

Guest Editors' Introduction: Implantable Medical Devices

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■ **THIS SPECIAL ISSUE** of *IEEE Design&Test* (D&T), sponsored by the IEEE Computer Society (CS), is devoted to the emerging biomedical devices, circuits, systems, and applications. In fact, the Special Issue covers several topics dealing in particular with implantable/wearable electronics, brain-machine/-computer interfaces, biosensor devices and interfaces, telecare/point-of-care systems, body area/sensor networks, lab-on-chip and BioMEMS, bioinspired/biomimetic systems, biofeedback sensing and treatment, biomedical/clinical imaging technologies, analog/digital biosignal processing methods, and biosensing/biostimulation system modeling.

Over the past decade, circuit techniques intended to build wearable and implantable medical devices (IMDs) such as biosensors and biostimulators have been applied, dealing with exponential increasing needs and not only addressing various medical diseases but also used to discover various unknown phenomena in neuroscience at various cell levels, particularly in areas of brain sciences and cognition as well as various neural pathologies. The recent development in neuroengineering techniques has attracted attention of researchers from numerous fields of interests in order to solve the complexity of building heterogeneous microsystems and find solutions on how to deal with the various bottlenecks of IMDs. Authors were invited to submit original research and application contributions to this Special Issue.

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The call for contributions was spread at large; we did not target any specific IEEE society meeting, nor a conference. Most IEEE societies are publishing annual special issues in main journals such as the IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS (TBioCAS) as destination, so then here we decided to cover more events from various societies (CASS, SSCS, EMBS) dealing with the proposed topic.

This Special Issue attracted several full paper submissions from many countries. The selected papers reflect continuing trends toward circuits and systems techniques covering a wide variety of subjects within the biomedical research fields, ranging from basic building blocks to system applications. Among the submitted contributions, a preselection of best papers has been carefully reviewed by international experts, and finally five contributions have been accepted for publication in this Special Issue. These selected contributions deal with all types of ultralow power wireless technologies and include: 1) implantable systems for neurostimulation; 2) implantable glucose sensors; 3) biosignal analog/digital converters; 4) multichannel wireless neural recording; and 5) wireless power and data telemetry systems. We are aware that we probably missed excellent contributions, but we do know that we did our best to put together a Special Issue as complete as possible.

The review process of this Special Issue is the result of a truly international cooperation of experts. We feel very much indebted to the leadership of our IEEE colleagues and thank them for the invaluable support to make this Special Issue happen.

We wish to thank our co-researchers from all around the world, for choosing to submit their contributions to this Implantable Medical Devices Special Issue for review. Due to their many and important contributions, we managed to create an issue of high scientific quality. In fact, it has been gratifying to learn more about the advances in this emerging field of interests.

We would like to thank the numerous volunteers that helped to review the submitted manuscripts. We wish to thank Andre Ivanov, the former EIC of *IEEE D&T*, and Jörg Henkel, the current EIC of *IEEE D&T*, and Sara Dailey, the Administrator, for giving us the opportunity to organize this Special Issue. We also wish to express our deepest gratitude to the CS personnel for their efforts; this Special Issue was possible only with their expert help.

Here is the lineup of the papers in this Special Issue:

- 1) "Advances in Scalable Implantable Systems for Neurostimulation Using Networked ASICs," by Liu et al.;
- 2) "Multichannel Wireless Neural Recording AFE Architectures: Analysis, Modeling, and Trade-offs," by Tong and Ghovanloo;
- 3) "*In Vitro* Long-Term Performance Evaluation and Improvement in the Response Time of CMOS-Based Implantable Glucose Sensors," by Tokuda et al.;
- 4) "Pulse-Width-Modulating Biosignal ADC for Rapid ASIC Design and IP Core Reuse," by Rieger and Ou;
- 5) "A Multichannel Power-Supply-Modulated Microstimulator With Energy Recycling," by Lee et al. ■

Mohamad Sawan joined Polytechnique Montréal, Montréal, QC, Canada, in 1991, where he is currently a Professor of Microelectronics and Biomedical Engineering. His interests are the design and test of analog, digital, RF, MEMS, and optic circuits and microsystems. Sawan has a PhD in electrical engineering from Sherbrooke University, Sherbrooke, QC, Canada (1990). He holds a Canada Research Chair in Smart Medical Devices (2001–2016). He is

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He is founder and cofounder of several international conferences such as the IEEE NEWCAS, ICECS, and BIOCAS. He is also cofounder, Associate Editor (AE), and Editor-in-Chief of the IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS (BIOCAS) and AE of the IEEE TRANSACTIONS ON BIOMEDICAL ENGINEERING. He is Guest Editor, AE and member of the board of several other international journals. He is the General Chair of the IEEE-ISCAS 2016 in Montreal. He is Fellow of the IEEE, Fellow of the Canadian Academy of Engineering, Fellow of the Engineering Institute of Canada, and Officer of the Quebec's National Order.

Shuenn-Yuh Lee is currently a Professor at the Department of Electrical Engineering, National Cheng Kung University, Tainan, Taiwan. His research interests include biomedical circuits and systems design, low-power signal acquisition systems, and wireless healthcare systems. Lee has a PhD from the National Cheng Kung University, Tainan, Taiwan (1999). He served as the Chairman of Heterogeneous Integration Consortium (HIC) under the VLSI Educational Program sponsored by Ministry of Education, Taiwan, from 2009 to 2011. He served as the Technical Program Chair (TPC) of the 2011 International Symposium on Bioelectronics & Bioinformatics (ISBB) and the 2013 IEEE International Conference on Orange Technologies (ICOT), and the Publication Chair for the 2012 IEEE Asia Pacific Conference on Circuits and Systems (APCCAS). Since 2013, he serves as the Chairman of IEEE Solid-State Circuits Society Tainan Chapter. He is a member of the IEEE Engineering in Medicine and Biology (EMB) Society, the IEEE Circuits and Systems (CAS) Society, and the IEEE Solid-State Circuits (SSC) Society.

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