antenna structure, its radiation efficiency, and simulation methodology.

All who were polled agreed that Prof. Niknejad's technical vision and stunning presentation set a new bar for SSCS-Vancouver.

—Shahriar Mirabbasi
Chair, SSCS-Vancouver

"Brain-Machine-Brain Wireless Interfaces for Intracortical Biosensing and Subsequent Treatments" in Talk by DL Mohamad Sawan at SSCS-New York and Santa Clara in May and June

In two lectures at SSCS-New York in May and SSCS-Santa Clara in June, Prof. Mohamad Sawan of Polytechnique Montreal focused on circuits and systems techniques for the design, implementation, and integration of biosensing and treatment microsystems. He described fully implantable devices that interact with the neural system and interconnect with intracortical neural tissues to bidirectionally exchange data with an external base station, with wireless links used for powering up.

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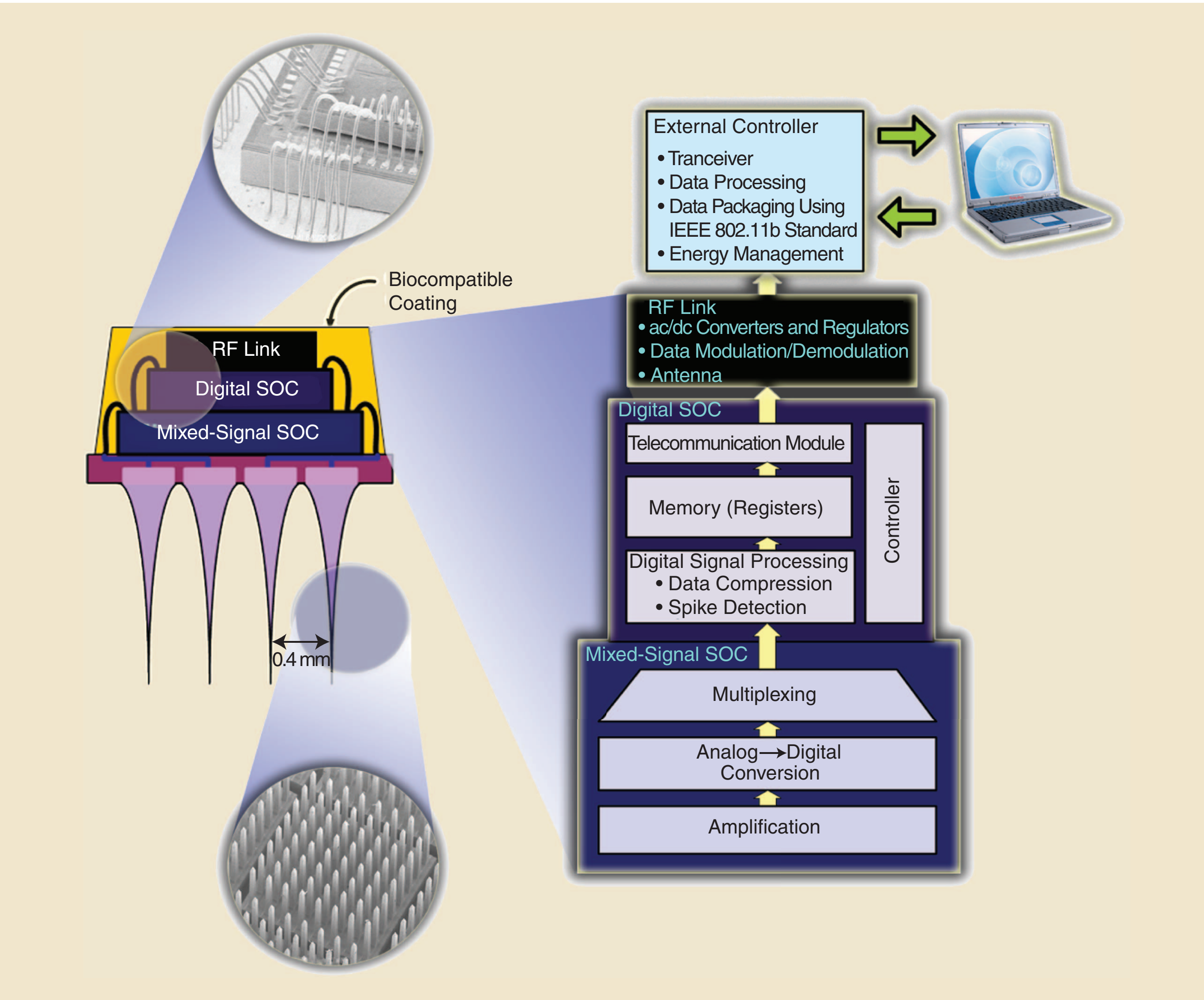

FIGURE 1: Digital building blocks to record APs and transmit them to the base station.

