Guest Editorial—Selected Papers from the 2014 IEEE International Solid-State Circuits Conference

The IEEE International Solid-State Circuits Conference (ISSCC) is the flagship conference of the IEEE Solid-State Circuits Society and the foremost global forum for presenting advances in solid-state circuits and systems-on-a-chip. From 2010 to 2013, the IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS has highlighted selected papers from ISSCC on topics related to biological and healthcare applications. This special issue once again features six selected papers from ISSCC 2014, held in San Francisco, CA, USA on February 9–13, 2014.

This set of papers offers a sample of the rapidly expanding developments in solid-state circuits for health monitoring, therapeutics, diagnostics, and medical research applications. The selection of these papers, whose final decision was based on a thorough peer review process, was coordinated with the Editor-in-Chief of the IEEE JOURNAL OF SOLID-STATE CIRCUITS (JSSC), Prof. Michael Flynn, to avoid overlap with its ISSCC 2014 special issue, which includes biomedical papers as well. We also acknowledge the ISSCC 2014 General Chair, Prof. Anantha Chandrakasan, and the Editor-in-Chief of the IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS, Prof. Gert Cauwenberghs, for their support.

The paper by Roh *et al.* from KAIST, Korea entitled "A Wearable Neuro-feedback System with EEG-based Mental Status Monitoring and Transcranial Electrical Stimulation" presents a wearable neuro-feedback system. At its core is a low-power SoC that supports EEG-based mental status monitoring and transcranial electrical stimulation (tES) for closed-loop neuro-modulation. A self-configured independent component analysis (ICA) is implemented to accelerate the source separation with low power dissipation. An embedded support vector machine (SVM) enables online source classification. The 130 nm CMOS SoC dissipates 4.45 mW of power in order to obtain 16 independent components. For non-invasive neuro-modulation, the tES stimulation with a current of up to 2 mA is implemented on the SoC.

The paper by Chiu *et al.* from National Tsing Hua University, Taipei Medical University, Chung-Shan Institute of Science and Technology, and National Chiao Tung University, all in Taiwan, entitled "A Fully Integrated Nose-on-a-Chip for Rapid Diagnosis of Ventilator-Associated Pneumonia" presents a rapid diagnostics strategy for ventilator-associated pneumonia. A nose-on-a-chip is installed in a ventilator in order to monitor and detect pneumonia at an early stage. The chip has eight on-chip gas sensors, an adaptive sensor interface, a SAR ADC, a continuous restricted Boltzmann machine learning kernel, and a RISC core with a low-voltage SRAM. The chip is fabricated in 90 nm CMOS and consumes 1.27 mW at 0.5 V.

Digital Object Identifier 10.1109/TBCAS.2014.2386411

The paper by Long *et al.* from IMEC, Belgium; TU Eindhoven, The Netherlands; Olympus, Japan; and KU Leuven, Belgium is entitled "A 680 nA ECG Acquisition IC for Leadless Pacemaker Applications." This paper presents a sub-μW ECG acquisition IC for single-chamber leadless pacemaker applications. It integrates a low-power, wide-dynamic-range ECG readout front-end together with an analog QRS-complex extractor. The ASIC consumes 680 nA and achieves CMRR $>$ 90 dB, PSRR $>$ 80 dB, an input-referred noise of 4.9 μVrms in a 130 Hz bandwidth, and exhibits rail-to-rail DC offset rejection. Low-power heartbeat detections are evaluated with the help of the IC acquiring nearly 20,000 beats across 10 different records from the MIT-BIH arrhythmia database. In the presence of muscle noise, both the average sensitivity and positive predictivity are more than 90% when the input SNR is greater than 6 dB.

The paper by Lu *et al.* from National Taiwan University, National Taiwan University Hospital and Chang Gung University Taiwan entitled "A Remotely-Controlled Locomotive IC Driven by Electrolytic Bubbles and Wireless Powering" presents a battery-less and remote-controlled IC that is able to move across a liquid surface by generation of electrolytic bubbles as the propelling force. The IC is both wirelessly powered and controlled by a 10 MHz ASK modulated signal to execute movement in four moving directions and two speeds. The receiving coil and electrolysis electrodes are all integrated on the locomotive chip. Experimental results demonstrate that the bare IC is able to move across the surface of an electrolyte with a speed of up to 0.3 mm/s, and is also able to change direction of movement under remote control. The chip is fabricated in a 0.35 μm CMOS technology and exhibits power consumption of 125.4 μW and 82 μW, for transceiver control and electrolytic generation, respectively.

The paper by Um *et al.* from SK Hynix, POSTECH, and Samsung Korea, entitled "An Analog-Digital Hybrid RX Beamformer Chip with Non-Uniform Sampling for Ultrasound Medical Imaging with 2 D CMUT Array," introduces a 64-channel ultrasound array with a hybrid analog-digital two-stage non-uniform sampling beamformer. This approach reduces the system memory requirements by approximately forty times over conventional designs. Implemented in 0.13 μm CMOS, the chip was demonstrated to achieve a steering angle of $\pm 45^\circ$ in phantom models, all with a power consumption of 1.14 W.

Finally, the paper by Huang *et al.* from National Chiao Tung University, Taiwan, entitled "2.5 D Heterogeneously Integrated Microsystem for High-Density Neural Sensing Applications," describes a 16-channel neural interfacing system featuring TSV-based microprobes integrated within an interposer connecting four heterogeneous chips for acquisition and processing of neural data. The data acquisition chip, implemented in 0.18 μm CMOS, features 16 analog front-ends, analog multiplexors, and 4 ADCs, which then drive feature extraction processing and control logic on low-power FPGA and MCU dies. Occupying a total footprint of $5 \times 5\ \mathrm{mm}^2$, the system consumed a total of $676.3\ \mu\mathrm{W}$, and was demonstrated *in-vivo* in a rat model.

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Dr. Genov was a corecipient of the Best Paper Award of the IEEE Biomedical Circuits and Systems Conference, Best Student Paper Award of the IEEE International Symposium on Circuits and Systems, Best Paper Award of the IEEE Circuits and Systems Society Sensory Systems Technical Committee, Brian L. Barge Award for Excellence in Microsystems Integration, MEMSCAP Microsystems Design Award, DALSA Corporation Award for Excellence in Microsystems Innovation, and Canadian Institutes of Health Research Next Generation Award. He was a Technical Program Cochair of the IEEE Biomedical Circuits and Systems Conference. He was an Associate Editor of IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS-II: EXPRESS BRIEFS and IEEE SIGNAL PROCESSING LETTERS. Currently, he is an Associate Editor of IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS and a member of IEEE International Solid-State Circuits Conference International Program Committee.

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Dr. Mercier was a corecipient of the 2009 ISSCC Jack Kilby Award for Outstanding Student Paper at ISSCC 2010. He also received a Natural Sciences and Engineering Council of Canada (NSERC) Julie Payette Fellowship in 2006, NSERC Postgraduate Scholarships in 2007 and 2009, an Intel Ph.D. Fellowship in 2009, the Graduate Teaching Award in ECE at UCSD in 2013, and the Hellman Fellowship Award in 2014. He currently serves as an Associate Editor of the IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS.