The term Internet of Things (IoT) refers to the connection and interaction of many devices and objects to the Internet, in addition to traditional laptops and mobile devices.

I remember a first experiment in 1995, aimed to remotely connect two measurement stations equipped with standard instrumentation (scope, waveform generator, multimeter) through the Internet. The aim of such activity was two-fold: the remote control of a measurement station and the synergic interaction and data exchange between the two stations. The question is: was this a first example of IOT? Talking about IOT, two main scenarios must be accounted for: Short Range IoT including devices connected within a range of 100 m; and Wide Area IoT, including devices connected through smartphones. IOT applications belonging to the last category involve Massive M2M (Machine to Machine) devices, e.g., sensors for agriculture or smart cities, and systems for Critical IoT contexts, e.g., remote surgery applications, fully automated vehicles and industry 4.0.

Hot topics in the IOT framework are related to the measurement of quality of massive data produced by connected devices (sensors, instrumentation), latency in connectivity and data transmission, and the assessment of the actual number of devices connected in order to estimate the potential demands in terms of communication infrastructure. Privacy, security, interoperability, numbering and standardization are other IOT related topics worthy of investigation.

The IEEE Instrumentation and Measurement Society has always been attentive to the strict connection between IOT and the instrumentation and measurement world. Sponsored conferences, such as Measurement and Networking, and many papers covering different aspects and subjects of the IOT have been published in Instrumentation and Measurement Magazine and the Transactions on Instrumentation and Measurement.

This issue of the Magazine aims to provide specific examples of IOT related measurement subjects. I would like to thank the Guest Editor for this Special Issue, Prof. Ricardo Jardim-
Goncalves, Full Professor at the New University of Lisbon, Faculty of Sciences and Technology, and a Principal Investigator at UNINOVA–Instituto de Desenvolvimento de Novas Tecnologias. This is the last issue planned for 2019, and we are working now on the 2020 publications. I would like to thank all of the authors who have valuably contributed to this years' issues. All of the contributors were great at addressing challenging and timely topics, and I'm sure our readership appreciates their efforts. Thanks a lot to all of the reviewers who guaranteed a transparent and efficient peer review process for each article published in this Magazine. Anyway, ending the year with six such well-edited issues is also credited to the work of our editorial team, so thanks a lot to Kristy Virostek and Allen Press for the great job.

Some great news for 2020 is the expected publication of a couple of electronic issues of the Magazine, in addition to the six traditional printed issues...but much more than this is coming.

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Guest Editorial

Instrumentation and Measurement in the Internet-of-Things

Ricardo Jardim-Goncalves

The use of sensors and actuators as a way of controlling cyber-physical systems in integrated networks of digital devices has been referred to as the Internet of Things (IoT). The term IoT became popular in the late 1990s after it came up with several technologies related to the development and automation of sensors connected to the World Wide Web. Recent developments in wireless sensor networks have driven the expansion of IoT applications in a variety of areas like in industry, home, cities and healthcare. Actually, IoT technologies offer several possibilities by providing efficient and real-time operations over the Internet. However, the integration of many standalone IoT systems over the Internet introduces many challenges that require instrumentation and measurement practice to ensure the accuracy required in the application environment. For example, the advent of Industry 4.0 intends to optimize production, which will introduce new hybrid business models and exploit smart technologies while accelerating innovation cycles. Thus, several efforts have been made in industry to seek automatic cyber-physical interconnection between the virtual and physical worlds by linking the data acquired from the shop floor to manufacturing execution systems.

This special issue brings a set of papers contributing to the advances in the state of the art and application in some of the main aspects related to research and development in measurement and instrumentation in the IoT. A novel framework that contributes for faster and more precise implementation of IoT solutions is proposed on self-test of high-speed Analog-to-Digital converters. As well, a new collaborative IoT-gateway architecture is suggested in support of more reliable and cost-effective measurements. The adoption of the new technologies 5G IoT is discussed, contributing for a visionary new era of communications and measurements in IoT. In the application domain, a smart pen-shaped digital multimeter system based on IoT and cloud is suggested, and a case study is presented and discussed on contaminants detection and classification through a customized IoT-based platform. A survey on supportive IoT technologies for people with dementia is described, together with analytics of data ingested in fog context...
setting. A remote laboratory design and implementation as a measurement and automation experiential learning opportunity is proposed. The final paper proposes a methodology and its associated software to support satellite functional testing.

Some of the promising research directions on this cutting-edge topic provide further possible directions to be addressed, as well as discoveries to create competitive technological innovation for digital engineering. Hence, instrumentation and measurement in the IoT domain require efficient mechanisms with a unified view of precision properties that must be preferably applied in advance to ensure the reliable use of sensors and actuators in IoT enabled networks. Such future trends have the potential to address precision concerns, which is one of the most important aspects of a full IoT adoption. Although digital platforms are comprised of technologies incorporating components directly related to IoT, such as 5G, edge computing, IoT and low-cost communication, these technologies will create more unpredictable and disruptive advances for humans, where instrumentation and measurement must once again be challenged. They will allow the gap to be filled between the precision of electronic devices and the accuracy of the data in very truthful integrated networks of digital devices able to provide awareness by the use of applications on top of the data received from the physical world.