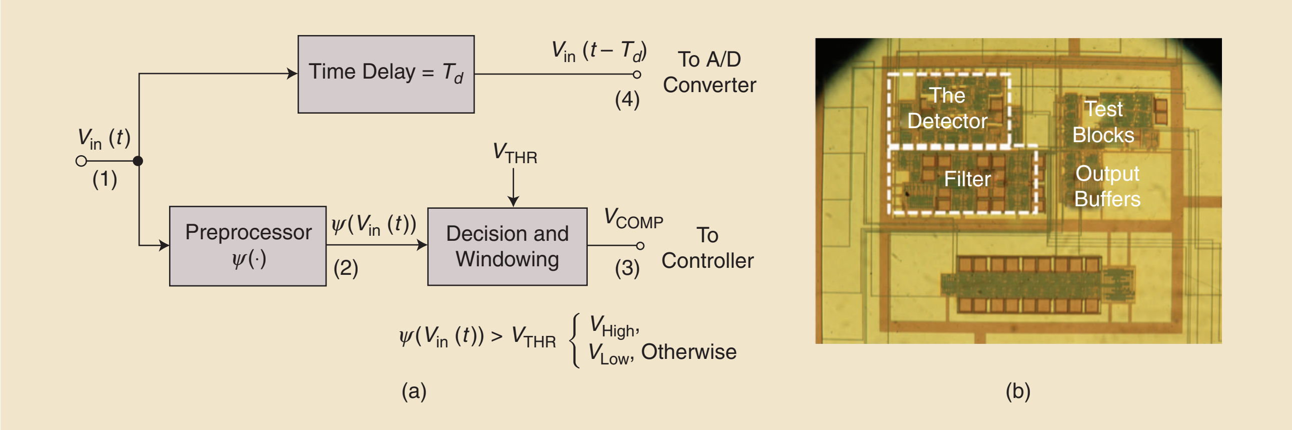

FIGURE 2: Analog building blocks to record APs and transmit them to a local controller: (a) block diagram and (b) photmicrograph of the chip. The preprocessor is based on a Teager energy operator. The total power consumption of the chip is 780 nW, and its area is 272 × 257 um².

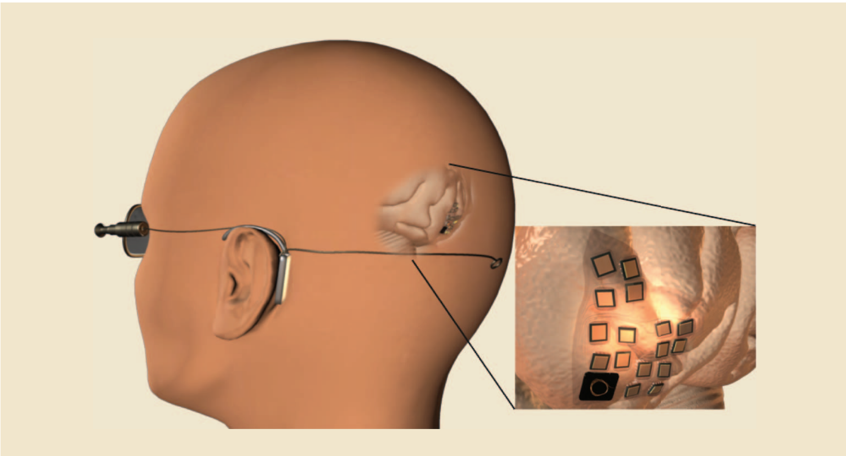

FIGURE 3: Microstimulation at the level of the primary visual cortex intended to recover vision for the blind. The system is composed of two main parts: 1) an external camera, image processor, and data/energy transmitter and 2) a multiunit implant dedicated to monitoring and microstimulation.

Extended Abstract

Emerging brain-machine interfaces for biosensing and treatment applications are a promising alternative for learning about intracortical organization, studying the neural activity underlying cognitive functions and pathologies, locating onset seizures, understanding neuron interactions, detecting mind-driven decisions, and addressing complex central neural system dysfunctions by microelectro-stimulation and drug delivery microsystems.

Providing a global view of typical devices and their multidimensional challenges, (e.g., power management, harvesting energy, high-data-rate bidirectional communication modules, and matrices of electrodes interfacing the neural tissues) Prof. Sawan paid special attention to achieved designs using ultra-low power mixed-signal (digital/analog) circuit techniques and several signal and image processing techniques implemented to reduce needed energy to operate these wireless systems.

The four main cases that he reported in addition to several circuit techniques were:

1) Two series of building blocks dedicated to the detection and recording of complete action potentials (APs) in multichannel structures. The first, digitally based series of circuits functions to detect APs, compress the corresponding data, and transmit through transceiver (Figure 1). The second detection method is implemented by an analog circuit (Figure 2). Multichip stacking techniques and other flip-chip assembly methods are used in these microsystems.
2) Microstimulation in the primary visual cortex intended to recover vision for the blind through multisite large arrays of microelectrodes (Figure 3). The stimulation takes place at the level IV-C in V1 region.
3) A full feedback control device for seizure onset detection and subsequent treatment through dedicated electrodes (Figure 4). The treatment either is electrical stimulation or drug delivery for the purpose of stopping the seizure just in time before it affects the normal life of the patient.
4) Lab-on-chip (LoC)-based neurotransmitters detection, manipulation, and characterization (Figure 5). Such LoC tools are intended for diagnostic purposes to locate dysfunctions at the level of cell interconnections.

Acknowledgments

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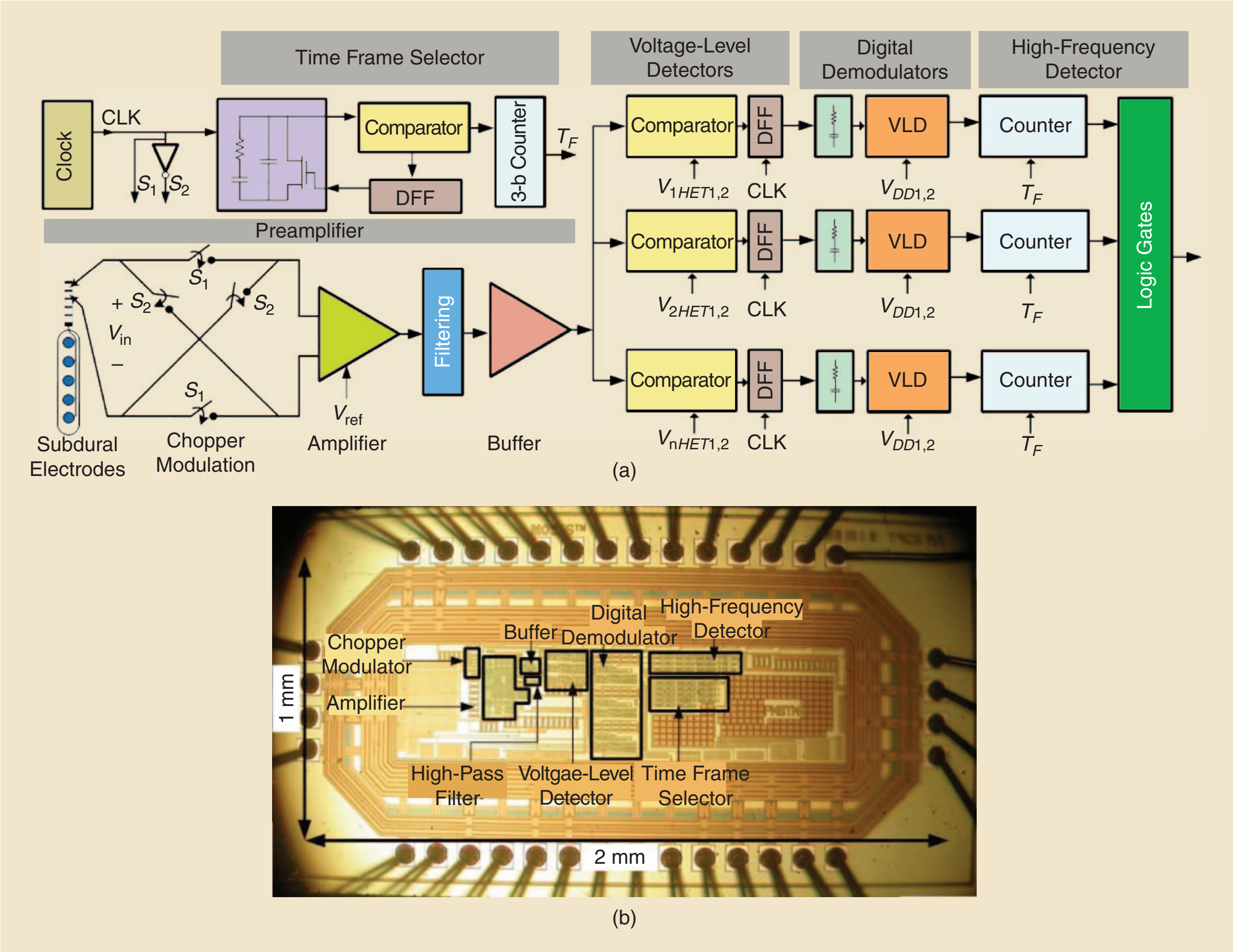

