abdulmotaleb El Saddik (University of Ottawa, Canada); Anderson Sunda-Meya (Xavier University of Louisiana, USA)

36: Agile Climate-Sensor Design and Calibration Algorithms Using Machine Learning: Experiments from Cape Point
Amit Kumar Mishra and Travis Barrett (University of Cape Town, South Africa)

37: Uncertainty and Lack of Information Affecting the Training of Machine Learning Algorithms for Fault Prediction of Cable-Joints
Virginia Negri, Alessandro Mingotti, Roberto Tinarelli and Lorenzo Peretto (University of Bologna, Italy)

38: An enhanced Smart Sampling algorithm based on Deep Learning
Vincenzo Gallo, Marco Carratù, Salvatore Dello Iacono and Vincenzo Paciello (University of Salerno, Italy); Gustavo Monte (UTN Facultad Regional Del Neuquen, Argentina); António Espírito Santo (University of Beira Interior, Portugal)

39: Sensitivity matrix update method based on Residual Attention Fusion Network
Chao Wang, Linshuo Zhao, Ran Pang and Jiamin Ye (Tianjin University, China)

40: Sparsity-based Compressed Covariance Sensing for Spectrum Reconstruction in Blade Tip Timing
Jiahui Cao, Shaohua Tian, Zhibo Yang and Xuefeng Chen (Xi'an Jiaotong University, China); Shuming Wu (Xi an Jiaotong University, China)

41: Anomaly Detection on Industrial Electrical Systems using Deep Learning
Marco Carratù and Vincenzo Gallo (University of Salerno, Italy); Antonio Pietrosanto (University of Salerno & CEO of Metering Research srl, Italy); Paolo Sommella (University of Salerno, Italy); Gabriele Patrizi, Alessandro Bartolini, Lorenzo Ciani, Marcantonio Catelani and Francesco Grasso (University of Florence, Italy)

42: Improving Power Quality measurements using deep learning for disturbance classification
Gabriele Patrizi, Carlos A. Iturrino, Alessandro Bartolini, Francesco Ermini, Libero Paolucci, Lorenzo Ciani, Francesco Grasso and Marcantonio Catelani (University of Florence, Italy)

43: An innovative method for log diameter measurements based on deep learning
Vincenzo Gallo, Marco Carratù and Consolatina Liguori (University of Salerno, Italy); Antonio Pietrosanto (University of Salerno & CEO of Metering Research srl, Italy); Mattias O'Nils and Jan Lundgren (Mid Sweden University, Sweden)

44: Explainable machine learning for motor fault diagnosis
Yuming Wang and Peng Wang (University of Kentucky, USA)

45: Wear Prediction of Petrochemical Granulator Gearbox Using Multiscale Temporal Convolutional Network via Online Oil Monitoring
Guo Yang and Hui Tao (South China University of Technology, China); Ruxu Du (Guangdong Janus Biotechnology Co. Ltd, China); Yong Zhong (South China University of Technology, China)

46: MCAN: Interpretable Multi-scale Component Analysis Network for Mechanical Fault Diagnosis
Fuhua Qin and Shiao Wang (The State Key Laboratory for Manufacturing Systems Engineering, Xian Jiaotong University, China); Shibin Wang (The State Key Laboratory for Manufacturing Systems Engineering, Xi'an Jiaotong University, China); Zhibin Zhao (The State Key Laboratory for Manufacturing Systems Engineering Xi'an Jiaotong University, China); Ruqiang Yan (Xi'an Jiaotong University, China); Xuefeng Chen (Xian Jiaotong University, China)

47: Gradient-Based Interpretability Graph Convolutional Network for Bearing Fault Diagnosis
Kairu Wen, Ruyi Huang, Dongpeng Li, Zhuyun Chen and Weihua Li (South China University of Technology, China)

48: Accurate Time Synchronization in a low-cost platform for the Design of a Distributed Digital Events Detector
Stefano Rinaldi, Alessandro Depari, Paolo Ferrari, Alessandra Flammini, Alessandro Musatti and Emiliano Sisinni (University of Brescia, Italy)

49: Noise and Uncertainty Analysis for Time and Frequency Domain Vibration Measurements using Acceleration Sensors
Markus Neumayer and Thomas Bretterklieber (Graz University of Technology, Austria)

50: Performance Evaluation of Simple Digital Measurement Platform for Remotely-Located RTD Applications
Elangovan K and Chandrika Sreekantan Anoop (Indian Institute of Space Science and Technology, India)

15:30 - 16:00
Coffee Break
Conference Hall 3

16:00 - 18:00
SPS: Applied AI for measurement uncertainty and decision making in machine intelligent diagnosis
Meeting Room 302/303
Session Chairs: Xingwu Zhang and Lee Barford

Decision Boundary Expansion For Open Set Fault Diagnosis
Yu Zhao (Xian Jiaotong University, China); Xingwu Zhang (State Key Laboratory for Manufacturing System Engineering, China); Ruqiang Yan (Xi'an Jiaotong University, China); Xuefeng Chen (Xian Jiaotong University, China)

Lithium-ion battery pack on-line health diagnosis based on multi statistical model fusion
Yuchen Song and Datong Liu (Harbin Institute of Technology, China); Yu Peng (Harbin Institute of Technology, HIT, China)

Time series fragmental variation trend anomaly detection method based on a temporal sequential modeling approach
Yingqi Wang, Shengwei Meng, Yuchen Song and Datong Liu (Harbin Institute of Technology, China)

A Fault Detection Method for Railway Turnout with Convex Hull-based One-Class Tensor Machine
Chen Chen (Tongji University & City University of Hong Kong, Hong Kong); Zhongwei Xu (Tongji University, China); Haidong Shao (Hunan University, China); Kai Huang (Jimei University, China); Qiaochuan Chen (Shanghai University, China); Meng Mei (Tongji University, China)

