Introduction to the Special Issue on Biomedical and Bioelectronic Circuits for Enhanced Diagnosis and Therapy

The application of innovative circuits and systems in healthcare is experiencing remarkable growth worldwide, spanning systems supporting health monitoring to rehabilitation. Examples include electronics for smart biosensors to detect or monitor the progress of various diseases, implantable neural prostheses to replace lost function due to neural damage, wireless brain–machine interfaces for neuroscience research and control of prosthetic devices, and new generation cardiovascular technology with real-time monitoring capability. Advances in medical device technology have been shown to greatly improve the quality of life for people with conditions such as Parkinson’s disease, diabetes, hearing loss, blindness, and heart failure, to name a few. The purpose of this Special Issue is to report the cutting-edge development of circuits and systems that have the potential to enhance diagnosis and therapy.

We received a large number of submissions in response to our call for papers, almost 100 manuscripts, of which 22 papers have been finally accepted for publication in this Special Issue of IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS—II: EXPRESS BRIEFS (TCAS-II). All the papers have been reviewed by at least three independent reviewers and were selected for publication based on the timeliness and fit of the topic, their technical and tutorial quality, and their ability to demonstrate advancement of the state of the art with measured results or (as an exception) with detailed simulated results.

The short length of the individual papers enables us to provide a broad (although naturally incomplete) view of the area of circuits and systems focusing on diverse aspects in enhanced diagnosis and therapy. The papers describe latest developments in multichannel signal processing, wireless power transfer through the human body, tissue sensing, neural stimulation, lab-on-a-chip, high-frequency circuits, including ultrawide-band (UWB) for cancer detection, and ultralow-power circuits.

- The contributions Quantization Effects in an Analog-to-Information Front-end in EEG Tele-Monitoring, A Flexible Multichannel EEG Feature Extractor and Classifier for Seizure Detection, and A Fully Integrated IC With 0.85-μW/Channel Consumption for Epileptic iEEG Detection focus on systems for processing the electroencephalogram (EEG) in order to extract information from the raw signal.
- Further papers with a strong focus on signal processing are An Energy-Efficient Design for ECG Recording and R-Peak Detection Based on Wavelet Transform and Nonlinear Cognitive Signal Processing in Ultralow-Power Programmable Analog Hardware.
- Direct RF Subsampling Receivers Enabling Impulse-Based UWB Signals for Breast Cancer Detection and A 180-V pp Integrated Linear Amplifier for Ultrasonic Imaging Applications in a High-Voltage CMOS SOI Technology are concerned with high-frequency circuits targeting diagnostic applications.
- A Wideband Low-Distortion CMOS Current Driver for Tissue Impedance Analysis, A Capacitance-to-Frequency Converter With On-Chip Passivated Microelectrodes for Bacteria Detection in Saline Buffers up to 575 MHz, and The Bio-Oscillator: A Circuit for Cell-Culture Assays present work in the area of tissue impedance spectroscopy.
- A Feasibility Study on the Adoption of Human Body Communication for Medical Service, Toward an Ultralow-Power Onboard Processor for Tongue Drive System, and Efficient Implementation and Design of A New Single-Channel Electrooculography-Based Human–Machine Interface System describe applications and circuits in the broader category of diagnosis and rehabilitation.
- Finally, the contributions A Low-Power 1-V Potentiostat for Glucose Sensors and A Submicrowatt Implantable Capacitive Sensor System for Biomedical Applications present implantable circuits for physiological sensing.

We would like to thank all the authors for their valuable contributions and all the reviewers for their time and effort in helping to select the papers. We would also like to express our gratitude to the TCAS II Editors, Prof. J. Silva-Martinez and

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Prof. A. Demosthenous, for their contribution to creating this Special Issue, and the TCAS II Editorial Staff for putting the issue together. We hope that this issue will provide new insights and a glimpse of the latest advances within the broad spectrum encompassing bioelectronic circuits.

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