

Guest Editorial: Special Section on AI-Based Biomedical Circuits and Systems

THIS special issue of the IEEE TRANSACTIONS ON BIOMEDICAL CIRCUITS AND SYSTEMS presents a selection of research papers on AI-based Biomedical Circuits and Systems. In the recent years, machine learning based Artificial Intelligence (AI) has been adopted in a wide spectrum of applications such as face recognition, voice recognition and autonomous vehicle. It has also been applied to biomedical applications such as ECG monitoring, brain-machine interface and medical imaging to help improve the intelligence and accuracy. However, most of the existing work for AI-based biomedical applications mainly focus on the AI algorithm design. To meet the requirements on accuracy, performance and power consumption, co-design and optimization of the algorithm and the hardware are needed. The purpose of this special issue is mainly to report recent progresses in the development of AI-based biomedical circuits and systems. It is also to provide a forum for the researchers on circuits, algorithms and systems design for biomedical applications to exchange ideas and knowledge. The papers in this special issue were selected from 35 submitted papers. Multiple rounds of peer review in the transactions resulted in the following 10 papers for this special issue. The papers cover several topics and can be combined in 5 broad categories, as per the follow:

- 1) Neuro-Inspired Circuits & Systems using Emerging Devices: emerging devices based circuits and systems that emulate the functionality/structure of the biological neural system for achieving higher accuracy & energy efficiency for recognition tasks and providing better understanding of the brain function.
 - a) Who is the winner? Memristive-CMOS hybrid modules: CNN-LSTM versus HTM by A. James *et al.*
 - b) The Design of Memristive Circuit for Affective Multi-associative Learning by Z. Wang *et al.*
- 2) Neural Network based ECG Monitoring and Authentication Circuits & Systems: ECG signal processing algorithms and hardware using neural network for cardiac arrhythmia classification and authentication to achieve high accuracy and low power consumption.
 - a) A 13.34 μ W Event-driven Patient-specific ANN Cardiac Arrhythmia Classifier for Wearable ECG Sensors by Y. Zhao *et al.*
 - b) ECG Authentication Neural Network Hardware Design with Collective Optimization of Low Precision and Structured Compression by S. K. Cherupally *et al.*
- 3) Machine Learning based EEG and neural signal monitoring circuits & systems: EEG and neural signal processing algorithms and hardware using supervised, semi-supervised and un-supervised learning for epileptic focus localization and neural spike sorting to improve accuracy and reduce power consumption.
 - a) Deep Learning Approach for Epileptic Focus Localization by H. Daoud *et al.*
 - b) Accurate, Very Low Computational Complexity Spike Sorting Using Unsupervised Matched Subspace Learning by A. Demosthenous *et al.*
- 4) EMG-based Hand Gesture Classification Systems using Deep Learning: surface EMG or high-density-surface EMG based hand gesture classification algorithms and systems using deep learning approach to deliver real-time performance and low power consumption while achieving high accuracy.
 - a) A Fully Embedded Adaptive Real-Time Hand Gesture Classifier Leveraging HD-sEMG & Deep Learning by S. Tam *et al.*
 - b) Robust Real-Time Embedded EMG Recognition Framework Using Temporal Convolutional Networks on a Multicore IoT Processor by S. Benatti *et al.*
- 5) Real-Time and High Performance Medical Image Systems: optical coherence tomography (OCT) based medical imaging systems with low complexity and adaptive processing for the spectral calibration to achieve high imaging acquisition speed while providing robustness to noise.
 - a) Kalman-Based Real-Time Functional Decomposition for the Spectral Calibration in Swept Source Optical Coherence Tomography by A. Tofghi Zavareh *et al.*
- 6) Review of AI-based biomedical processing algorithms and processors: comprehensive review on the state of the arts and trends of the AI-based biomedical processing algorithms and hardware.
 - a) A Review of Algorithm & Hardware Design for AI-Based Biomedical Applications by Y. Wei *et al.*

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