Machine Learning-based Explainable Stator Fault Diagnosis in Induction Motor using Vibration Signal
Aparna Sinha (International Institute of Information Technology Naya Raipur, India); Debanjan Das (IIIT Naya Raipur, India)

Multiscale Deep Attention Reinforcement Learning for Imbalanced Fault Diagnosis of Gearbox Under Multi-Working Conditions
Hui Wang (Southeast University, China); Zheng Zhou, Ruqiang Yan and Liuyang Zhang (Xi'an Jiaotong University, China)

16:00 – 18:00
Instrumentation and Measurement for Non-Destructive Testing and Evaluation (IMNDE)
Meeting Room 304
Session Chairs: Bo Feng and James Smith

Total Variation Regularized Sparse Tensor Decomposition for Eddy Current Pulsed Thermography Sequence Processing
Zhonghua Xiong, Libing Bai, Yiping Liang, Lulu Tian and Cong Chen (University of Electronic Science and Technology of China, China); Yuhua Cheng (University of Electronic Science and Technology of China & School of Automation Engineering, China)

Improved Quantification of Defect Cross-Section for Active Microwave Thermography
Logan M Wilcox and Kristen M Donnell (Missouri University of Science and Technology, USA)

Analysis of the Liftoff Effect in Motion-induced Eddy Current Testing
Bo Feng and Shuangnan Xie (Huazhong University of Science and Technology, China); Lian Xie (Universidade de Lisboa, Portugal); Kangxuan Deng, Shenghan Wang and Yihua Kang (Huazhong University of Science and Technology, China)

Sample Considerations for Short-Circuited Filled Transmission Line Measurements
Jared Sinkey, Alexander Hook and Kristen M Donnell (Missouri University of Science and Technology, USA)

Inspection of Defects Depth for Stainless-Steel Sheets Using 4-coil Excitation Sensor with 1D CNN
Saibo She (The University of Manchester, United Kingdom (Great Britain)); Xinnan Zheng, Kuohai Yu, Tian Meng and Yuchun Shao (University of Manchester, United Kingdom (Great Britain)); Wuliang Yin (The University of Manchester, United Kingdom (Great Britain))

Bearing Ball Property Estimation using Multi-frequency Eddy-current Testing
Zihan Xia and Gang Hu (University of Manchester, United Kingdom (Great Britain)); Ruochen Huang (Fuzhou University, China); Xiaofei Liu (The University of Manchester, United Kingdom (Great Britain)); Anthony Peyton (University of Manchester, United Kingdom (Great Britain)); Wuliang Yin and Wuqiang Yang (The University of Manchester, United Kingdom (Great Britain))

16:00 – 18:00
Instrumentation and Measurement for the Automotive, Transportation Industry, and Robotics
Meeting Room 306
Session Chairs: Max Cortner and Daniele Fontanelli

A method for the estimate erroneous fog detection in automotive LiDAR
Davide Cassanelli (Università degli studi di Modena e Reggio Emilia, Italy); Stefano Cattini (University of Modena and Reggio Emilia, Italy); Luca Ferrari (CNH Industrial, Italy); Luigi Rovati (University of Modena and Reggio Emilia, Italy)

A test bed for in-laboratory calibration of optical-based speedometers
Andrea Bernieri (University of Cassino, Italy); Gianluca Iannitti (University of Cassino and Southern Lazio, Italy); Marco Laracca (Sapienza University of Rome, Italy); Gianfranco Miele (University of Cassino and Southern Lazio, Italy); Silvia Sangiovanni (Sapienza University of Rome, Italy)

Assessing Driver Gaze Location in a Dynamic Vehicle Environment
Aidan Lochbihler (Carleton University, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada); Kathleen Van Benthem, Chris Herdman, Will Sloan and Kirsten Brightman (Carleton University, Canada); Frank Knoefel (Bruyere Continuing Care, Canada); Shawn Marshall (Ottawa Hospital, Canada)

GPS-Aided Odometry Navigation for IAVs: An Assessment of Integration Topologies and Odometry Mounting Configurations
Felipe Oliveira Silva and Victor Hugo Leite Pereira (Federal University of Lavras, Brazil)

Robot-based measurement system for double-sided inspection of optical components
Daniel Wertjanz, Thomas Kern and Ernst Csencsics (TU Wien, Austria); Georg Schitter (Vienna University of Technology, Austria)

A Robot Hand with Capacitive Tactile Sensor for Object Recognition using Support Vector Machine
Xiaofei Liu and Wuqiang Yang (The University of Manchester, United Kingdom (Great Britain)); Fan Meng and Tengchen Sun (Tashan Technology Co. Ltd, China)

16:00 – 18:00
Sensors and Transducers
Meeting Room 305
Session Chairs: Bruno Ando and Katie Brinker

Force sensing utilizing a CoFeSiB microwire: a preliminary experimental study
Gianluca Caposciutti, Alessandro Spalletta, Mirko Marracci and Bernardo Tellini (University of Pisa, Italy); Carlo Trigona and Salvatore Baglio (University of Catania, Italy)

A Capacitive ppmv Moisture Sensor with Hybrid Oxide-Polymer Sensing Film
Uzma Salmaz (JAMIA MILLIA ISLAMIA NEW DELHI, India); Tarikul Islam (Jamia Millia Islamia University, India); Suriani Ibrahim (University of Malaya, Malaysia)

Electromagnetic Induction Sensing of Soil Dielectric Permittivity and Electrical Conductivity from 10 MHz to 30 MHz
Dorijan Špikić, Matija Švraka and Darko Vasić (University of Zagreb, Croatia)

Design of a Windowed Sinc for a Simplified Characterization of Low-Power Current Transformers
Christian Betti, Alessandro Mingotti, Roberto Tinarelli and Lorenzo Peretto (University of Bologna, Italy)

Mass Flow Measurement of Slurry Using Coriolis Flowmeters
Wasif Shafaet Chowdhury and Yong Yan (University of Kent, United Kingdom (Great Britain)); Jingqiong Zhang (University of Sheffield, United Kingdom (Great Britain)); Marc-Antony Coster-Chevalier and Jinyu Liu (KROHNE Ltd, United Kingdom (Great Britain))

19:00 - 22:00
Gala Dinner
Grand Hyatt: Grand Ballroom

I²MTC 2023 Technical Schedule – Thursday

8:30 - 10:30
Signal Processing for Instrumentation and Measurement
Meeting Room 302/303
Session Chairs: Michele Magno and Antonio Moschitta

Nonparametric Frequency Estimation Below Two Signal Periods Using Two Windows and DFT
Dušan Agrež (University of Ljubljana, Slovenia)

Fast-settling Onboard Electrochemical Impedance Spectroscopy System Adopting Quasi-linear-phase Band-pass filter
Young-Nam Lee and Kyung-Sik Choi (Korea Advanced Institute of Science and Technology (KAIST), Korea (South)); Seong-Won Jo (Autosilicon Company, Korea (South)); Gul Rahim (Autosilicon Company, Pakistan); Kyeongha Kwon (KAIST, Korea (South)); Sang-Gug Lee (Korea Advanced Institute of Science and Technology (KAIST), Korea (South))

Localization of Electrodes based on Resistance Measurements
Sabrina Affortunati (Johannes Kepler University, Austria); Bernhard G. Zagar (University of Linz, Austria)

Gradient-Guided Multi-Modal Image Reconstruction for Electrical Impedance Tomography
Zhe Liu, Huazhi Dong and Zhou Chen (The University of Edinburgh, United Kingdom (Great Britain)); Yunjie Yang (University of Edinburgh, United Kingdom (Great Britain))

Instrumented Milling Process and Analysis for Tool Wear Measurement
Dimitar Ninevski (University of Leoben, Austria); Yitzchak Yifrach (College of Engineering Karmiel, Israel); Paul O'Leary (University of Leoben, Austria)

Unipolar Excitation Signal with Two Phases for Impedance Spectroscopy of Li-ion battery cells
Ahmed Yahia Kallel (TU Chemnitz, Germany); Hanen Nouri (Technische Universität Chemnitz & Fakultät für Elektrotechnik und Informationstechnik, Germany); Thomas Keutel (University of Technology, Germany); Hamza Boughanmi (Measurement and Sensor Technology, Germany); Amin Fischer (TU Chemnitz, Germany); Olfa Kanoun (Chemnitz University of Technology, Germany)

8:30 – 10:30
Advances in Measurement Theory and Metrology; and Circuits and Embedded Systems for Instrumentation and Measurement
Meeting Room 304
Session Chairs: James Smith and Luigi Rovato

A Propagation-model Empowered Solution for Blind-Calibration of Sensors
Amit Kumar Mishra (University of Cape Town, South Africa)

Impulse Train Test Accuracy versus Resources for Evaluation of Supraharmonics Assessment Methods
Philippe Blanchard (Université du Québec à Trois-Rivières, Canada); Manouane Caza-Szoka (Universite du Quebec a Trois-Rivieres, Canada); Roger Bergeron (Les Services Électrigenies, Canada); Daniel Massicotte (Universite du Quebec a Trois-Rivieres, Canada)

Enhanced Digital Interface Circuit for Three-wire Connected Resistance Thermometers
Elangovan K and Chandrika Sreekantan Anoop (Indian Institute of Space Science and Technology, India)

Shock Tolerated Low Noise Analog Front-End for Milliamp Measurement on a Low Resistance Shunt
Shaoyang Wang, Mingli Chen and Y. DU (The Hong Kong Polytechnic University, Hong Kong)

A Non-Volatile Memory Emulation Tool and its Use in Analyzing eMMC-based Devices
Maria Varsamou, Eleni Bougioukou, Nikolaos Toulgaridis and Theodore A. Antonakopoulos (University of Patras, Greece)

Neuron Model Database for Arm-Based Multi-Core Neuromorphic Computing
Bo Gong (Tianjin University & School of Electrical and Information Engineering, China); Jiang Wang, Siyuan Chang, Jixuan Wang, Weitong Liu and Xile Wei (Tianjin University, China)

8:30 – 10:30
Machine Learning and Big Data for Instrumentation and Measurement
Meeting Room 306
Session Chairs: Marco Carratù and Juan Manuel Ramirez Cortes

LSTM-based hand thermal recovery analysis using infrared and RGB-visual imagery
Ayari Rodas-Flores (National Institute of Astrophysics Optics and Electronics, Mexico); Juan M. Ramirez-Cortes (INAOE, Mexico); Pilar Gomez-Gil (National Institute of Astrophysics, Optics and Electronics, Mexico)

Multi-compartment structure optimizes the deep learning network from the biophysical perspective
Jixuan Wang, Bin Deng and Tianshi Gao (Tianjin University, China); Bo Gong (Tianjin University & School of Electrical and Information Engineering, China); Weitong Liu (Tianjin University, China); Jiang Wang (Tianjin University, USA); Chen Liu (Tianjin University, China)

GRNN-based hydraulic hose bulk modulus measurement and prediction method
Tengfei Ma and Bin Wang (Nanjing University of Aeronautics and Astronautics, China)

Battery Remaining Useful Life Prediction Supported by Long Short-Term Memory Neural Network
Emil Petkovski, Loredana Cristaldi, Marco Faifer and Iacopo Marri (Politecnico di Milano, Italy)

Deep Learning Based Dual-Modality Fusion for TMR-EMT/ERT
Jiamin Ye, Maomao Xie and Chao Wang (Tianjin University, China)

A Rayleigh-Ritz Autoencoder
Paul O'Leary, Anika Terbuch and Dimitar Ninevski (University of Leoben, Austria); Elias Jan Hagendorfer (Materials Center Leoben Forschung GmbH, Austria); Elke Schlager (Know-Center GmbH, Austria); Andreas Windisch (Know-Center & Washington University in St. Louis, Austria); Christoph Schweimer (Know-Center GmbH, Austria)

8:30 – 10:30
Instrumentation and Measurement for Oil and Gas Industry, Chemical and Biological Quantities, and Agriculture, Food Production and Food Safety
Meeting Room 305
Session Chairs: Chao Tan and Sabrina Grassini

On the feasibility of a portable electrochemical measuring system for the on-site measurement of cannabinoids
Alessandro Monari (University of Modena and Reggio Emilia, Italy); Chiara Zanardi (Ca Foscari University, Italy); Loris Bruzzi, Barbara Zanfrognini, Stefano Cattini, Luigi Rovati and Laura Pigani (University of Modena and Reggio Emilia, Italy)

Automatic classification and permittivity estimation of glycerin solutions using a dielectric resonator sensor and Machine Learning techniques
Miguel Monteagudo Honrubia, Francisco Javier Herraiz-Martínez and Javier Matanza (Universidad Pontificia Comillas, Spain)

FCN-Based Method for Phase Fraction Measurement of Oil-Gas-Water Three-Phase Flow
Sijie Ma, Xuewei Shi, Chao Tan and Feng Dong (Tianjin University, China)

Hidden Markov Model Based Status Monitoring for Gas-liquid Two-phase Flow in Horizontal Pipe
Liyuan Zhang, Wentao Wu and Feng Dong (Tianjin University, China)

Detection of Ripening stage of Banganapalle Mango using KNN method on PCA-reduced EIS Data
Dibakar Roy and Avishek Adhikary (Indian Institute of Technology Bhilai, India)

On machine learning methods to estimate cannabidiolic acid content of Cannabis sativa L. from near-infrared hyperspectral imaging
Wayne Holmes (Unitec Institute of Technology, New Zealand); Melanie Ooi (University of Waikato, New Zealand); Ye Chow Kuang (University of Waikato & Monash University, New Zealand); Serge Demidenko (Sunway University, Malaysia); Ray Simpkin (Callaghan Innovation, New Zealand); Sanush Abeysekera (University of Waikato, New Zealand)

10:30 - 11:00
Thursday AM Break
Conference Hall 3

11:00 - 12:00
Keynote Speaker: Sharul A Rashid
Auditorium

12:00 - 13:00
Lunch
Conference Hall 2

13:00 - 15:00
Signal Processing for Instrumentation and Measurement; and SPS: Edge Computing for Smart and Low Power Sensing in Emerging Applications
Meeting Room 302/303
Session Chairs: Michele Magno and Antonio Moschitta

Fast and accurate object recognition based on tactile data by using Dendrite Net
Haonan Liang, Tianshi Gao, Tian Gao, Jiangtao Luo, Jiang Wang and Bin Deng (Tianjin University, China)

Time-Frequency Analysis using V-band Radar for Drone Detection and Classification
Ian WK Lam (Carleton University, Canada); Shashank Pant (National Research Council Canada, Canada); Max Manning, Michael Kubanski and Peter Fox (AiRadar Inc., Canada); Sreeraman Rajan (Carleton University, Canada); Prakash Patnaik (NRC, Canada); Bhashyam Balaji (Defence R&D Canada, Ottawa Research Center, Canada)

Fault Diagnosis of ERT System Based on Choquet Integral
Kun Li, Yue, Fanpeng Dong and Ying Xu (Tianjin University, China)

Tiny compensation of pressure drift measurements due to long exposures to high temperatures
Danilo Pietro Pau (STMicroelectronics, Italy); Paola Vitolo and Gian-Domenico Licciardo (University of Salerno, Italy); Massimiliano Pesaturo, Stefano Bosco and Santo Pennino (STMicroelectronics, Italy)

Low-cost Smart Raven Deterrent System with Tiny Machine Learning for Smart Agriculture
Seonyeong Heo (ETH Zurich, Switzerland); Nicolas Baumann (ETH Zürich, Switzerland); Carla Margelisch, Marco Giordano and Michele Magno (ETH Zurich, Switzerland)

Adapted Compressed Sensing with Incremental Encoder and Deep Performance Predictor for Low-Power Sensor Node Design
Alex Marchioni, Filippo Martinini and Livia Manovi (University of Bologna, Italy); Silvano Cortesi (ETH Zurich, Switzerland); Riccardo Rovatti (University of Bologna, Italy); Gianluca Setti (KAUST Jeddah, Saudi Arabia); Mauro Mangia (University of Bologna, Italy)

13:00 – 15:00
Instrumentation and Measurement in Environmental Monitoring and in Medical, Biomedical and Healthcare Systems
Meeting Room 304
Session Chairs: Yong Yan and Octavian Postolache

Noise Floor Characterization in Accelerometers for Earthquake Monitoring
Vincenzo Gallo, Daniele Buonocore, Marco Carratù, Salvatore Dello Iacono and Vincenzo Paciello (University of Salerno, Italy)

Analysis of Arctic Buoy Dynamics using the Discrete Fourier Transform and Principal Component Analysis
James H Hepworth and Amit Kumar Mishra (University of Cape Town, South Africa)

Weighing Cylinder Instrument with Controlled De-Icing for Ice Accretion Measurements
Eero O. Molkoselkä, Ville Kaikkonen and Anssi Mäkynen (University of Oulu, Finland)

An Affordable EOG-based Application for Eye Dystonia Evaluation
Alberto López Martínez (University of Oviedo, Spain); Saeed Mian Qaisar (LINEACT CESI, France); Francisco Ferrero Martín (University of Oviedo, Spain); Humaira Nisar (Universiti Tunku Abdul Rahman, Malaysia)

Online processing for motor imagery-based brain-computer interfaces relying on EEG
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); Nicola Moccaldi (University of Naples Federico II, Italy); Angela Natalizio and Marco Parvis (Politecnico di Torino, Italy)

An Intra-oral EEG System with Accelerometer For Motion Artifact Free EEG Recording
Shibam Debbarma and Sharmistha Bhadra (McGill University, Canada)

13:00 – 15:00
Instrumentation and Measurement for Physical and Electromagnetic Quantities
Meeting Room 306
Session Chairs: Kamel Haddadi and Consolatina Liguori

Machine Learning-Based Monostatic Microwave Radar for Building Materials Classification
Nawal Alsaleh (University of Lille, France); Denis Pomorski (Université des Sciences et Technologies de Lille, France); Mohamed Sebbache (IEMN CNRS, France); Kamel Haddadi (University of Lille / IEMN CNRS8520, France)

Trap Dynamic Detection of GaN HEMT under Repetitive Short Circuit Degradation
Wenjuan Mei, Chaowu Pan and Zhen Liu (University of Electronic Science and Technology of China, China); Qi Zhou (University of ELectronic Science and Technology of China, China); Yuanzhang Su and Yusong Mei (University of Electronic Science and Technology of China, China)

Optimization of Electrostatic Sensors for Rotational Speed Measurement
Xuanda Liu (North China Electric Power University, China); Yong Yan (University of Kent, United Kingdom (Great Britain)); Yonghui Hu (North China Electric Power University, China); Lijuan Wang (University of Kent, United Kingdom (Great Britain))

An Enhanced Voltage Amplifier Scheme Insensitive to Cable Parasitic Capacitance for Interfacing Piezoelectric Sensors
Byju C (Centre for Development of Advanced Computing (C-DAC),Thiruvananthapuram, Kerala ,India); Vijayakumar Sreenath (Indian Institute of Technology Palakkad, India)

Study of Methanol Concentration Effect in Direct Methanol Fuel Cells by Electrochemical Impedance Spectroscopy
Elena Giordano (Politecnico di Torino, Italy); Andrea Zaffora (Università degli Studi di Palermo, Italy); Leonardo Iannucci (Politecnico di Torino, Italy); Monica Santamaria (Università degli Studi di Palermo, Italy); Sabrina Grassini (Politecnico di Torino, Italy)

A Comparative Investigation of Deformation Transducers Based on Bacterial Cellulose and Different Ionic Liquids
Santhosh Kurukunda, Salvatore Graziani and Carlo Trigona (University of Catania, Italy); Giovanna Di Pasquale (Università degli Studi di Catania, Italy); Antonio Pollicino (University of Catania, Italy); Kaija Põhako-Esko (University of Tartu, Italy); Alvo Aabloo (IMS Lab, Institute of Technology, University of Tartu, Estonia)

13:00 – 15:00
Data Acquisition and Real-time Measurement Systems; and Instrumentation and Measurement for Physical and Electromagnetic Quantities
Meeting Room 305
Session Chairs: Luca De Vito and Paolo Carbone

Dynamic Modeling and Simulation of Multiple Piezoelectric Magnetic Fans (MPMF) for Electronic Cooling System
Robiah Ahmad (Universiti Teknologi Malaysia, Malaysia); Fadhilah Abdul Razak and Shamsul Sarip (UTM Kuala Lumpur, Malaysia); Kushsairy Kadir (Universiti Kuala Lumpur British Malaysian Institute, Malaysia)

Normal Vector Direction-based 3D LiDAR Point Cloud Planar Surface Removal for Object Cluster Minimization in Human Activity Monitoring System
Nova Eka Budiyanta (Institut Teknologi Sepuluh Nopember, Indonesia); Eko Mulyanto Yuniarno (Institut Teknologi Sepuluh November, Indonesia); Tsuyoshi Usagawa (Kumamoto University, Japan); Mauridhi Hery Purnomo (Institut of Technology Sepuluh Nopember, Indonesia)

One-Bit Time-domain Sensing in Microwave Resonators
Paolo Carbone, Marco Dionigi, Alessio De Angelis, Antonio Moschitta and Francesco Santoni (University of Perugia, Italy)

Enhancement of Quality Factor in ST-cut Quartz Surface Acoustic Wave Devices by using Different Numbers of IDTs and Wavelengths for gas sensing
Aliza Aini Md Ralib (International Islamic University Malaysia, Malaysia); Nur Fatin Mohamad Razali (IIUM, Malaysia); Matthieu Chatras (Université de Limoges, France); Anis Nurashikin Nordin (International Islamic University Malaysia, Malaysia); Arnaud Pothier (Univ Limoges - CNRS - XLIM UMR7252, France); Farah Abdul Rahman (International Islamic University Malaysia, Malaysia); Damien Passerieux (University of Limoges, France); Cyril Guines (XLIM - Université de Limoges, UMR CNRS, France)

Quantitative Surface Potential Measurements by AC Electrostatic Force Microscopy
Thomas Hackl and Mathias Poik (TU Wien, Austria); Georg Schitter (Vienna University of Technology, Austria)

Study on Voltage Influence on FPGA-Based Time-to-Digital Converters
Xinchi Xu and Yonggang Wang (University of Science and Technology of China, China)

15:00 - 16:00
Coffee Break
Conference Hall 3

15:00 - 16:00
Poster Session
Conference Hall 3
Session Chairs: Katie Brinker and Kurt Barbe

1: Improved genetic inversion algorithm for ultrasonic measurement of liquid droplet distribution
Jianqiang Mei (Tianjin University of Technology and Education, China); Dandan Zheng (Tianjin University, China)

2: Studies on Linearizing Direct-Digital Converter Schemes for Thermistors
Thomaskutty Mathew, Simhadri Nani and Chandrika Sreekantan Anoop (Indian Institute of Space Science and Technology, India); Vineeth Bala Sukumaran (Indian Institute of Space Science and Technology, Trivandrum, India)

3: Corrupted Data Recovering for Electrical Capacitance Tomography Based on RPCA
Jiamin Ye and Chaoyuan Jiang (Tianjin University, China); Qiang Zhang (Petrochina Southwest Oil and Gas Field Company, China)

4: DBH Extraction of Standing Trees Based on a Binocular Vision Method
Keyi Fu and Yue (Tianjin University, China)

5: An ML pipeline for real-time activity detection on low computational power devices for metaverse applications
Amit Kumar (Indian Institute of Technology, Ropar, Rupnagar, Punjab, India); Amanpreet Chander (IIT ROPAR, India); Ashish Kumar Sahani (Indian Institute of Technology Ropar, India)

6: Demonstration of Measurement Method based on Under-sampling for mmWave Radio Communication Signals
Masatsugu Shimoda, Sou Uchiumi, Shouta Kanno and Akihito Otani (Nihon University, Japan)

7: Ambient-Aware Sound-Based Production Counter for Manufacturing Machines
Boon Yaik Ooi (UTAR, Malaysia); Woan Lin Beh and Soung Yue Liew (Universiti Tunku Abdul Rahman, Malaysia); Shervin Shirmohammadi (University of Ottawa, Canada)

8: Evolutionary Optimization of Neuromorphic Architecture for Low-power Cerebellum Prosthetic Instrumentation and Device in Biomedical Systems
Shuangming Yang and Haowen Wang (Tianjin University, China); Mostafa Rahimi Azghadi (James Cook University, Australia)

9: Realize High Dynamic Range qPCR System by Visualized Fluorescent Intelligent Frame Selection calculus and Precise Photothermal Control
Ching-Ching Yang, Chun-Han Chou, Liang-Chieh Chao, Hsin-Yi Tsai and Yu-Hsuan Lin (Taiwan Instrument Research Institute, National Applied Research Laboratories, Taiwan); Dar-Bin Shieh (National Cheng Kung University & NCKU Hospital, Taiwan); Cheng-Ru Li (Instrument Technology Research Center, National Applied Research Laboratories, Taiwan)

10: Metrological Quality Assurance of Automated Solid Phase Extraction in Compound Oriented Measurements
Heidi Fleischer, Thomas Roddelkopf and Sybille Horn (University of Rostock, Germany); John Fuller (Beckman Coulter Life Sciences, Germany); Kerstin Thurow (Center for Life Science Automation - CELISCA, Germany)

11: Machine Learning Approach to Classify Postural Sway Instabilities
Bruno Ando, Salvatore Baglio, Valeria Finocchiaro and Vincenzo Marletta (University of Catania, Italy); Sreeraman Rajan and Ebrahim Nehary (Carleton University, Canada); Valeria Dibilio and G. Mostile (AOU Policlinico Vittorio Emanuele of Catania, Italy); M. Zappia (University of Catania, Italy)

12: EEG Signal based Schizophrenia Recognition by using VMD Rose Spiral Curve Artificial Butterfly Optimization and Machine Learning
Sibghatullah I Khan (Sreenidhi Institute of Science and Technology Hyderabad & JNTU Hyderabad, India); Saeed Mian Qaisar (LINEACT CESI, France); Alberto López Martínez (University of Oviedo, Spain); Humaira Nisar (Universiti Tunku Abdul Rahman, Malaysia); Francisco Ferrero Martín (University of Oviedo, Spain)

13: Estimation of knee flexion features using foot motion data from in-shoe motion sensors
Kazuki Ihara, Chenhui Huang, Zhenwei Wang, Fumiyuki Nihey, Kenichiro Fukushi, Hiroshi Kajitani, Yoshitaka Nozaki and Kentaro Nakahara (NEC Corporation, Japan)

14: Modeling Changes in Electrical Properties of Tissues Under Low Intensity Focused Ultrasound
Pengyu Yin, Shengnan Zhang, Yanbin Xu and Feng Dong (Tianjin University, China)

15: Acquiring Photoplethysmography (PPG) Signal Without LED
Shahab Mahmoudi Sadaghiani and Sharmistha Bhadra (McGill University, Canada)

16: Spirometer and sEMG respiratory patterns for clinical decision support system
Amit K Kumar (Beijing Institute of Technology, China); Mansour H Assaf (University of South Pacific & Faculty of Science & Technology, Fiji); Voicu Groza and Emil M. Petriu (University of Ottawa, Canada)

17: Machine Learning to Determine Handle Force and Direction Using Strain Gauge Measurements
Bahareh Chimehi (Carleton University & AGE-WELL NIH SAM3, Canada); Bruce Wallace (AGE-WELL NIH SAM3 & Carleton University, Canada)

18: Depth Detection of Pressure Ulcers Using Electrical Impedance Tomography
Tianxiao Song, Yanbin Xu, Qingwei Hu, Feng Dong and Sitong Chen (Tianjin University, China)

