Session 6 Overview: *Emerging Medical and Sensor Technologies*

Technology Directions Subcommittee

Session Chair: *David Ruffieux*
CSEM, Neuchatel, Switzerland

Session Co-Chair: *Yogesh Ramadass*
Texas Instruments, Dallas, TX

This session presents recent advances in semiconductor devices for health status diagnosis and therapy, from ICs for adaptive drug delivery to wearable monitoring and analysis of physiological signals including EEG and EMG. The second half of the session focuses on emerging technologies for sensor applications including ADCs implemented in fully-printed organic technologies, capacitive sensors made completely with carbon nano-tube FETs and SPAD line sensors for Raman spectroscopy in Mars rover applications.

1:30 PM

6.1 An 87mA·min Iontophoresis Controller IC with Dual-Mode Impedance Sensor for Patch-Type Transdermal Drug Delivery System
K. Song, KAIST, Daejeon, Korea

In Paper 6.1, KAIST demonstrates a 110nm, 5.5mm^2, 2.2mW, 87mA×min iontophoresis smart controller IC with dual-mode impedance sensors for a patch-type transdermal drug delivery system. It can measure skin temperature and contact/tissue impedance to adapt the stimulation allowing real-time monitoring of the delivered drug dosage.

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6.2 A 1.83µJ/Classification Nonlinear Support-Vector-Machine-Based Patient-Specific Seizure Classification SoC
M. Altaf, Masdar Institute of Science and Technology, Abu Dhabi, United Arab Emirates

In Paper 6.2, Masdar Institute of Technology introduces a 0.18µm, 25mm^2, non-linear support vector machine-based seizure classification SoC with multichannel EEG data acquisition and storage for epileptic patients monitoring. The system achieves a seizure detection accuracy of 95%, a false alarm rate below 1% while consuming1.8mJ per classification.

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6.3 Through-Silicon-Via-Based Double-Side Integrated Microsystem for Neural Sensing Applications
C-W. Chang, National Chiao Tung University, Hsinchu, Taiwan

In Paper 6.3, National Chiao Tung University, China Medical University and Advanced Semiconductor Engineering Group presents a single die microsystem consisting of a 16-channel neural microprobe array connected with Through Silicon Vias to 0.18µm CMOS readout circuitry to enable low noise EEG measurements. The front-end achieves 1mV_{rms} input-referred noise in a 0.4-to-7.3kHz bandwidth, while consuming 350mW.

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6.4 1µm-Thickness 64-Channel Surface Electromyogram Measurement Sheet with 2V Organic Transistors for Prosthetic Hand Control

H. Fuketa, University of Tokyo, Tokyo, Japan and JST/ERATO, Tokyo, Japan

In Paper 6.4, University of Tokyo and JST/ERATO presents a 18cm^2 64-channel surface electromyogram measurement sheet implemented with 2V organic transistors for prosthetic hand control. A 4-fold increase in electrode density is achieved using a distributed and shared amplifier architecture while a post-fabrication select-and-connect method reduces transistor mismatch and power consumption.

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6.5 A 4b ADC Manufactured in a Fully-Printed Organic Complementary Technology Including Resistors

S. Abdinia, Eindhoven University of Technology, Eindhoven, The Netherlands

In Paper 6.5, Eindhoven University of Technology, CEA-LITEN, University of Catania and STMicroelectronics describes a 4b ADC manufactured in a fully-printed organic complementary technology. With the help of an R2R DAC, the converter achieves rail-to-rail 40V operation with an SNDR of 19.6dB, SNR of 25.7dB and 2Hz bandwidth. The DAC's DNL and INL are 0.24 and 0.42LSB, respectively.

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6.6 An Organic VCO-Based ADC for Quasi-Static Signals Achieving 1LSB INL at 6b Resolution

D. Raiteri, Eindhoven University of Technology, Eindhoven, The Netherlands

In Paper 6.6, Eindhoven University of Technology and Polymer Vision presents a 6b organic VCO-based ADC. Implemented in a p-only double-gate organic TFT technology, the ADC achieves an INL of 1LSB, DNL of 0.6LSB without calibration and consumes 2.4uA of current for a die area of 19.4mm^2.

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6.7 A 1024×8 700ps Time-Gated SPAD Line Sensor for Laser Raman Spectroscopy and LIBS in Space and Rover-Based Planetary Exploration

Y. Maruyama, Delft University of Technology, Delft, The Netherlands

In Paper 6.7, Delft University of Technology and Jet Propulsion Laboratory presents a 30mm^2, 1024x8 time-gated SPAD line sensor for time-resolved laser induced Raman spectroscopy. Intended for next generation Mars rovers, the 0.35µm HV CMOS sensor has a 44% fill factor, achieves 21% photon detection probability at 475nm, 250ps time resolution and fast 1.1ns gating.

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6.8 Experimental Demonstration of a Fully Digital Capacitive Sensor Interface Built Entirely Using Carbon-Nanotube FETs

M. Shulaker, Stanford University, Stanford, CA

In Paper 6.8, Stanford University and KU Leuven unveils a fully digital capacitive sensor interface built using carbon nanotube FETs and implemented in a VLSI compatible fashion. It is the first demonstration of a complete system implemented with such a technology. The sensor interface based on a sensor-controlled oscillator consumes 336uW from a 3V supply while achieving a 1.83% nonlinearity.