Foreword
Embedded Sensor Systems

EMBEDDED sensor systems are gaining a role of importance in the research community because a large number of embedded computers are deeply integrated into our lives, cars, houses, and work environments. They support us in decisions, analyze and process physical quantities surrounding us in order to simplify our lives. Embedded sensor systems control our health status, allow us to prevent diseases, or help a physician to monitor us while we are at home or at work. At the same time, they prevent accidents and control our level of fatigue or attention. Embedded sensor systems may also bring significant improvements in the industrial field and factory automation. It is not futuristic to think about a world where manufacturing robots and other industrial automation systems meaningfully interact with the objects they are assembling, or a factory in which they are able to move with deftly and safety, because they know the surrounding environments well. Embedded sensor systems can allow working machines to be able to "see," "hear," and thus understand their surroundings. They can improve our safety, life, health, and industrial production. It clearly seems that the smart factories, such as the intelligent houses, proactive smartphones, and wearable mobile health systems, are no longer science fiction. These applications lay the foundations for greater challenges on smart sensors and embedded sensor systems. These challenges need innovative solutions, and this Special Section realizes a forum for designers, researchers, and major industrial personalities, in which to present their latest developments in the embedded sensor systems.

The Special Section of the IEEE TRANSACTIONS ON COMPONENTS, PACKAGING, AND MANUFACTURING TECHNOLOGY wants to investigate in this direction. In this aim, we proposed to the best paper authors—but not limited to them—of the 7th IEEE International Workshop on Advances in Sensors and Interfaces (IWASI 2017) Proceedings to submit unpublished manuscripts that could contribute innovative ideas to the Special Section on the following topics:

1) sensor networks in industrial environmental applications;
2) printed, flexible sensors and interfaces;
3) sensor interfaces: analog and digital sensor data processing architectures;
4) energy harvesting approaches for sensor systems;
5) noise and artifacts rejection techniques in hardware design and signal processing;
6) architectures for energy-neutral and self-sustaining sensing systems;
7) ultra-low-power read-out systems for sensor networks;
8) brain–computer interfaces and robotics.

After a careful peer-review phase, we selected ten papers out of 30, of which nine are in the present issue.

Here, the proposed papers investigate a wide range of the embedded sensor system peculiarities.

Several papers are dedicated to embedded systems for healthcare, ranging from lab-on-chip applications to multi-biosignal-based architecture for disease monitoring or robot remote control. Other papers investigate technological impacts and mathematical modeling of the embedded sensor systems. Attention has also been dedicated to the chemical sensor system for food safety and flexible sensing system.

Paun and Paun realized a novel 3-D model to accurately characterize the antenna in cochlear implants. The model embeds a complete mathematical description of the tissues (skin and mastoid bone) surrounding the implanted antenna.

Costantini *et al.* outline the development of a lab-on-chip, based on thin-film sensors, suitable for DNA treatments. The proposed approach exploits the combination between a polydimethylsiloxane microfluidic network, thin-film electronic devices, and surface chemistry to realize a fast and low reagent consumption system.

Meattini *et al.* developed a human–robot interface system based on electromyography (EMG) sensors connected to a wearable sensor node for the acquisition and processing. It was then remotely interfaced to two robotic hands. The novel bio-inspired approach merges pattern recognition and factorization techniques to combine a natural selection of the robotic hand configuration with the proportional control of the related grasps.

Fattori *et al.* present the design and experimental characterization of large-area active matrixes on foil for pressure-sensing applications. The proposed front-end circuits are fully based on organic thin-film transistors, placed on a flexible substrate, which are laminated with a foil hosting screen-printed PDVF-TrFE piezo sensors to create the complete flexible sensing system.

An embedded cyber-physical system, based on a field-programmable gate array (FPGA) core, for the identification and the real-time extraction of highly selective diagnostic indexes of Parkinson's disease (PD) patients, has been proposed by De Venuto *et al.* The authors developed and implemented on FPGA the complete noninvasive, wearable, and wireless architecture from the EEG/EMG acquisition to the FPGA processing and classification. The architecture proved suitable for PD recognition during gait and for the postural instability detection.

In their work, Asquini *et al.* describe the analysis and development of an evanescent waveguide sensor system, based

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on a hydrogenated amorphous silicon (a-Si:H) photodiode and a double ion-exchanged waveguide diffused in a borosilicate BK7 glass substrate. The paper details simulation results, jointly with the realization of the first prototype made using standard microelectronics techniques.

Licciardo *et al.* investigate three different designs of a Gabor filter, showing different tradeoffs between accuracy, area, power, and timing. They propose an accurate comparative study, highlighting the strength points of each one and choosing the best design. The designs have been targeted to a Xilinx field-programmable gate array platform and synthesized to 90-nm CMOS standard cells.

De Cesare *et al.* report on the design, fabrication, and characterization of a prototype of a portable detection system, which is able to determine if the contamination level of Ochratoxin A (OTA) is below or above the limit imposed by the EU Commission for a specific food. The authors exploit the natural fluorescence of the OTA molecules by using a UV excitation source, allowing detection of the re-emitted light with an array of amorphous silicon photosensors.

Marin *et al.* analyze the drift error analysis of integrated resistive sensor interfaces proposing their improvement by using drift-cancellation techniques. The work focuses on highly digital time-domain bang–bang phase-locked loop-based architectures, taking into the account feedback mechanisms of the architecture under nonideal circuit conditions.

We think that this special section gives new ideas and new starting points of research in the embedded sensors systems field.

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Prof. De Venuto has been an IEEE ISQED Fellow since 2010. She was a recipient of several best paper awards at several international conventions. She initiated the biannual IEEE Advances in Sensors and Interfaces Workshop, which successfully continued over the years since 2005, in collaboration with the IEEE Electronics Packaging Society (formerly the IEEE Components, Packaging, and Manufacturing Technology Society).

Thilo Sauter (F'14) received the Dipl.-Ing. and Doctorate degrees in electrical engineering from the Vienna University of Technology (VUT), Vienna, Austria, in 1992 and 1999, respectively.

From 1992 to 1996, he was a Research Assistant with the Institute of General Electrical Engineering, VUT, and was involved in research on programmable logic and analog application-specified integrated circuit design. He was with the Institute of Computer Technology, VUT, and led the Factory Communications Group. From 2004 to 2013, he was the Founding Director of the Institute for Integrated Sensor Systems, Austrian Academy of Sciences, Wiener Neustadt, Austria. Since 2013, he has been with the Center for Integrated Sensor Systems, Danube University Krems, Krems, Austria. In 2014, he became a tenured Associate Professor of automation technology at VUT. He has authored over 300 scientific publications. His current research interests include smart sensors and automation networks with a focus on real-time, security, interconnection, and integration issues.

Dr. Sauter was recognized by IEEE for his contributions to synchronization and security in automation networks in 2014. He is the Vice President of the Austrian Association for Instrumentation, Automation, and Robotics, an AdCom Member of the IEEE Industrial Electronics Society, and a Treasurer of the IEEE Austria Section. He has held leading positions in renowned IEEE conferences. He is currently an Editor-in-Chief of the *IEEE Industrial Electronics Magazine* and an Associate Editor of the IEEE TRANSACTIONS ON INDUSTRIAL INFORMATICS and the IEEE SENSORS JOURNAL. Moreover, he has been involved in the standardization of industrial communication systems for more than 15 years.