Oral S03

Advanced Analog Circuit Techniques

Date/Time 8/3(三)13:30-14:30

Chair(s) 蔡宗亨教授 / 國立中正大學電機工程學系

S03.1 13:30—13:45

A Self-powering Wireless Soil-pH and Electrical Conductance Monitoring IC with Hybrid Microbial Electrochemical and Photovoltaic Energy Harvesting

Yao-Wei Huang[1], Chun-Ting Chang[1], Chuan-Yi Wu[1], Chi-Wei Liu[1], Jing-Siang Chen[1], Cong-Sheng Huang[1], Ting-Heng Lu[1], Ling-Chia Chen[1], I-Che Ou[1], Sook-Kuan Lee[2], Yen-Chi Chen[2], Po-Hung Chen[1], Chi-Te Liu[2], Ying-Chih Liao[2], and Yu-Te Liao[1]
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This paper presents an energy-autonomous wireless soil pH and electrical conductance measurement IC using soil-microbial and photovoltaic (PV) energy harvesting. The chip scavenges soil/PV energy while achieving a peak efficiency of 81.3% over a 0.05-14 mW power range. A readout circuit attains a sensitivity of -8.8 kHz/pH and 6 kHz·m/S. The 433 MHz chirp-modulation transmitter and self-frequency tracking receiver provide a data rate of 100 kb/s (uplink) and 10 kb/s at a sensitivity of -80 dBm (downlink).

S03.2 13:45—14:00

A 14-bit DACLS Ringamp-Based Pipelined-SAR ADC

Jia-Ching Wang and Tai-Haur Kuo
National Cheng Kung University

This work presents a 14-bit pipelined-SAR ADC using a DACLS ring amplifier which can reduce the residue amplification gain error and retain a wideband opamp design. In addition, a latency-reduced (LR) SAR logic is proposed to improve the SAR logic speed around 30%. Furthermore, a customized bypass windows design for the backend ADC of which reduces the power by 30%. Under 130MS/s, this ADC achieves 72.5 dB SNDR with 0.82 mW, resulting in Walden FoM and Schreier FoM of 1.8 fJ/conv. and 181.5 dB, respectively.

S03.3 14:00 — 14:15

An 8Mb DC-Current-Free Binary-to-8b Precision ReRAM Nonvolatile Computing-in-Memory Macro using Time-Space-Readout with 1286.4 - 21.6TOPS/W for Edge-AI Devices

Je-Min Hung[1], Yen-Hsiang Huang[1], Sheng-Po Huang[1], Fu-Chun Chang[1], Tai-Hao Wen[1], Chin-I Su[2], Win-San Khwa[2], Chung-Chuan Lo[1], Ren-Shuo Liu[1], Chih-Cheng Hsieh[1], Kea-Tiong Tang[1], Yu-Der Chih[2], Tsung-Yung Jonathan Chang[2], and Meng-Fan Chang[1]
[1]National Tsing Hua University
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This study sought to achieve high capacity nonvolatile CIM (nvCIM) with high energy efficiency (EFMAC) and short computing latency (TAC) per output precision (TAC-OUT) for multiply-and-accumulate (MAC) operations with high input (IN) and weight (W) bit-precision. This proposed 22nm 8Mb ReRAM macro is the first uses a time-space readout scheme without DC-current to achieve the highest ever TAC-OUT (1.06-0.757 ns/b) and EFMAC (21.6 TOPS/W) from binary to 8bIN-8bW-19bOUT precision.

S03.4 14:15 — 14:30

A 0.8V Intelligent Vision Sensor with Tiny Convolutional Neural Network and Programmable Weights Using Mixed-Mode Processing-in-Sensor Technique for Image Classification

Tzu-Hsiang Hsu[1], Guan-Cheng Chen[2], Yi-Ren Chen[2], Chung-Chuan Lo[2], Ren-Shuo Liu[2], Meng-Fan Chang[2], Kea-Tiong Tang[2], and Chih-Cheng Hsieh[2]
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A 0.8V intelligent vision sensor with a tiny convolutional neural network and programmable weights using the processing-in-sensor (PIS) technique is implemented for real-time inference applications of low-power edge devices. Using the proposed efficient mixed-mode PIS technique (3×3 convolution with ReLU, 2×2 maximum pooling, and 1×1 fully-connected), the prototype is configured to demonstrate a face detection task with an achieved accuracy of 93.6% and an ultra-low power consumption of 122.6μW at 250fps.