19: A Multiplexed Sonomyography System for Proprioceptive Proportional Control of Biomechatronic Interfaces
Anne Tryphosa Kamatham (Indian Institute of Technology Delhi, India); Azadeh Shariati and Helge Arne Wurdemann (University College London, United Kingdom (Great Britain)); Biswarup Mukherjee (Indian Institute of Technology Delhi, India)

20: A virtual reality based system for a more engaging indoor exercise biking experience
Amanpreet Chander (IIT ROPAR, India); Abhinav Airan (Magnimus Systems Private Limited, India); Ashish Kumar Sahani (Indian Institute of Technology Ropar, India)

21: Optimising Multi-Wavelength Attenuation-Based Length Sensors
Hayden Randles (University of Auckland, New Zealand)

22: Development of an Optical Pressure Sensing Array: Initial Validation
Alistair Newcombe (University of Auckland & Auckland Bioengineering Institute, New Zealand)

23: Robust Time-Based Finite-Rate-of-Innovation Sampling Method and Hardware Implementation
Ning Fu, Hongyi Zhang and Liyan Qiao (Harbin Institute of Technology, China)

24: Comparing Different Feature Extraction Methods in Condition Monitoring Applications
Payman Goodarzi, Steffen Klein and Andreas Schütze (Saarland University, Germany); Tizian Schneider (Saarland University & Center for Mechatronics and Automation Technology (ZeMA), Germany)

25: Asymptotic Properties of a One-bit Estimator of Parametric Signals
Paolo Carbone (University of Perugia, Italy); Johan Schoukens (Vrije Universiteit Brussel, Belgium); Alessio De Angelis, Antonio Moschitta and Francesco Santoni (University of Perugia, Italy)

26: Assessment of Sparse Fourier Transform for Spectral Measurements
Pasquale Daponte, Luca De Vito, Francesco Picariello, Sergio Rapuano and Ioan Tudosa (University of Sannio, Italy)

27: Measurement of bubble velocity distribution in horizontal gas-liquid slug flow by single-layer wire-mesh sensor
Junwen Yin, Ningde Jin, Lusheng Zhai, Wenhao Wang and Bo Xu (Tianjin University, China)

28: Health Status Remote Monitoring System: ECG Peaks Detection by Successive Thresholding Algorithm Employing Envelope Function
Valentina Di Pinto, Federico Tramarin and Luigi Rovati (University of Modena and Reggio Emilia, Italy)

29: Comparison of Explainable Machine Learning Algorithms for Optimization of Virtual Gas Sensor Arrays
Yannick Robin, Johannes Felix Amann and Payman Goodarzi (Saarland University, Germany); Tizian Schneider (Saarland University & Center for Mechatronics and Automation Technology (ZeMA), Germany); Andreas Schütze and Christian Bur (Saarland University, Germany)

30: A time-of-flight estimation method based on central frequency matching for ultrasonic flowmeters
Yizhou Jiang, Yong Bao, Shangjie Ren, Feng Dong and Chao Tan (Tianjin University, China)

31: Inductor-less FO Low-pass Notch Filter with High Q and High Attenuation for ECG Signal Processing
Agniv Tapadar and Avishek Adhikary (Indian Institute of Technology Bhilai, India)

32: Robot-based measurement of comfort through thermal infrared imaging and wearable sensors
Vittoria Cipollone (Università Politecnica Delle Marche, Italy); Nicole Morresi, Sara Casaccia and Gian Marco Revel (Università Politecnica delle Marche, Italy)

33: Realization and validation of a piezoresistive textile-based insole for gait-related measurements
Ilaria Mileti (University Niccolò Cusano, Italy); Simone Pasinetti (University of Brescia, Italy); Juri Taborri (University of Tuscia, Viterbo, Italy); Fabrizio Patanè (Niccolò Cusano University, Italy); Matteo Lancini (University of Brescia, Italy); Stefano Rossi (University of Tuscia, Italy)

15:00 – 16:00
Late Result Poster Session
Conference Hall 3
Session Chairs: Katie Brinker and Kurt Barbe

34: Validation of 4TP impedance bridge developed at GUM
Krzysztof Musiol (Silesian University of Technology, Poland); Maciej Koszarny, Jolanta Jursza and Adam Ziółek (GUM, Poland); Marian Kampik (Politechnika Slaska / Silesian University of Technology, Poland); Paweł Zawadzki (GUM, Poland); Frédéric Overney (METAS, Switzerland)

35: Nanometer Displacement Measurements Based on Open-Ended Coaxial Cable Resonator Using Phase Detection
Chen Zhu (Zhejiang Lab, China)

36: Tunable confocal displacement sensor for centering and profiling of optical lens
Chao-Feng Liu (Taiwan Instrument Research Institute, Taiwan); Bo-Rong Lu and Zheng-Jie Ye (National Chiao Tung University, Taiwan); Guo-Hao Lu (Taiwan Instrument Research Institute, Taiwan & National Applied Research Laboratories, Taiwan); Pi-Ying Cheng (National Chiao Tung University, Taiwan); Chun-Jen Weng (Taiwan Instrument Research Institute & National Applied Research Laboratories, Taiwan)

37: Interaction of Lamb Waves with Cracks using Space-time and Wavenumber-Frequency Analysis
Artur L. Ribeiro (Instituto de Telecomunicações & Instituto Superior Técnico, University of Lisbon, Portugal); Dario J. Pasadas (Instituto Telecomunicações & Instituto Superior Técnico, Portugal); Mohsen Barzegar (Instituto de Telecomunicações & Instituto Superior Técnico, Portugal); Helena G. Ramos (Instituto de Telecomunicacoes, Instituto Superior Tecnico, Portugal)

38: Electrostatic Tunable Q-Factor in a Crab-Leg AlN-MEMS Oscillator
Claudia Ferro, Carlo Trigona and Salvatore Baglio (University of Catania, Italy); Adi R. Bulsara (Space and Naval Warfare Center (San Diego), USA)

39: Thermal Comfort Measurement on a Single-Room Fan Coil Unit System
Mohammad Mehdi Salehi Dezfouli (British Malaysian Institute Universiti Kuala Lumpur, Malaysia); Kushsairy Kadir (Universiti Kuala Lumpur British Malaysian Institute, Malaysia); Alireza Dehghani-Sanij (Waterloo Institute for Sustainable Energy- University of Waterloo, Canada); Shirin Rostami (The National University of Malaysia, Malaysia); Suhairi Rizuan Che Ahmad and Muhd Khairulzaman Abdul Kadir (Universiti Kuala Lumpur, Malaysia)

40: Compressed Learning based Features Extractions from Physiological Signals
Bharat Lal, Raffaele Gravina and Pasquale Corsonello (University of Calabria, Italy)

41: A defect detection method of the novel underwater Friction Stir Welding of steel using unsupervised machine learning algorithm
Farhan Tanvir Santo, Min Xia and Darren Williams (Lancaster University, United Kingdom (Great Britain))

42: A Spherical Sensor Array to Detect Extra-Terrestrial Mass Asymmetry
Peter Mark Jansson (Bucknell University & Center for Sustainability & the Environment, USA)

43: Determining Swine Respiratory Rate Using Abdomen Video Recorded by Single Camera
Chi-Hung Hwang (Taiwan Instrument Research Institute, NARLabs, Taiwan); RongQing Qiu (National Applied Research Laboratories, Taiwan); Chun-Wei Lai and Hsin-Ping Peng (National Tsing Hua University, Taiwan); Rui-Cian Weng (Taiwan Instrument Research Institute, National Applied Research Laboratories, Taiwan); Yen-Pei Lu (Instrument Technology Research Center, Taiwan)

16:00 - 16:30
Closing Ceremony & 2024 Announcement
Auditorium

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Important Dates

September 22, 2023
Special Session Proposal Deadline

November 24, 2023
Full Paper Submission

January 24, 2024
1st Review Round Notification (Accept, Revise, Reject)

February 9, 2024
Submission of Revised Papers

February 24, 2024
2nd Review Round – Final Notification deadline for revised papers (Accept or Reject)

March 1, 2024
Final Manuscript Submission of ALL Papers

The IEEE I2MTC – International Instrumentation and Measurement Technology Conference – is the flagship conference of the IEEE Instrumentation and Measurement Society and is dedicated to advances in measurement methodologies, measurement systems, instrumentation and sensors in all areas of science and technology. These features make I2MTC a unique event and one of the most important international conferences in the field of instrumentation and measurement.

Following the 2021 virtual edition, I2MTC is returning to Glasgow, this time to be held in-person!

Topics for IEEE I²MTC 2024 include

- Instrumentation and Measurement in Medical, Biomedical and Healthcare Systems
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- Advances in Measurement Theory and Metrology
- Data Acquisition Systems
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- Instrumentation and Measurement for Industry 4.0
- Instrumentation and Measurement for Advanced Manufacturing
- Instrumentation and Measurement for the Energy and Power Industry
- Instrumentation and Measurement in Environmental Monitoring
- Instrumentation and Measurement in Agriculture, Food Production and Food Safety
- Instrumentation and Measurement for the Automotive and Transportation Industry
- Instrumentation and Measurement in Aerospace and Space Systems
- Circuits and Embedded Systems for Instrumentation and Measurement
- Instrumentation and Measurement for Communications and IoT
- Instrumentation and Measurement for Non-Destructive Testing and Evaluation
- Instrumentation and Measurement for Physical and Electromagnetic Quantities
- Instrumentation and Measurement for Chemical and Biological Quantities
- Instrumentation and Measurement for Renewable Energy Systems
- Instrumentation and Measurement for the Oil and Gas Industry
- Live Demonstration: Instrumentation & Measurement

In addition to regular papers, many activities such as industry sessions, exhibits, tutorials, demos, I&M patents, student contests, TIM journal papers, and others are planned to enhance the conference experience. Delegates will have opportunities to meet with Instrumentation and Measurement professionals from around the world, making I2MTC 2024 a vibrant and exciting event. Papers that are accepted and presented will be submitted for inclusion in the IEEE Xplore digital library.

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Please contact the Conference Manager with any questions about the Code of Conduct and Inclusivity & Diversity at I²MTC 2023.

Event Conduct and Safety Statement

IEEE believes that science, technology, and engineering are fundamental human activities, for which openness, international collaboration, and the free flow of talent and ideas are essential. Its meetings, conferences, and other events seek to enable engaging, thought-provoking conversations that support IEEE's core mission of advancing technology for humanity. Accordingly, IEEE is committed to providing a safe, productive, and welcoming environment to all participants, including staff and vendors, at IEEE-related events.

IEEE has no tolerance for discrimination, harassment, or bullying in any form at IEEE-related events. All participants have the right to pursue shared interests without harassment or discrimination in an environment that supports diversity and inclusion.

Participants are expected to adhere to these principles and respect the rights of others. IEEE seeks to provide a secure environment at its events. Participants should report any behavior inconsistent with the principles outlined here, to on site staff, security or venue personnel, or to eventconduct@ieee.org.

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See IEEE Policies, Section 9.26 - IEEE Policy Against Discrimination and Harassment (PDF, 45 KB) for the complete Policy.

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COVID Protocols

The health and safety of our conference attendees and exhibitors is our priority. We look forward to welcoming you all to a fantastic in-person conference in Ottawa. I²MTC will be following local guidelines related to COVID-19. To learn more about local guidelines visit https://ottawa.ca/en/health-and-public-safety/covid-19-ottawa.