Editorial
Bruno Andò

Dear Readers,
I wish you a very warm welcome to this second special issue of the Magazine on Instrumentation and Measurement in 2020."

Along with the previous Part A issue, this issue aims to celebrate Instrumentation and Measurement in 2020 by highlighting challenging subjects in the field. In particular, we will read about “the impact of the new International System of Units in the measurement sector,” “Artificial Intelligence applied to Instrumentation and Measurement,” “Evolution of Sensors in the last ten years” and “Advanced Measurement Systems.”

These subjects fill the pool of topics which are typically addressed by the Magazine, which aims to highlight Open Problems and Hot Topics in the Instrumentation and Measurement framework.

I would really like to thank all of the colleagues who have contributed to the realization of this second volume of the special issue on “Instrumentation and Measurement in 2020,” providing unique readings on such amazing subjects.

Enjoy your reading,
Bruno

Article Summaries

The Impact of the New SI in the Measurement Sector
(Summary)

Alan Steele and Barry Wood
Recent changes to the world’s measurement system have been carefully designed to appear to the general public, and even to most of the scientific community, as if nothing substantial has changed. The same units exist, no new ones have been created, and the values of the properties of physical artifacts remain the same for all but the most extreme accuracies. In fact, only the definitions of the seven base units have been altered while keeping their sizes virtually unchanged. And so it might appear that these changes to our measurement system are simply a bit of tidying up and of no practical consequence to any except those few metrologists responsible for realizing and maintaining the measurement system at its highest levels of accuracy and precision. But this is just appearance, and in fact a wide range of measurement options have changed or become available. The purpose of this review is to explain the changes to our measurement system that occurred in 2019 and to illustrate some of the measurements that have become possible or more practical as a result. So, while the 2019 changes to the SI certainly impact metrologists, it is these new measurements that will more broadly impact measurement science.

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**Applied AI in Instrumentation and Measurement: The Deep Learning Revolution**

Mounib Khanafer and Shervin Shirmohammadi

AI is one of the core enabling components of the fourth industrial revolution that we are currently witnessing, and the applications of AI are truly transforming our world and impacting all facets of society, economy, living, working, and technology. The field of Instrumentation and Measurement (I&M) is no exception and has already been impacted by Applied AI. In this article, [the authors] give an overview of Applied AI and its usage in I&M. [They] then take a deeper look at the I&M applications of one specific AI method: Deep Learning (DL), which has recently revolutionized the field of AI. Our survey of DL papers published in the *IEEE Transactions on Instrumentation and Measurement* and *IEEE Instrumentation & Measurement Magazine* showed that, since 2017, there is a very strong interest in applying DL methods to I&M, in terms of measurement, calibration, and other I&M challenges.

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**Changes in Sensors Technologies during the Last Ten Years: Evolution or Revolution?**

Carlo Trigona, Salvatore Graziani, and Salvatore Baglio
The evolution of sensing scenarios has produced both incremental improvements of existing technologies and the introduction of novel disruptive ones. The focus of this contribution will be on some totally new paradigms that have deeply changed the sensors’ state of the art. Restricting the attention on the last decade, the main changes can be found in the adoption of various technologies and processes starting from systems on a centimeter scale through millimeter scale, devices up to silicon-based solutions, micro-machined systems and nano-scale approaches. Other approaches exploited during the last years regard polymeric materials capable of converting deformations into an electrical power. In particular, Ionic-electroactive polymers have been the object of various manuscripts considering that they conjugate mechanoelectrical conversion features, with interesting properties of lightness and flexibility. Some of these technologies are still at an embryonic stage and are the object of vivid lab research activity. Others are mature and have already been adopted by the industry and are entering real-life applications.

This text was taken from the article.