FIGURE 4: Epileptic seizures onset detection: (a) block diagram of the system and (b) photomicrograph of the chip, which consumes 7.6 uW and measures 1 × 2 mm^2.

Sciences and Engineering Research Council of Canada (NSERC), the Canadian Institutes of Health Research (CIHR), and the Canada Research Chair on Smart Medical Devices. Tools and infrastructures are supplied by The Microsystems Strategic Research Alliance of Quebec (ReSMiQ) and the Canadian Microelectronics Corporation (CMC Microsystems).

My thanks are also due to my graduate students and postdoctoral fellows for their contributions.

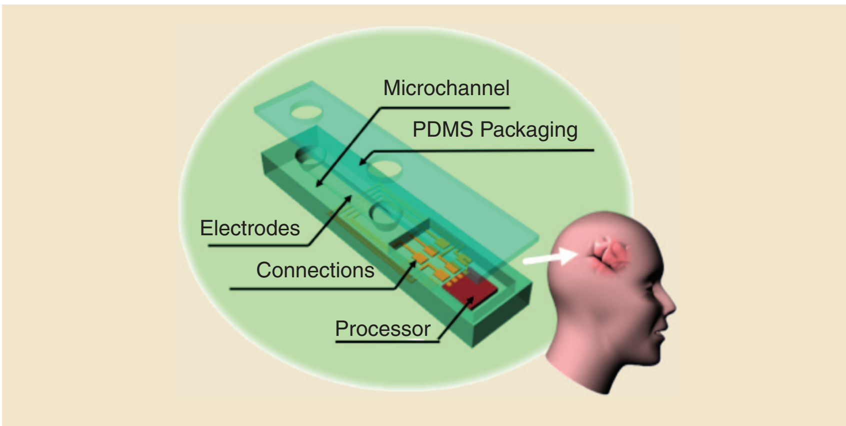

FIGURE 5: Neurotransmitters detection and manipulation.

—Mohamad Sawan
Professor and Canada Research Chair in Smart Medical Devices
Polystim Neurotechnologies Laboratory, Polytechnique Montreal

Mohamad Sawan received the Ph.D. degree in 1990 in electrical engineering from Sherbrooke University, Canada. He joined Polytechnique Montréal in 1991, where he is a professor of microelectronics and biomedical engineering. His interests are oriented toward biomedical and telecommunications applications, including the design and test of mixed-signal (analog, digital, RF, MEMS, and optic) circuits and microsystems: design, integration, assembly, and validations.

Dr. Sawan holds a Canada research chair in smart medical devices. He is founding director of the Polystim Neurotechnologies Laboratory at Polytechnique Montréal, and leads the Microsystems Strategic Alliance of Quebec (ReSMiQ), which receives membership support from 11 universities.

He has founded or cofounded several international conferences including NEWCAS, BiOCAS, and ICECS, and he is editor/associate editor of several international journals such as *IEEE Transactions on Biomedical Circuits and Systems* and *Springer Mixed-Signal Letters*. Dr. Sawan has published more than 450 papers in peer-reviewed journals and conference proceedings and has offered more than 100 invited talks/keynotes. He has also been awarded six patents in the field of biomedical sensors and actuators.

Dr. Sawan received several prestigious awards; the most important of them are the Medal of Honor from the president of Lebanon, the Bombardier Award for technology transfer, the Barbara Turnbull Award for medical research in Canada, and the achievement award from the American University of Science and Technology. Dr. Sawan is a Fellow of the IEEE, the Canadian Academy of Engineering, and the Engineering Institute of Canada and is an officer of the Quebec's National Order.

Doubleheader on "The Different Faces of Variability" by DL Marcel Pelgrom at SSCS-Maine and Montreal

SSCS Distinguished Lecturer Marcel Pelgrom visited IEEE Solid-State Circuits Society (SSCS) Chapters in Maine and Montreal in late June to speak on the sources and impact of process and performance variation within semiconductor devices.

Prof. Anas Hamoui, Montreal SSCS Chapter chair, organized the event at McGill University, while David Potts and Courtney Parker, the vice chair and chair of the Maine SSCS Chapter, respectively, coordinated the meeting at Fairchild Semiconductor in South Portland, Maine.

"This was our first experience with the SSCS DL Program in Maine, and it was very well received," Dr. Potts said. "A number of attendees commented on how impressed and grateful they were that we could offer a speaker of that caliber here."

—*Katherine Olstein*

Summary

Dr. Pelgrom chose to focus on two major issues of many involving variability.

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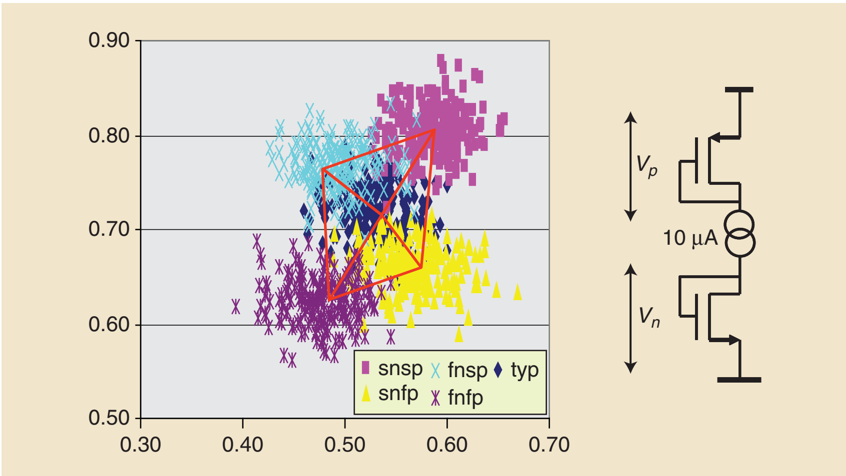

FIGURE 1: Comparing global parameter and local mismatch variations.

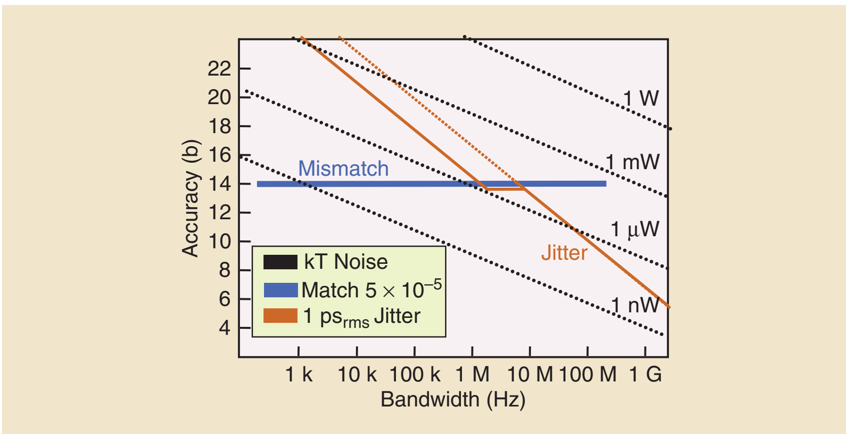

FIGURE 2: The effect of a jittering sample pulse for a range of bandwidths of an analog-to-digital converter.