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**Article Summaries**

**Built-In Self Test of High Speed Analog-to-Digital Converters**

*(Summary)*

Edinei Santin, Luis B. Oliveira, and Joao Goes

In this paper the authors discuss the use of built-in self-test (BIST) techniques for testing high speed ADCs and present a specific solution in which the analog input signal and the clock are generated internally. This fully integrated, low cost, and reconfigurable architecture for coherent self-testing of high-speed ADCs is based on two synchronized phased-locked loops, one to synthesize the analog input signal and another to synthesize the clock signal for the ADC under test. This synchronization is a key feature of the proposed approach, since it allows coherent sampling. With coherent sampling, the digital output data of the converter are well-behaved and their spectrum is unambiguous, since it is not necessary to worry about spectral leakage, windowing, etc.

*This text is from the article.*
**A Collaborative IoT-Gateway Architecture for Reliable and Cost-Effective Measurements**

(Selection)

Boon-Yaik Ooi, Zan-Wai Kong, Wai-Kong Lee,
Soung-Yue Liew, and Shervin Shirmohammadi

To address connection reliability, the authors propose the concept of collaborative IoT-gateways, to manage the internetworking connections among the devices, other sub-systems, and connection to the cloud. The authors elaborated on the concept and justified the design of the collaborative IoT-gateway and also showed that the concept can be easily implemented with existing technology and software.

*This summary includes text from the article.*

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**5G and IoT: Towards a New Era of Communications and Measurements**

(Selection)

Meisu Zhong, Yongsheng Yang, Haiqing Yao, Xiuwen Fu, Octavia A. Dobre,
and Octavian Postolache

An overview of the upcoming 5G wireless systems is described, including a glimpse into the timeline, technical requirements, and enabling technologies. Other IoT solutions are presented, with a focus on applications to industrial settings, smart ports, and healthcare. Specific instrumentation setup and measurement methods associated with 5G and IoT implementations are discussed.

*This text is from the article’s introduction.*

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**Smart Pen-Shaped Digital Multimeter System Based on IoT and Cloud**

(Selection)

Kun Xia, Hua Su, Jiawen Ni, Bangzheng Liu, Yanghong Ye, and Han Li

With the rapid development of integrated circuit technology, a favorable condition has been created for miniaturization, intelligence, and digitization of the measurement instruments. Meanwhile, with the advent of the Internet of Things, another possibility for advancement of the digital multimeter (DMM) is found. A DMM is designed to measure some key electrical parameters such as dc voltage, ac voltage, and resistance. In this article, a smart pen-shaped digital multimeter (PDMM) is proposed, which is more compact in structure and more intelligent in function. By employing a smartphone as the display, the volume of DMM is reduced. Through Bluetooth, PDMM can communicate with a smartphone, where data cloud management can be implemented.

*This text is from the introduction of the article.*
Contaminants Detection and Classification through a Customized IoT-Based Platform: A Case Study

(Summary)

Giovanni Betta, Gianni Cerro, Marco Ferdinandi, Luigi Ferrigno, and Mario Molinara

Internet of Things is involving more and more fields where monitoring actions and fast and reliable data communication are simultaneously needed. Inside the general class of monitoring applications, those related to pollutant detection and classification are currently faced by many researchers and companies. This contribution proposes a novel low-cost and highly flexible platform which is intended to tackle such challenges, adopting ad-hoc hardware and software techniques. The proposed solution is applied to air and water contaminant detection case studies, and provides the reader with an innovative system in the field of pollution monitoring and focuses the attention on limitations, challenges and possible improvements needed to obtain reliable contaminant detection and, consequently, improve life quality.

This text is from the article’s introduction.

Survey on Assistive Technologies for People with Dementia

(Summary)

Fernando Luís-Ferreira, Majid Zamiri, João Sarraipa, Gary McManus, Philip O’Brien, and Ricardo Goncalves

The number of people living with Dementia in societies is now rising at an unprecedented rate. Neither decisive treatment, nor effective medicines have been introduced to help society cope with such age associated pathologies. However, one promising alternative to this emerging crisis has been the adoption of Assistive Technologies. This paper provides an overview about recent findings in this field of study and also address some available technologies that have potential application for Dementia sufferers. The findings provide insight into the types and percentages of suggested technologies for each classification that aim to be useful for those researching the field or who want to know state of the art in this presently relevant domain. Concluding points and discussion are presented subsequently.

This text is from the article’s introduction.
Fog Computing Context Analytics
(Summary)

Nikos Papageorgiou, Yiannis Verginadis, Dimitris Apostolou, and Gregoris Mentzas

Through this article, the authors introduce the basic methods of context classification and prediction, and we present their application to facilitate fog infrastructure management. A fog infrastructure typically includes cloud, stationary as well as mobile computing devices which host distributed software systems. Fog infrastructures utilize sophisticated algorithms and advanced software or hardware sensors to make intelligent decisions to increase quality of service, utilization of resources and scalability. Context classification and prediction uses multivariate, sensor-generated data to infer contextual knowledge about the status of a fog resource, which can facilitate decision making with respect to infrastructure management by supporting auto-scaling and infrastructure optimization strategies.

Remote Laboratory Design and Implementation as a Measurement and Automation Experiential Learning Opportunity
(Summary)

Francesco Bonavolontà, Mauro D'Arco, Annalisa Liccardo and Oscar Tamburis

The primary focus of the work presented in this paper is the educational validity of designing and implementing a remote laboratory and only secondarily the possibilities related to its use. The authors present a straightforward solution to guide the students throughout the realization of a remote laboratory that functions to accomplish several complementary goals of courses dealing with remote process control and automation.

Satellite Overall Test Matrix
(Summary)

Malik Khalfallah and Parisa Ghodous

In this article, the authors discuss a methodology for functional testing for satellite systems and its supporting software called Overall Test Matrix (OTM). Defining functional tests for satellites relies on the measurements embedded in satellite telemetries. The paper presents how these telemetries are created and managed and how test specifications use satellite telemetries to define success criteria. The authors discuss how the OTM supports the definition and execution of tests while ensuring an end-to-end data continuity. Their implementation replaces the currently used excel files that do not ensure data continuity.
Columns

Future Trends in I&LM

Industrial Strength Security

(Summary)

Richard Nelson

A note from Melanie Ooi: Cyber-security is a particularly important concern as we race towards Industry 4.0 and IoT. Our guest columnist, Dr. Richard Nelson, is the project leader of a NZD $12.2 Million Cyber-security project funded by New Zealand's Ministry of Business, Innovation and Employment. This project, named STRATUS, commenced in 2014 and aims to empower users to be able to control the security of their data in the Cloud, and to create security tools and services for companies to sell. He shares with us some important insights on the role that the instrumentation and measurement community can have in the Cyber-security road map.

This text is from the introduction to the column.

Basic Metrology

Scattering of Light by Light

(Summary)

Richard Davis

This past summer, the ATLAS Collaboration at CERN's Large Hadron Collider (LHC) reported having observed elastic scattering of light by light [1], [2]. In this column, the author talks a little about how the experiment was conducted, how the results were analyzed, and the significance of this work.

This summary was provided by the author.

Life After Graduation

IoT: Forecasts, Challenges and Opportunities

(Summary)

Vincenzo Marletta
The author discusses how, in this issue of the magazine, readers “have read contributions that highlight a strong link between the IoT and the world of measurements and ...how we are only at the dawn of IoT.” He poses some key questions: What are the forecasts for the future? What is the current market in this sector? What are the job opportunities, and what skills are required?

**Society News**

**IEEE Measurement and Networking Symposium, 2019 (M&N 2019)**

Bruno Andò

IEEE Symposium on Measurements and Networking (M&N) is one of the flagship conferences of the IEEE Instrumentation and Measurement Society (IMS). M&N 2019 presented a forum for researchers and practitioners from industry, academia, government and standardization committees interested in the areas of measurements, communications, computer science, wireless systems, and sensor networks and fostered discussion on the role of both measurements for networking and networking for measurements.

The Symposium is mainly promoted by IEEE IMS TC-37 Measurements and Networking, the IEEE Instrumentation and Measurement Italy Chapter and the IEEE Italy Section Systems Council Chapter. In 2019, this biennial event reached the 5th edition, and it involved researchers and experts coming from different parts of the world.

**The Venue**

The venue of M&N 2019 was the Museo Diocesano, located in the heart of the city of Catania, which hosts the oldest University of Sicily, Italy. The Museo Diocesano is equipped with religious, art, furniture and various artifacts within the seminar building that date from the 17th century. Museo Diocesano is a large museum representing the history and culture of the diocese. It is divided into two sections: one dedicated to liturgical furnishings of the cathedral and one that includes furniture of other churches in the city and the diocese.

**The Technical Program**

M&N 2019 edition drew a remarkable interest worldwide. From the 81 originally submitted papers, 76 went through the full revision process, which involved 61 reviewers within and outside the Technical Program Committee. The M&N review process is designed to ensure high quality of accepted papers. At the end of this process, 62 papers were accepted for presentation at M&N 2019, leading to an acceptance rate of about 80%. A special thanks to all of the authors and reviewers for having contributed their high-quality papers and their valuable comments, respectively, to the great success of the conference.

Accepted papers were divided for presentation in seven Oral Sessions and two Poster Sessions during the three days of the conference. Oral Sessions included the following four Special Sessions, organized to provide a better overview of hot topics in the subjects addressed by the
symposium:

- Measurements for Networking: Traffic Monitoring and Performance Analysis (organizers: Prof. Alfio Lombardo and Prof. Laura Galluccio, University of Catania, Italy)
- Sensor Networks and Sensing Systems for Assistive Technology (organizers: Prof. Bruno Andò and Prof. Vincenzo Marletta, University of Catania, Italy)
- Antenna and RCS Measurements (organizers: Prof. Claudio Curcio, Università degli Studi di Napoli Federico II Italy; Prof. Francesco D’Agostino, Università degli Studi di Salerno, Italy; and Prof. Marco D. Migliore, Università degli Studi di Cassino e del Lazio Meridionale, Italy)
- Intelligent Sensors Technologies for Structural Health Monitoring (organizers: Prof. Luca De Marchi, University of Bologna, Italy and Prof. Davide Brunelli, University of Trento, Italy)

Many thanks go to the Special Sessions organizers.

Topics of the Technical Sessions included: Channel quality prediction and QoS measurements in wired and wireless networks (short-range and cellular systems), Anomaly Detection, Measurements on Telecommunication systems, Electromagnetic exposure to BS, Electromagnetic interference measurements, 5G perspective, Sensor and Sensor networks (for assistive technologies, structural health monitoring, air-quality monitoring, health monitoring), Uncertainty in antenna measurements, Wearable antenna design and characterization, NF-FF measurements, Measurements and Networking for localization (Indoor location, Object classification for autonomous navigation, and Ultrasound time of flight).

Many thanks also go to the 20 Session Chairs who contributed to profitable discussions during all of the sessions. Special thanks go also to all of the instrument manufacturers that have really contributed to the success of the symposium and of the technical program.

The authors of papers presented at M&N 2019 will have the opportunity to extend their paper and submit to a special issue of the *IEEE Transactions on Instrumentation and Measurement*.

**The Keynotes**

Keynotes provided attendees with additional broad perspectives on particular issues. This year, during the opening day, we had two keynote speakers: Carla-Fabiana Chiasserini from Politecnico di Torino, Italy who presented “Implementation and Performance Measurements of a MEC-based Automotive Service” and Dr. Giuseppe Bruno from ST Microelectronics who shared his insights into “ST Environmental sensors and main applications.”

On Day 2, two additional keynote speakers enriched the program with very up-to-date topics: Prof. Ricardo Goncalves from New University of Lisbon, Portugal presented the results of an important project “Electronic citizen-centered electronic data exchange for personalized digital health,” and Prof. Kaushik Chowdhury from Northeastern University, MA, USA had a speech on, “(Air)space is the Final Frontier: Experiments with Learning, Sensing and Communications in UAVs.” Many thanks go to the Keynote Speakers for their interesting and involving talks.

**The Social Events**

Catania also means exceptional food and drink, and the social events during M&N 2019 were not an exception. A Welcome reception was held at the Cafeteria of the Museo Diocesano. The Gala dinner took place at the wonderful “Palazzo Manganelli,” very close to the conference venue.
During the gala dinner, the Conference Organizing Committee announced the winners of conference awards.

**The Awards**

M&N 2019 is committed to encouraging student engagement in the field of measurements and networking. To this aim, a specific category of award, the Best Paper Young Author Award “Nicola Pitrone” was delivered. To be a candidate for this award, a paper must be co-authored and presented by a researcher younger than 35 years of age. Best Paper Award “Domenico Grimaldi” and Best Poster Award were also presented. For each category, two positions of equal merit were awarded. The selection of best papers was made by the Technical Program Chairs on the basis of paper quality.

During this edition, winners of M&N 2019 Best Paper Young Author Award “Nicola Pitrone” were Federica Zonzini, Michelangelo Maria Malatesta, Denis Bogomolov, Nicola Testoni, Luca De Marchi, and Alessandro Marzani for the paper “Heterogeneous Sensor-network for Vibration-based SHM” and Carl J. Debono, Matthew Sacco, Joshua Ellul for the paper “An RGB-D based Framework for Ambient Assistive Living Applications.”

The M&N 2019 Best Paper Award “Domenico Grimaldi” was given to Marjo Heikkilä, Arto Seppänen, Marjut Koskela, Jukka Pihonen, Jan Engelberg, and Ari T. Pouttu for the paper entitled “The Use of Unmanned Aircraft System for the Radio Frequency Interference Measurements” and to Alessandra Galli Giorgi, Giada Giorgi, and Claudio Narduzzi for the paper entitled “Multi-User ECG Monitoring System based on IEEE Standard 802.15.6.”

The M&N 2019 Best Poster Award was given to Ghada Bouattour, Bilel Kallel, Houda Ben Jmaa Derbel, and Olfa Kanoun for the paper entitled “Passive Peak Voltage Sensor for Multiple Sending Coils Inductive Power Transmission System” and to Vincenzo Paciello, António Espírito Santo, Francesco Abate, and Gustavo Monte for the paper entitled “Smart Sensor Efficient Signal Processing for Earthquake Early Detection.” Congratulations to all the winners!

**Future Perspectives**

M&N 2019 was very successful. General Chairs of the conference: Prof. Bruno Andò, University of Catania, Italy and Prof. Domenico Capriglione, University of Salerno, Italy; Technical Program Chairs Prof. Marco Di Felice, University of Bologna, Italy, Prof. Gianfranco Miele, University of Cassino and Southern Lazio, Italy and Prof. Octavian Postolache, Instituto de Telecomunicações, Portugal have received much positive feedback from people who attended the symposium for the first time. The high level of interdisciplinarity together with high quality papers (62) and presentations have been particularly appreciated by the participants (80 in this edition).

Indeed, we really think that given the complexity of modern networks and related systems, a multidisciplinary approach has to be followed for correctly addressing current and incoming technological challenges. We are very enthusiastic because we are feeling an increasing interest of the international community in the participation at this interdisciplinary symposium.

At this edition, 251 authors were from all over the world. Looking at the attendees, Europe is the
most represented continent, but researchers also came from USA, Asia, South America and New Zealand. This trend is particularly important, because it means that the measurements and networking community, since the first edition in 2011 (Capri, Italy) has been continuously increasing, attracting newer and newer people also outside Europe and North America, which are the regions historically more represented in the IMS field.

The Steering Committee (Prof. Leopoldo Angrisani, Prof. Claudio Narduzzi, Prof. Bruno Andò, Prof. Domenico Capriglione and Prof. Luigi Ferrigno) is encouraged to continue in this way and to promote international cooperation in the field of measurements and networking.

The print magazine includes a photo from the event.

14th IEEE MeMeA Symposium

Baki Karaböce

The 14th IEEE International Symposium on Medical Measurements and Applications (MeMeA) was organized at Kadir Has University (KHU) in İstanbul, Turkey from 26-28 June, 2019. We welcomed 110 registered participants from mainly Italy, Turkey, India and Canada and but also from all over the world.

MeMeA 2019 carried on the leadership role in the field of measurements for medicine and healthcare. Since the first idea arose from special sessions on medical measurements organized by the IMS TC-25 in IEEE International Instrumentation and Measurement Technical Conferences and the IEEE International Workshop on Medical Measurements and Applications (MeMeA), this international series has now reached its 14th symposium.

Workshops:
Benevento, Italy in 2006
Warsaw, Poland in 2007
Ottawa, Canada in 2008
Cosenza, Italy in 2009
Ottawa, Canada in 2010

Symposia:
Budapest, Hungary in 2012
Gatineau, Canada in 2013
Lisbon, Portugal in 2014
Rochester, Minnesota, USA in 2017

We met in 2019 in Istanbul, a city which served as the capital of three empires and the east-west intersection of two continents, Europe and Asia. This city is renowned for its long and exceptional history, its prestigious monuments and its welcoming social and cultural life. İstanbul is the forward-looking inheritor of 8,500 years of history—cradle of faith, culture, and
trade—and the heart of the Turkish economy. Turkey's top universities are located in İstanbul, which is the base for 54 universities.

MeMeA 2019 was held at KHU, which has seven faculties: Engineering and Natural Sciences; Economics, Administrative and Social Sciences; Communication; Management; Law; Art and Design; and Applied Sciences. The main building was originally a tobacco factory, erected in 1884 by the İstanbul-based Ottoman Armenian architect Hovsep Aznavur. The factory was used for nearly seventy years by TEKEL, the state tobacco producer, and then renovated as the university building in 1997. KHU won the Europa Nostra Award for the beautiful restoration of an historic place.

Interest in the MeMeA symposium continues to increase from a variety of disciplines, including our main participants from engineering and medicine. This year we also had an important contribution from metrologists from the national metrology institute of Turkey, TUBİTAK UME, that supported the theme of the symposium entitled “Metrological point of view in medical measurements.”

After a rigorous review, more than 120 high quality papers by 585 authors from academia, industry, government and NGOs from 26 different countries of Europe, Asia, Africa and America were selected for presentation in this outstanding symposium.

Two keynote presentations were given by experts in the field of medical measurements and applications: Tobias Schaeffter, who heads the Division 8 of Medical Physics and Metrological Information Technology at Physikalisch-Technische Bundesanstalt (PTB) in Berlin, Germany spoke about “Quantitative Measurements in Medicine.” Zijad Džemić, General Director of the Institute of Metrology of Bosnia and Herzegovina, spoke about “Conformity Assessment of Medical Devices in the Frame of Legal Metrology.” We were honored to have them as plenary speakers and thank them for sharing their knowledge and experiences with us.

Two tutorials were presented by: Sandro Carrara from EPFL Lausanne, Switzerland concerning “Ultrasensitive Memristive Biosensors” and Irfan Karagöz from Gazi University, Turkey about “Imaging Systems and Effectiveness of Physiological Imaging Systems in Early Diagnostic Process.”

In light of the symposium theme: metrological point of view in medical measurements, a panel discussion was organized. Sandro Carrara moderated the panel, with valuable contributions of panelists Maria Ferroro García, Tobias Schaeffter, Yekta Ülgen and Marco Parvis. Over the three days, four parallel sessions ran each day and were organized as follows:

Once: “Imaging and Communication,” “Novel Techniques in Medical Ultrasound” and “Medical and Instrumentation Uncertainty and Calibrations” sessions.

Twice: “Bioengineering and Rehabilitation,” “Biosignal Processing,” “IoT Devices and Systems for Biomedical Applications and Health Parameters Monitoring” and “Measurement Systems and Sensors for Diagnostic and Therapeutic Procedures” sessions.

Three times: “Wearable and Unobtrusive Monitoring Systems for Medical Applications” and “Medical Metrology and Medical Device Calibration” sessions.

Five times: “Sensors and Devices for Medical Measurements” sessions.
Once: Poster Session.

Traditionally, several awards are distributed: Best Paper Award, Best Student Paper Award, Best Women in Engineering Paper Award and the Best Poster Award are granted on the evaluation of presentation quality by the Technical Program Committee. The Best Paper Award has been designated the “Domenico Grimaldi” Best Paper Award in memory of him. For the third year, MeMeA 2019 provided travel support grants to student authors of high-quality papers selected by the Technical Program Chairs on the basis of the reviewers' evaluations.

The MeMeA 2019 Special Issue of IEEE Transactions on Instrumentation and Measurement will be prepared and published to promote the best results presented at the symposium. The MeMeA 2019 Special Issue will contain technically extended papers selected on the basis of the results of regular peer review of the manuscripts submitted for consideration by the participants of the symposium.

Great support has been received from our supporters IEEE, IEEE I&M Society, TÜBİTAK UME and KHU, the Steering Committee members and the reviewers who contributed to make the outstanding program of this year’s edition possible. This symposium has been realized naturally with the valuable contributions of authors, whose research and development efforts were presented during the MeMeA 2019 İstanbul.

The Organizing Committee received plate gifts designed by artist Dr. Nur Balkır that represent medical applications at Ottoman times. The Committee also organized an opening concert, a Whirling Dervish show called the Mevlevî Semâ Ceremony (designated as one of the Masterpieces of the Oral and Intangible Heritage of Humanity) and a symposium dinner on the boat tour for all participants and their guests.

MeMeA 2019 welcomed almost 140 scientists, academicians, researchers, engineers, students and accompanying persons in İstanbul, Turkey with scientific works and good memories.

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**Departments**

**New Products**

Robert Goldberg

Please send all “New Products” information to:

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Clifton, NJ 07012 USA

E-mail: r.goldberg@ieee.org
**Portable Arbitrary Waveform Generator Allows Signal-Generation for Up To 16 Channels**

Spectrum Instrumentation’s latest line of Arbitrary Waveform Generators (AWGs) is based on the LXI instrumentation standard and has been created for engineers and scientists that need to simultaneously generate up to 16 precise electronic signals. Small and compact, the units are ideal in automated testing or remote-control type applications. With six new instruments being released, users are offered a wide choice of configurations and performance levels. All the units feature the latest 16 bit digital-to-analog converter (DAC) technology and combine this with low-noise flexible outputs, allowing them to generate almost any test signal in the dc to 60 MHz frequency range. Furthermore, full remote control is achieved through a simple Ethernet connection to any PC or local area network (LAN) making them easy to integrate into virtually every test system.

The new DN2.65x series of generatorNETBOX instruments are available with 4, 8 or 16 fully synchronous channels and offer output rates of 40 MS/s or 125 MS/s. Signals with a programmable output swing of up to ±6 V into high impedance or ±3 V into 50 Ω can be generated. The units also include large on-board memories of up to 2 x 512 MSamples that can be utilized in different operating modes to allow the generation of long and complex waveforms. This includes Single-Shot, Loop, FIFO, Gated and Sequence Replay modes. Signals can even be generated while new waveform data is being loaded to the on-board memory.

Weighing as little as 6.3 kg, the generatorNETBOX products are easily portable and can work almost anywhere: freestanding on a test bench, rack mounted with other equipment or even mobile (when powered by the optional 12 or 24 V dc sources).

The instruments are fully self-contained and come with all the tools necessary to generate an unlimited variety of waveforms. Simply connect them to a host computer (e.g., laptop or workstation) or anywhere on the corporate network and start up Spectrum's SBench 6 Professional software.

More information about Spectrum can be found at [www.spectrum-instrumentation.com](http://www.spectrum-instrumentation.com).

**Handheld Indoor Air Quality Monitors**

The Ace AI-IAQ-IoT-SP series is a smart handheld Air Quality Monitor which measures, displays and transmits temperature, humidity and CO2 levels. It can record temperature from 0 to 50 degrees Celsius with an accuracy of ±0.5 Degrees, humidity from 0 to 100% RH with accuracy of ±2% RH and CO2 from 0 to 5000 ppm with an accuracy of ±3% FS.

Assisted by high performance, fast and responsive NDIR sensors, it provides accurate readings in industrial conditions. It has a graphical large LED display with white backlight. Enabled with a smart cloud option using cutting edge IoT technology, you can push the recorded data directly to a web server and generate vital reports of historic data captured. Other options include data download through USB and a password protected Admin screen to view Device IMEI, Recorded data.
The RFID option helps record locations along with CO₂, temperature and RH readings (useful for multiple Floors/Zones). The monitor is GSM enabled and supports any network SIM. The battery is rechargeable with a backup of 10-12 hours on full charge. Its IP65 enclosure makes this GSM based Monitor ready for tough Industrial environments. This device finds its acceptance well in applications like IT Facilities and Buildings, Workspace Management, Warehouse, Hospitals, R&D Labs and academic environments.

Find more information at [http://acefirst.com](http://acefirst.com).

**16 GHz Sampler-extended Real-time Oscilloscope**

Pico Technology has introduced the PicoScope 9404-16 SXRTO, a 16 GHz sampler-extended real-time oscilloscope. The new model joins the 5 GHz 9404-05 model launched earlier this year. Ideally suited to repetitive or clock-derived signals, both models feature four high-resolution 12-bit channels, each supported by real-time sampling to 500 MS/s per channel and up to 5 TS/s (0.2 ps) equivalent-time sampling. These are voltage and timing resolutions that match or exceed the best available among broadband real-time oscilloscopes today.

The wide-band inputs, and fine timing and voltage resolutions, display and accurately measure transitions as fast as 22 ps and pulses and impulses down to 45 ps wide, and allow clock performance and eye diagram analysis of up to 11 Gb/s gigabit signals (to third harmonic). Less than 2 ps RMS trigger jitter and 5 GHz trigger support margin analysis and characterization of today’s high-speed serial data systems, while integrated clock and data recovery to 11 Gb/s and an external prescaled trigger input extend the SXRTO trigger capability to the full bandwidth of the 16 GHz model. In addition, the real-time broadband sampling modes can support capture of carrier envelope, baseband modulation and other envelope tracking signals around amplify, route and transmit paths, including major wireless communication frequency bands such as 900 MHz, 2.4 GHz and 5.5 GHz and upwards.

In contrast to “sampling oscilloscopes,” the ETS technique supports trigger and pre-trigger capture and the familiarity, convenience and ease of real-time oscilloscope operation. Pico’s SXRTO technology seamlessly transitions to single-event waveform capture at sampling rates at and below 500 MS/s and both sampling modes capture to memory of 250,000 samples (single channel), particularly valuable for the capture of slower system signals, modulation envelopes and repeating pulse or data patterns, for example.

This USB-controlled instrument is supplied with PicoSample 4 software. The touch-compatible GUI controls the instrument and presents waveforms, measurements and statistics on your preferred size and format of display. There is full support for available Windows display resolutions, allowing the inspection of waveform detail or presentation of measurements, for example, on 4k monitors or projection, or across multiple monitors. Additionally, up to four independent zoomed trace views can fully reveal 12-bit, 250 kS waveform detail.

For further information, visit [www.picotech.com](http://www.picotech.com).
Automated Optical Inspection (AOI) System
Seica's new desktop Dragonfly AOI inspection system utilizes leading-edge LED technology to perform conformal coat and through-hole-technology inspection, including presence checks of pins and solder, effectively combining two distinct inspection processes in a single machine.

The Dragonfly is easily able to detect UV trace elements in a variety of conformal coat chemistries but also allows for quick and accurate detection of contamination at the micron level, de-lamination of the conformal coat, air gaps/voids, and many other defects not detectable with the naked eye or traditional AOI systems.

The Dragonfly is available in two models: a low-cost, desktop version with a drawer that allows for easy manual PCB loading, and an in-line SMEMA-compliant system which is Factory 4.0 ready and can include additional options, such as side access inspection of conformal coat, as well as thickness measurements.

