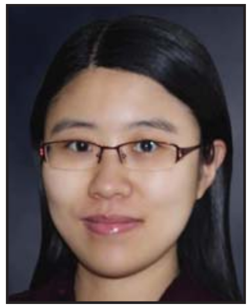
Session 18 Overview:
Biomedical Devices, Circuits, and Systems
TECHNOLOGY DIRECTIONS SUBCOMMITTEE

Session Chair:
Rabia Tugce Yazicigil
Boston University, Boston, MA



Session Co-Chair:
Milin Zhang
Tsinghua University, Beijing, China

Session Moderator:
Patrick P. Mercier
University of California San Diego
La Jolla, CA

This session covers biomedical systems with innovations that traverse device, circuit, and system-level design. The first paper describes a retinal prosthetic that utilizes an optically-addressed nanowire array in conjunction with a transmitter-offloaded wireless neural stimulation approach for efficient operation near sensitive retinal tissue. A pneumatic-free fully-CMOS-controlled microfluidics platform for label-free cellular and bio-molecular sensing comes next, followed by a CMOS microscopic-scale thermal actuation and sensing array for localized heating of magnetic nanoparticles for hyperthermia cancer therapy. The final paper showcases a wireless multimode IC integrating electrochemical sensors, a temperature sensor, and a current stimulator for monitoring chronic wound healing processes.

8:30 AM

18.1 An Optically-Addressed Nanowire-Based Retinal Prosthesis with 73% RF-to-Stimulation Power Efficiency and 20nC-to-3μC Wireless Charge Telemetering

Abraham Akinin, University of California, San Diego, La Jolla, CA

In Paper 18.1, the University of California San Diego and Nanovision Biosciences present a retinal prosthetic that enables scaling to 1512 channels via an optically-addressed nanowire array. The system achieves an RF-to-stimulation efficiency of 73% by off-loading charge-balancing and regulation to a wearable transmitter via an integrated charge-metering feedback approach.

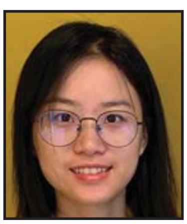
8:38 AM

18.2 CMOS-Driven Pneumatic-Free Scalable Microfluidics and Fluid Processing with Label-Free Cellular and Bio-Molecular Sensing Capability for an End-to-End Point-of-Care System

Chengjie Zhu, Princeton University, Princeton, NJ

In Paper 18.2, Princeton University presents a CMOS-microfluidic bio-sensing platform integrating cytometry sensors and actuators with an AC electrokinetic fluid flow eliminating the need for a pressure-driven flow. This system achieves a velocity up to 160μm/s by driving the bulk fluid at 100kHz, while it can precisely control the cell focus within ±3μm of a central flow.

8:46 AM



18.3 An Integrated Thermal Actuation/Sensing Array with Stacked Oscillators for Efficient and Localized Heating of Magnetic Nanoparticles with Sub-Millimeter Spatial Resolution

Yingying Fan, Rice University, Houston, TX

In Paper 18.3, Rice University presents a thermal actuation and sensing array for localized heating of magnetic nanoparticles at 1.18-to-2.62GHz. This array consists of 12 pixels with 0.6mm × 0.7mm spatial resolution and an embedded electro-thermal feedback loop to regulate the temperature with 0.53/0.29°C maximum/rms error.

8:54 AM

18.4 A Wireless Multimodality System-on-a-Chip with Time-Based Resolution Scaling Technique for Chronic Wound Monitoring

Shao-Yung Lu, National Chiao Tung University, Hsinchu, Taiwan

In Paper 18.4, National Chiao Tung University presents a wireless system supporting C-reactive protein, uric acid, and temperature readout while providing current stimulation for chronic wound healing process. This multi-mode readout IC achieves electrochemical sensing at a scanning rate ranging from 0.08 to 400V/s, while providing a resolution of 2pA for a current range of 12μA.