

Guest Editorial

Special Section on the 2019 IEEE Measurement and Networking Symposium, Catania, Italy, July 8–10, 2019

THE IEEE Symposium on Measurements and Networking (M&N) is a conference sponsored by the IEEE Instrumentation and Measurement Society (IMS). It is a privileged forum for discussing the emerging trends in the areas of measurements, communications, computer science, wireless systems, and sensor networks and fostering a debate with engineers and researchers from academia, government, and industry on the crucial role of measurements for networking and networking for measurements.

The Symposium has been mainly promoted by the IEEE IMS TC-37 “Measurements and Networking,” the IEEE Instrumentation and Measurement Italy Chapter, and the IEEE Italy Section Systems Council Chapter.

The fifth edition of this biennial event was held in Catania, Italy, on June 8–10, 2019, in a wonderful venue, “Museo Diocesano,” located in the heart of the city. Catania is the second largest city of Sicily, and it hosts the oldest University of Sicily, Italy, and its foundation dates back to 1434.

The symposium was attended by 70 registered participants, with an increment of 45% respect the previous edition. The technical program included a total of 64 accepted articles, after the usual review process, from all over the world and covering all the aspects of the abovementioned subjects. It was organized in seven oral presentation sessions and two poster presentation sessions held during the three days of the conference. The oral presentation sessions included four special sessions that have been characterized by a great response of the measurement and networking communities because they have been focused on the following hot research topics: 1) measurements for networking: traffic monitoring and performance analysis; 2) sensor networks and sensing systems for assistive technology; 3) antenna and RCS measurements; and 4) intelligent sensors technologies for structural health monitoring (SHM).

Furthermore, the technical program was enhanced by four invited keynotes that have presented to the attendance the most recent results in challenging issues: 1) performance measurements of an MEC-based automotive service (Prof. Carla-Fabiana Chiasserini, Politecnico di Torino, Turin, Italy); 2) environmental sensing (Dr. Giuseppe Bruno, ST-Microelectronics); 3) electronic data exchange for

personalized digital health (Prof. Ricardo Goncalves, New University of Lisbon, Lisbon, Portugal); and 4) experiments with learning, sensing and communications in UAVs (Prof. Kaushik Chowdhury, Northeastern University, MA, USA).

During this edition, three awards have been assigned by the Technical Program Chairs with the aim of strongly encouraging the research in the measurement and networking fields, selecting the best articles in the following categories.

- 1) Best Paper Award “Domenico Grimaldi.”
- 2) Best Paper Young Author Award “Nicola Pitrone.” To be a candidate for this award, a paper must be co-authored and presented by a researcher younger than 35 years of age.
- 3) Best Poster Award.

The Symposium was organized in the context of new advances in material science, embedded systems and communication, and the increased demand to perform the real-time process and structures monitoring associated with smart cities and smart healthcare. In this new era, the measurements associated with sensing and networking as part of the Internet of Things Ecosystems become extremely important for industry and services. Gathering data from real or virtual environments nowadays the sensors are part of instrumented objects and processes. Information about environment parameters or material characteristics can be obtained. Thus, air quality or water quality can be monitored using novel sensing solution that provides information about the general conditions of indoor or outdoor air quality or drinking water or seawater. Temperature, humidity, and light measurement channels are usually implemented on the level of the wireless sensor network for air quality monitoring. Exigent requirements for the air quality sensing and instrumentation manufacturers are covering metrological characteristics, mainly expressed by accuracy and sensitivity, interoperability, low power consumption, smart size, and low cost. Together with the air quality, the water quality is an important issue in the context of the increase of the global population and economic activities without appropriate optimization of water consumption. The online monitoring of water pollutants became a challenging problem considering the necessity to discover the accidental pollutant event and to avoid the water contamination using latest developments in the field sensing and instrumentation for water quality monitoring.

Statistics underlines the fact that contemporary population are spending big part of their life in indoor conditions. Safe indoor conditions can not only be expressed by indoor air quality but also related to the building structure. The latest developments provide instrumentation and measurement solutions regarding SHM that is defined as a process of implementing the damage detection and characterization strategy for engineering structures. Inertial MEMS sensors are usually employed as part of automated instrumentation to extract information about anomalies in structures in real time based on vibration measurement.

The inertial sensors can also be used to extract other type of information from moving objects and are commonly used for gait and posture assessment during diagnosis or rehabilitation of human motor system impairments.

The “M&N 2019” IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT Special Issue consists of five articles that were accepted after a peer-reviewed process that satisfies the exigencies of the IEEE TIM. The articles were presented in a shorter format at IEEE M&N 2019, and the authors have extended their contributions with more research results to be included in the article submitted and accepted for this special issue.