Find more information at www.seica.com.

Radio Frequency Vector Signal Generator
Keysight Technologies, Inc. has announced the new CXG X-Series Radio Frequency (RF) Vector Signal Generator (CXG), which delivers advanced performance, is standards-compliant, and meets the demands of engineers designing IoT and general-purpose devices at a reasonable price.

IoT and general-purpose R&D and design validation (DVT) engineers need to keep up with today's expanding consumer electronics market. They want an economic and versatile test and measurement system that can handle a diverse set of consumer electronic devices and deliver the performance required to generate receiver tests across different wireless standards.

Keysight's new CXG enables engineers designing IoT and general-purpose devices to:
- Accelerate the product development cycle,
- Gain greater confidence in design characterization with Keysight's PathWave Signal Generation software, and
- Meet budget constraints without sacrificing the ability to test with quality signals.

Key features provided by Keysight's CXG signal generator include:
- Frequency range of 9 kHz – 3/6 GHz and up to 120 MHz RF modulation bandwidth that cover most of consumer wireless application testing requirements,
- Basic parametric testing of components and functional verification of receivers,
- Testing of devices with multiple standards-compliant vector signals while reducing the time spent on signal creation,
- Troubleshooting of components within a wireless communication system using a reliable vector signal generator, and
- Minimizing downtime and expenses with self-maintenance solutions and low-cost repairs.
More information is available at www.keysight.com.

**Family of Electrical Energy Meters**
CAS DataLoggers has announced the WattNode family of power and electrical energy meters. The WattNode meters are available in several styles, from simple devices that measure kWh with a pulse output, to multifunction device meters with a Modbus RTU interface that measure more than 90 parameters.

They work with single or three-phase service from 100-600 Vac. When coupled with a dataTaker or Delphin data logger/data acquisition system, they provide the base for a comprehensive monitoring system that can capture electrical parameters like ac voltage, current, power, energy and power factor along with other data like temperature, pressure, and flow.

These systems are used in applications including:
- Energy efficiency studies
- Pump, compressor and equipment monitoring
- Energy conservation projects
- Renewable energy systems

For more information, please visit http://DataLoggerInc.com.

**Mini-Distillation Analyzer**
PAC introduces OptiPMD, ISL's latest version of its robust and portable micro-distillation analyzer. OptiPMD combines 15 years of experience with the latest technology to offer a user-friendly solution that significantly reduces the need for training. OptiPMD follows ASTM D7345, which is approved in more than 10 fuel specifications, including gasoline with up to 20% ethanol, diesel, jet fuel, kerosene and bio-diesels.

OptiPMD performs a physical atmospheric distillation in just 10 minutes using only 10 ml of sample. This allows you to make faster decisions for process optimization and potentially save you millions in off-spec products.

OptiPMD is designed to be a true "one-push-button" solution, with a fully automated test sequence, allowing minimal operator attendance. Simply prepare the sample and load it into the analyzer. Type in a sample ID, select it from the pre-loaded options, or scan it with the barcode reader. Then, just press START to run the sample. The results can be stored, printed or shared via ethernet, LIMS or with a USB drive.

OptiPMD is the fastest way to perform a distillation of petroleum products. The analyzer saves between 25 to 35 minutes per distillation, compared to D86 analyzers.

OptiPMD's robust design and compact size makes it ideal for mobile lab applications. It also includes the highest safety standards including an optical flame detector, a built-in fire
suppression system, and quality control functions, which allow users to enter specification limits by product.

OptiPMD is compliant with ASTM D7345, IP 596 and in perfect correlation to ASTM D86, D1160 (biodiesel B100), ISO 3405 and IP123.

Visit [www.paclp.com](http://www.paclp.com) for more information.

**Automotive Ethernet Testing Software**

Tektronix, Inc. has released two new software packages that greatly simplify Automotive Ethernet testing, debug and Protocol Decode for use with its 5 and 6 Series mixed signal oscilloscopes (MSO). Using the new Signal Separation software, automotive engineers can now perform Automotive Ethernet testing without disrupting the ECU system or cutting the Ethernet cable to install a directional coupler, while the PAM3 analysis package provides in-depth insight into signal characteristics at the system level.

As the move toward Automotive Ethernet or IEEE 802.3bw (formerly BroadR-Reach) technology in vehicles accelerates, comprehensive design validation is vital to ensure interoperability and reliable operation across multiple ECUs. Current Automotive Ethernet testing solutions require engineers install a directional coupler to separate the full duplex signal. This adds insertion and return loss and makes it difficult to determine if an error is a result of the system or the additional hardware.

To eliminate these problems, Tektronix’ unique Signal Separation software separates the full duplex signal by looking at voltage and current waveforms from both master and slave test points and provides separated signals using a proprietary algorithm. This method displays true ECU signals without the need for a directional coupler and provides full protocol debug of master and slave ECUs simultaneously. Tektronix Signal Separation software is easy to use, reduces testing costs and improves measurement accuracy. Signal Separation supports full lifecycle Automotive Ethernet testing from design through service. Users can use this solution for in-car testing, as well as Signal integrity testing during cranking or other scenarios.

The three levels of PAM3 in Automotive Ethernet introduce additional complexity in signaling and place new demands on test methodology, in part because the three amplitudes produce two eye diagrams. The Tektronix PAM3 analysis package provides a comprehensive set of measurements with software clock recovery that offer greater insight into signal characteristics, speeding up validation and characterization of PAM3 designs with different cable lengths, noise conditions or ECU configurations. The solution also enables eye opening measurements, eye mask testing, jitter separation and Bit Error Rate (BER) plotting in a real ECU environment.

