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Presents

"Energy-Efficient Capacitance-to-Digital Converters for Low-Energy Sensor Nodes"

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Abstract: Energy efficiency is a key requirement for wireless sensor nodes, biomedical implants, and wearable devices. The energy consumption of the sensor node needs to be minimized to avoid battery replacement, or even better, to enable the device to survive on energy harvested from the ambient. Capacitive sensors do not consume static power; thus, they are attractive from an energy efficiency perspective. In addition, they can be employed in a wide range of sensing applications, such as pressure, humidity, biological, and chemical sensing. However, the capacitive sensor readout circuit—i.e., the capacitance-to-digital converter (CDC)—can be the dominant source of energy consumption in the system. Thus, the development of energy-efficient CDC architectures is crucial to minimizing the energy consumption of capacitive sensor nodes. In the first part of this talk, we propose several energy-efficient CDC architectures for low-energy sensor nodes. In the second part, we study the matching properties of small integrated capacitors, which are an integral component of energy-efficient CDCs. Despite conventional wisdom, we experimentally illustrate that the mismatch of small capacitors can be directly measured, and we report experimental mismatch measurements for sub-femtofarad integrated capacitors. We also correct the common misconception that lateral capacitors match better than vertical capacitors, and we identify the conditions that make one implementation preferable.

Biography: Dr. Salama received his bachelor's degree with honors from the Electronics and Communications Department at Cairo University in Egypt in 1997, and his master's and doctorate degrees from the Electrical Engineering Department at Stanford University in the United States, in 2000 and 2005 respectively. He was an assistant professor at RPI between 2005 and 2008. He joined King Abdullah University of science and technology (KAUST) in January 2009 and was the electrical engineering founding program chair till August 2011. His work on CMOS sensors for molecular detection has been funded by the National Institutes of Health (NIH) and the Defense Advanced Research Projects Agency (DARPA), awarded the Stanford-Berkeley Innovators Challenge Award in biological sciences and was acquired by Lumina Inc in 2008. He is the cofounder of ultrawave labs, a biomedical imaging company that was recently acquired. He is the co-author of 90 papers and 10 patents on low-power mixed-signal circuits for intelligent fully integrated sensors and non linear electronics specially memristor devices. He is a senior member of IEEE.

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Hosts: Fadi J. Kurdahi and Ahmed Eltawil