

# Guest Editorial

## Special Section on the 2022 IEEE International Instrumentation and Measurement Technology Conference

**T**HE IEEE I2MTC—International Instrumentation and Measurement Technology Conference—is the flagship conference of the IEEE Instrumentation and Measurement Society. It has been organized annually since 1984 and is dedicated to the advances in measurement methodologies, measurement systems, instrumentation, and sensors with applications in all areas of science and technology. In addition, the IEEE I2MTC is a research-focused conference and is also intended to serve as a catalyst to promote interactions between industry and academia with a dynamic and diversified format, including technical sessions, demo sessions, interactive panel discussions, distinguished keynote speakers, and membership-oriented events, all in the same venue.

Including its first edition in Long Beach, CA, USA, the conference, once called the Instrumentation and Measurement Technology Conference (IMTC), was held 18 times in the United States, four times in Canada, four times in Italy, and one time in Malaysia, New Zealand, Taiwan, Uruguay, Austria, China, Singapore, Poland, Hungary, and Japan, covering all the IEEE Regions. In 2024, it will be held in Glasgow, Scotland, U.K.

I2MTC 2022 was held in Ottawa, Canada's capital, for the third time, after 1997 and 2005. The theme of this year's conference was "Instrumentation and Measurement under Pandemic Constraints." It was the first edition, almost fully in-person, following two editions mandatorily virtual due to COVID-19. Unfortunately, ongoing government-imposed COVID-19 travel restrictions in some regions of the world prevented some authors from coming to Ottawa in person, and therefore, some presentations were virtual, making I2MTC 2022 a hybrid conference.

The final technical program included five tutorials, 30 oral sessions, and five poster sessions, including a TIM@I2MTC session—providing the opportunity for existing authors to disseminate their papers already published in the TRANSACTIONS. Some 244 papers were presented (from 400 papers submitted), with 1158 authors from 35 countries. The extraordinary attendance from all over the world presented innovative proposals in the fields of instrumentation and measurement. In addition to the regular technical sessions, the program included engaging panel discussions and four plenary sessions that were delivered by high-profile distinguished speakers: Ian Hunter from MIT's BioInstrumentation Laboratory, the 2022 winner of the prestigious IEEE Joseph F. Keithley

Award in Instrumentation & Measurement, delivering a talk on *nonlinear system identification in instrumentation applications over 40 years*; Andreas Steiger of Germany's national metrology institute Physikalisch-Technische Bundesanstalt (PTB), and winner of the prestigious 2021 IEEE Instrumentation and Measurement Society Andy Chi Best Paper Award, on *linking the power scales of free-space and waveguide-based electromagnetic waves*; Marina Gertszov of the National Research Council (NRC) Canada and Chair of the International Atomic Time Working Group at the Consultative Committee of Time and Frequency (CCTF-WGTAI) on *the preparations for the redefinition of the second in the next few years*; and, finally, Paul Corkum of the University of Ottawa and of NRC on *optically generated magnetic fields*. A portion of the presented papers were technically extended by the authors and submitted to IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT (TIM) for this Special Issue. About 50% of the submitted extended papers completed the peer-review process, and you will find them in this Special Issue. The contributions to this Special Issue deal with several research areas in instrumentation and measurement. In particular, they propose novel sensors and sensing methods, signal processing and image processing methods for instrumentation and measurement, machine learning for measurement methods and systems, and signal conditioning circuits.

We hope the readers will enjoy this sample of the content of our conference and invite everyone to submit papers to the next edition in Glasgow.

We sincerely thank all authors for their outstanding work and the reviewers who contributed to the review process. Both the authors and the reviewers' efforts guaranteed the high quality of the published papers in this Special Issue. Since TIM's quality standards have continued to increase in recent years, as evidenced by a continuous increase in quality metrics, the higher number of papers in this Special Issue is a clear indication of the increase in the quality of I2MTC 2022 papers and their extended versions.

A special thanks goes to the Editor-in-Chief, who has the overall responsibility of the journal quality, and to Reta Wehmeier for her assistance during the Special Issue development process.