The PAM3 Analysis along with Signal Separation solutions have been tested and validated by leading automotive OEMs and T1 companies.
In addition to signal and protocol analysis, the Tektronix solution also includes Automotive Ethernet Physical layer compliance testing as per Open Alliance TC8 specification with full test automation and detailed pass/fail reporting.

More information is available at www.de.tek.com.

**Universal O-Level Armament Tester for Smart and Legacy Systems**

The MTS-3060A SmartCan™ Gen2 builds on the features and capabilities of the MTS-3060 SmartCan™, offering advanced flightline test capabilities for suspension and Alternate Mission Equipment (AME) including pylons, launchers, bomb racks, and pods. A high-performance, hand-held device with a shape of a “beercan,” the MTS-3060A offers advanced flightline test capabilities as well as providing test capabilities associated with traditional "beercan" test sets.

The state-of-the-art MTS-3060A SmartCan Gen2 is unlike any other beercan tester and provides measurement, loading and stimuli functions that are typically associated with large O-Level testers such as the SERD-75501 and the A/E241-199. With multiple measurement channels, dedicated and continuous squib circuit monitoring, multiple load channels, audio and video simulation, and MIL-STD-1760 support, the MTS-3060A can support any platform and any “smart” and legacy armament system, without updating the OFP.

The MTS-3060A SmartCan Gen2 delivers advanced flightline test capabilities and is an ideal O-Level tester for AME and other aircraft systems as well as providing comprehensive test capabilities for both legacy and 5th generation platforms.

An innovative power management system allows operation of the SmartCan Gen2 for over 24 hours without the need to replace the standard or rechargeable AA batteries.

The MTS-3060A is supplied with ATEasy® which provides the software development environment for creating test programs. The development of test programs can be done by the end user or MTS personnel.

For more information, visit www.marvintest.com.

**Measurement Software**

Hexagon’s PC-DMIS (Dimensional Measuring Interface Standard) 2019 R2 introduces Home Page, a new way to interact with PC-DMIS that improves convenience, productivity and brings content to the user in an attractive, intuitive way, whether user focus is on the creation of measurement routines or executing them in the factory. Home Page is a significant enhancement of the traditional PC-DMIS main screen to make recent programs and favorites accessible directly from the home screen. Users can create folders and organize their measurement routines how they need them. Home Page also brings helpful content and support directly into PC-DMIS. Users now have seamless access to the latest product news, support contact, helpful videos, the PC-DMIS idea center and the regular PC-DMIS newsletter (SMA needed).
The already broad capabilities of PC-DMIS are extended further with new optional support for the skidless Breitmeier Messtechnik Roughness Sensor. Allowing users to measure roughness in PC-DMIS for the first time, the user-friendly interface enables the user to create a roughness scan command in one click, without needing extensive training or to learn new software.

The new Thickness Colormap function provides the user with clear, intuitive graphics showing the thickness of a component.

With the new Ring Light Migration feature, users can now move measurement programs from one machine to a machine that uses different ring light configurations faster and with fewer errors.


**High Mating Cycle (HMC) Enables Flexible Production and Simplified Installation**

One of the core requirements of flexible production is the ability to quickly install machines and modules, reconfigure them at will and operate them without disruption. With its Han® ES Press HMC series, HARTING has developed an interface that can be installed quickly without tools and is robust enough to be connected and disconnected ten-thousand times.

This quick-connect technology is the Han® ES Press HMC, with the suffix ‘HMC’ standing for High Mating Cycles. The contact inserts are equipped with a pre-tensioned cage clamp that is triggered by an actuator. If the actuator is pushed into the contact chamber, the cage clamp returns to its original position and secures the conductor. Only a screwdriver is needed to release the connection.

The Han® ES Press HMC fits with Han® standard housing sizes 6 B to 24 B. The standard housings are already available in versions with locks and seals optimized for high mating cycles. Complementing this, contacts and grounding elements are now used that are extremely resistant to abrasion due to a special surface coating.

The Han® ES Press series is reliable in all types of harsh environments, including high vibration environments. This is due to how tightly the conductor sits as a result of the constant pressure of the cage clamp. Installation and connection times are reduced when compared to conventional cage clamps, screw connections or hard wiring techniques. As a result, on-site installation time is reduced, and fast detachability facilitates servicing.


**Surge Protection Devices**

Littelfuse, Inc. has announced the launch of its SPD2 series of Type 2 surge protection devices. Transient overvoltage, or power surges, can damage components and drive added costs to repair or replace as well as create unplanned downtime. To prevent these events, the SPD2 series,
utilized at power distribution or branch circuits, safeguards components from surges by limiting the fault current to a load or the unit being protected.

The SPD2 series is DIN-rail mounted for electrical cabinets and comes in a wide range of operating voltages including DC power for solar applications. The product is ideal for power distribution, electrical loads, industrial controls, computers and communications as well as medical equipment.

The SPD2 features include:

- Capability to clamp and withstand high-energy transients to prevent disruption, downtime, and degradation or damage to equipment
- Thermal protection to eliminate catastrophic failure
- Each part is both UL Recognized and IEC-compliant to reduce inventory and support global usage
- A compact footprint to increase electrical panel design flexibility
- An interlocking tab mechanism to withstand vibration
- An SPD type and voltage-coded plug to prevent the module from being placed in the wrong base, eliminating the risk of improper protection
- A visual life indicator for quick determination of module replacement status.

For more product information, visit: www.littelfuse.com/SPD.