**SAR Sensors Measurements for Environmental Classification: Machine Learning-Based Performances**

(Summary)

Aimé Lay-Ekuakille, Moise Avoci Ugwiri, John Peter Djungha Okitadiowo, Vito Telesca, Pietro Picuno, Consolatina Liguori, and Satya Singh

Artificial intelligence, in particular a supervised and unsupervised machine learning approach, has been becoming an interest in the field of measurement and instrumentation. Many problems of classification can be faced by a machine learning approach. [The authors] know machine learning is a broad area of artificial intelligence that comprises some other lines of research and activities such as deep learning. Synthetic aperture radar measurements by means of its sensors are of great interest in environmental monitoring, in particular in land classification. This paper presents findings related to measurements and characterization through land classification of an environmentally sensitive area in Italy over two different time periods in order to assess changing parameters. A deep learning algorithm has been designed and implemented, and a comparison has been established with a spectral density approach.

This text was taken from the article.

**An Automatic Lameness Detection System for Dairy Cattle**

(Summary)

Gourab Sen Gupta, Aaron Dalbeth, Johann Nel, and Ken Mercer
Lameness in dairy cattle negatively effects the welfare of affected cows and is the third biggest cause of economic loss to the dairy industry in New Zealand. As the cost and frequency of lameness continues to increase, profitability will further decrease unless a more effective and efficient method of detecting cattle lameness is developed. In this article, [the authors] outline the design of the measurement platform which detects lameness. The walk-over-platform has four independent platform segments, with each segment containing four shear beam load cells and electronic hardware for processing. The load cell signals are processed to determine the three basic kinematic variables associated with lameness: force, position and duration. Lameness was successfully detected using several parameters, namely asymmetry in weight distribution, stride length and abduction.

This text was taken from the article.

Columns

Society News

Technical and Standards Activities Committee

Ruqiang Yan

The mission of Technical and Standards Activities Committee (TSAC) of the IEEE Instrumentation and Measurement Society (IMS) is to enable and promote Technical Committees (TCs) as the Society’s “Centers of Expertise,” and support and promote participation of individual IMS members in Standards Activities. Over the past years, the TSAC has managed 22 active TCs and supported the development of 18 IEEE Standards. The TSAC has worked closely with other committees in the IMS to promote various activities. For example, the TSAC works tightly with the Conference Committee to engage in the organization of various conferences and workshops. To date, our TC-25 fully sponsors the IEEE International Symposium on Medical Measurements & Applications (MeMeA), TC-37 sponsors the IEEE International Symposium on Measurements and Networking, TC-17 and TC-19 sponsor the Conference on Precision Electromagnetic Measurements (CPEM), and TC-13 and TC-37 sponsor the International Symposium in Sensing and Instrumentation in IoT Era. Since 2017, our TCs have been actively involved in promoting our flagship conference: IEEE International Instrumentation & Measurement Technology Conference (I2MTC). Every year, some of the TCs propose special sessions that are related to their technical expertise and attract many attendees to join the I2MTC.
TSAC actively monitors activities in which each TC is engaged. We have TC guidelines to help TCs maintain their normal operation and provide detailed procedures to form a new TC or close a TC that is not active for several years. As an example, condition monitoring and fault diagnosis is attracting more and more attention from both the academic and industrial community in the era of Industry 4.0. To encourage research on subtopics and challenging topics related to condition monitoring and fault diagnosis, and to promote and facilitate the exchange of knowledge between scientists, a new TC-3: Condition Monitoring and Fault Diagnosis Instrument was proposed by Drs. Xuefeng Chen and Weihua Li, and approved by AdCom of the IMS, to serve as a platform for scientists and engineers involved in the field of condition monitoring and fault diagnosis in order to focus on the potential applications in industry.

To recognize the best technical committee of the IMS, an outstanding TC award was set up. Each year, one TC is selected to receive this award. In 2017, the first one was awarded to TC-39, which was founded in 2009 to create a reference for many members of the society working in the field of definition and characterization of measurement systems, devices, components and methods for modern power grids. TC-25 and TC-32 received the outstanding TC award in the following years, respectively.

In summary, TSAC would like to serve all of our IMS members in various capacities.