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**Sergio Rapuano** (Senior Member, IEEE) received the Ph.D. degree in computer science, applied electromagnetism and telecommunications from the University of Salerno, Italy, in February 2003.

He is a Full Professor of electric and electronic measurement with the University of Sannio, where he is currently a Rector's Delegate to Scientific Research. He led the development of the IEEE Standard 2414 on jitter, wander, and phase noise, and participated in the development and/or update of the IEEE Standards 181, 1057, 1241, and 1658. His research interests include digital signal processing for measurement in telecommunications, ADC and DAC characterization, distributed measurement systems, virtual laboratories, and medical measurement.

Dr. Rapuano received the Outstanding Young Engineer Award from the IEEE Instrumentation and Measurement Society in 2008 and the Distinguished Service Award by the IEEE Italy Section in 2020. He is the Past Chair of the IEEE Italy Section, a Member-at-Large of the

Administrative Committee and the Vice President for Technical and Standards Activities of the IEEE Instrumentation and Measurement Society (IMS), the Chair of the IMS TC-25 Medical and Biological Measurement, and the Subcommittee Chair of the IMS TC-10 Waveform Generation, Measurement and Analysis. In the past, he was the Vice President (Membership) of IMS from 2018 to 2019 and the Vice President (Education) of IMS from 2020 to 2022. He was the TPC Chair or the Co-Chair of I2MTC 2017, 2018, 2020, and 2022. He is an Associate Editor of IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT (TIM).



**Kristen M. Donnell** (Senior Member, IEEE) received the B.S.E.E. degree from Colorado State University, Fort Collins, CO, USA, in May 2001, and the M.S.E.E. and Ph.D. degrees in electrical engineering from the Missouri University of Science and Technology (Missouri S&T, formerly University of Missouri–Rolla), Rolla, MO, USA, in December 2003 and December 2010, respectively.

She was a Systems Engineer and an Electrical Engineer with Raytheon Company, Tewksbury, MA, USA, from 2003 to 2006. She is currently a Woodward Associate Professor of Excellence with the Department of Electrical and Computer Engineering, Missouri S&T, and also the Director of the Microwave Sensing ( $\mu$ Sense) Laboratory. Her current research interests include thermography, frequency selective surfaces, materials characterization, and microwave and millimeter-wave nondestructive testing.

Dr. Donnell has been involved with the IEEE Instrumentation and Measurement Society since 2007. She currently serves as the Vice-President for the Finance Committee and the Chair for the Distinguished Lecturer Program.



**Paweł Niewczas** (Member, IEEE) received the M.Sc. degree in electrical engineering from the Technical University of Lublin, Poland, in 1995, and the Ph.D. degree in optical current sensing from the University of Strathclyde, Glasgow, U.K., in 2000.

He is currently a Professor at the Department of Electronic and Electrical Engineering, University of Strathclyde, where he leads the Advanced Sensors Team, Institute for Energy and Environment. His main research interests center on the advancement of photonic instrumentation and measurement (I&M) methods and systems integration in applications that lie predominantly in power and energy sectors. He has carried out a unique portfolio of research programs, generally focusing on optical and fiber-based I&M techniques, addressing such issues as sensor design, fabrication, packaging, deployment, and delivering complete photonic I&M systems for measurements in challenging environments. He has published more than 130 technical papers in this area and holds six granted patents. He is the Co-Founder and the Research and Development Director of the spin-out company Synaptec that specializes in photonic instrumentation for the

energy grid.

Dr. Niewczas was an IEEE Distinguished Lecturer (DL) for the Instrumentation and Measurement Society (IMS) from 2007 to 2012 and from 2013 to 2016, the Technical Co-Chair (TCP) of the IEEE I2MTC 2021–2022, and an Associate Editor of the *Sensors* journal (MDPI) from 2020 to 2022. He was appointed as the General Co-Chair for I2MTC 2024. He also serves for the IMS Faculty Development Award Selection Committee.