The first two articles are on the area of the air and water quality monitoring. Novel sensing solution and sensor characterization are presented. Inertial MEMS sensors and their application are part of the next two articles, the applications of the inertial sensors for SHM and human postural stability being considered. The last but not least article accepted for this special issue refers to one of the latest results obtained in the field of visible light communication, communication solution that can be part of the sensing systems with application for smart cities deployments.

Regarding the humidity measurement, the article “Performance Analysis of a Humidity Sensor Based on a Micro-Resonator Functionalized With TiO₂ Nanoparticles” proposes a novel humidity sensor based on a low-frequency micro-machined electromechanical resonator functionalized with nanoparticles of TiO₂ deposited on a preparation layer of Al₂O₃ nanoparticles. A relationship between the sensor construction parameters, the obtainable sensor resolution, and the requirements in terms of resolution and accuracy of the measurement system is obtained being underlined the applicability of such type of sensors in the context of low-cost, low-power distributed sensing systems. Important findings can be mentioned the fact that the sensor sensitivity can be increased simply by repeating the TiO₂ nanoparticle deposition obtaining at least an increase of the relative sensitivity of 5 ppm/1% RH at each deposition step.

Water quality assessment solution in the laboratory scenario is presented in the “Towards Smart Selective Sensors Exploiting a Novel Approach to Connect Optical Fiber Biosensors in Internet” article. The selective detection of pollutants in water using low-cost optical biosensors based on plastic optical fibers (POFs) and biological or biomimetic receptors are described by the authors. The detection in water of naphthalene, perfluoroalkyl, and polyfluoroalkyl substances (PFAs) has been obtained with higher accuracy by comparison

with traditional approaches. The developed sensor can be easily integrated into complex systems that perform *in situ* for the remote measures of pollutants in water for smart city applications.

The application of smart sensing systems for smart cities also involves the SHM that becomes attractive for its potentialities in many applications where distributed sensing solutions are considered. Low-cost and low-power solutions are starting point requirements for these types of systems that assure and easy deployment of progressively denser sensor networks and their compatibility with a permanent installation. Real-time monitoring for reduced global maintenance costs is expected. In this context, the article “Vibration-Based SHM With Up-Scalable and low-Cost Sensor Networks” describes a sensor network that is based on either MEMS accelerometers or cost-effective piezoelectric devices to extract strictly synchronized modal parameters. The performances of the two sensing technologies are evaluated in two different setups to assess the reliability in the estimation of modal features even in the presence of potential damages. The consistency of the obtained results paves the way for a more compact and affordable monitoring system exploiting piezoelectric-driven modal analysis.

The postural stability can be defined as the ability to maintain an upright position. It comes in two forms, static and dynamic. Static postural stability is when you are standing and not moving, whereas dynamic stability is when you are moving or doing specific movement. Monitoring stability can be observed symptoms of disorders, such as ear diseases, high blood pressure, diabetes, psychiatric disorders, and neurodegenerative diseases such as Parkinson. In the article “A Measurement System to Monitor Postural Behavior: Strategy Assessment and Classification Rating,” the experimental assessment based on wearable inertial device is presented, aiming continuous monitoring of the user’s postural sway. The information is used to define a novel postural sway classification algorithm providing a classification index.

The limited radio frequency spectrum puts constraints on the increasing demand for ubiquitous connectivity and high capacity. In this context, visible light communication becomes one of the solutions for an alternative way of communication that can also be associated with the distributed sensing system. Different studies are reported regarding the visible light communication protocols. The article “Characterization and Measurement of Performance Properties of the UFSOOK Camera Communication Protocol” proposes a performance analysis of the undersampled frequency shift ON–OFF keying (UFSOOK) protocol and a measurement process associated with theoretical results validation. In the article, data transmission is modeled as a measurement process, and the analysis of the underlying measurement channel and the possible error sources reveals important performance properties of the protocol itself.

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It has been our great pleasure to be the guest editors of this special section. We owe to thank all the people that have made possible the publication of this special section.

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Dr. Miele is a member of the Italian Association “Electrical and Electronic Measurements Group,” the IEEE Instrumentation and Measurement Society, the IEEE 802.22 Working Group, and the IEEE 802.15.22 Task Group. He was a recipient of the Carlo Offelli Prize for the Best

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Prof. Postolache received the IEEE Best Reviewer and the Best Associate Editor in 2011, 2013, and 2017, and other awards related to his research activity at different international scientific forums. He is a Distinguished Lecturer of the IEEE IMS with more than 50 invited talks and keynotes, the Chair of the IEEE IMS TC 2013, and the current Chair of the IEEE IMS Portugal Chapter. He is an Associate Editor of the IEEE SENSORS JOURNAL and the IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT.