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Guest Editorial: Advanced Machine Learning Algorithms and Signal Processing

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This special issue of the circuits, systems and signal processing journal focuses on recent advances and improvements in leading-edge integrated machine learning algorithms and signal processing systems. Although signal processing has been studied over several decades, the computer industry is only beginning to understand how signal processing techniques can be well integrated for the development of human–machine interfaces with the advancement of machine learning algorithms. The design and development of machine learning algorithms plays a vital role in signal processing such as image and signal analysis, voice, vision, language, and text processing. The strengths and limitations of several technologies must be fully understood, and there is considerable effort concentrated on the field of applications of advanced machine learning algorithms and signal processing techniques. There is much research in the field of advanced machine learning algorithms and signal processing related to the development of advanced interfaces using voice, image, vision, gesture and other innovative interfaces with heuristic algorithms. These include advanced machine learning coding techniques that enable people to capture, store, transmit and present high-quality image, signal processing and synthesis; language recognition and understanding technology that allows machines learning algorithms to understand user interface technologies to create usable interfaces and signal dialogs between computer machinery which maintain natural and sustainable

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machine interactions through advanced learning techniques. As advances in signal processing tools and machine learning algorithms are becoming more powerful in terms of functionality and communicative capabilities, their contribution to the journal of circuits, system and signal processing is becoming more significant. This special issue is organized to promote and publish the state-of-the-art research papers, which are organized as follows.

1 Machine Learning Techniques in Image and Video Processing

In the first paper under this category, S.N. Kumar et al. propose an effective lossless compression algorithm using the least square approach for processing the CT images. This algorithm helps to reconstruct the images, and the design is implemented using Raspberry-Pi firmware for effective results.

In the second paper, Geng et al. present an unsupervised learning framework for estimating monocular depth and camera motion by exploiting the pose estimation method used in traditional simultaneous localization and map construction (SLAM).

In the third paper, Liang and Zou have proposed an improved semi-supervised SVM-FCM algorithm based on chaos and apply it to the problem of rock image segmentation, which is useful in the petroleum resource exploitation process.

In the fourth paper, Feng et al. propose a method for color image segmentation which is based on the region salient color and the fuzzy c-means algorithm. The authors claim that the proposed algorithm has the highest segmentation accuracy and shortest computational time among the algorithms compared in the paper.

In the fifth paper, M. Elhoseny develops an effective video surveillance system for multi-object detection and tracking process that utilizes the probability-based grasshopper algorithm (PGA). The author claims that the framework achieves maximum detection and tracking accuracies of 76.23 and 86.78%, respectively.

In the sixth paper, Nascimento et al. assess how the four methods, namely, Goertzel, HOS, and structural co-occurrence matrix (SCM), and their innovative fusion of SCM and Fourier transform perform on heart arrhythmia identification, by evaluating their performance on several classifiers. They point out the advantages of using HOS and SCM-Fourier over morphological feature extraction methods for ECG in that they not only lead to higher accuracy, but also reduce false diagnosis on patients.

In the seventh paper, Santos Filho et al. introduce a general technique for an automatic system for processing of sheep and goat leather images to monitor the leather quality. After extracting the leather texture features, the technique is analyzed with various classifiers such as Naive Bayes Classifier (NBC), Optimum-Path Forest and support vector machines (SVM). The authors claim that the SVM classifier using the RBF kernel exhibits excellent performance with a classification accuracy of 93.22% and processing time of 3.78 s.

In the eighth paper, Satheesh Kumar et al. utilize the hybrid bat algorithm (HBA) in conjunction with the ANFIS classifier to detect autism spectrum disorder in children by classifying the EEG signal using as normal and autistic. The authors claim that the HBA-ANFIS classifier successfully predicts the normal and autism-related signals with very highest accuracy.

In the ninth paper, Senthil Kumar and Kumutha propose two techniques, namely the fuzzy c-means and neuro-fuzzy methods to detect abnormalities in optical coherence tomography images of retinal blood cells to prevent blindness caused by diabetics and other disease. The authors claim that the neuro-fuzzy method exhibits a better overall performance for detecting abnormal OCT images in retinal blood cells than the fuzzy c-means method.

In the final paper in this category, Ru Xu proposes a computer vision model by unifying convolutional neural networks and conditional random fields into deep learning framework. Experimental results indicate that this model can use a small number of samples for high precision training and yield better estimation effects on images outside the dataset on which the model has been trained.

2 Significance of Learning Techniques in Neural Network-Assisted Video, Image and Signal Processing

In the first paper under this category, Ahilan et al. propose a moving vehicle detection system based on a hybridization of artificial neural network (ANN) and oppositional gravitational search optimization algorithm (OGSA). Based on experimental results on three types of videos, the authors claim excellent performance in terms of various metrics such as precision, recall, f-measure and similarity measure.

In the second paper, Rahman et al. present a detailed study in the area of brain tumor classification using two methods of transfer learning (Finetune and Freeze) and three powerful deep CNN architectures (AlexNet, GoogLeNet and VGGNet) on MRI slices of Figshare to identify the tumor type. The authors claim a recognition accuracy of 98.69% using Finetune-VGG16 network.

In the third article, Khamparia et al. propose a novel hybrid model using a combination of convolutional neural network and recurrent neural network (CNN-RNN) to generate high-quality captions and provide visual descriptions of video images.

In the next paper, Ramya et al. propose a 3D facial expression recognition system using a two channels deep learning framework. Features are extracted from the local binary and local directional patterns using pre-trained by Alex Net and shallow convolution networks and then fused using canonical correlation analysis. This fused feature set is fed to a multi-support vector machine to classify the facial expressions as anger, disgust, fear, happiness, neutral, sadness and surprise.

In the fifth paper, Shipeng Fu et al. article present a real-time single image super-resolution image method by applying convolution neural networks. Through experiments, the authors claim that the proposed system runs much faster existing methods on benchmark datasets.

The aim of the next paper by Khamparia et al. is to develop a novel technique for the detection and prediction of crop diseases using a combination of convolutional neural networks and autoencoders.

In the seventh paper, Wang and Liu propose a hierarchical deep long short-term memory neural network for predicting human activities from wearable sensor devices. Through experimental results conducted on three publicly available UCI

databases of human activities, the authors claim that their proposed network outperforms other deep learning algorithms with an accuracy of up to 99.15%.

In the eighth paper, Dilawari et al. present three computer vision algorithms, contour-based, HOG-based and SURF-based and propose a deep learning technique, which automatically extracts spatiotemporal annotations of humans and represent them by bounding boxes. Experimental results indicate an increase in the accuracy, but also a reduction in the human effort with respect to manual annotations.

In the final paper in this category, Mu et al. propose an unsupervised segmentation method by combining superpixel and deep learning models based on region-combined color images. Through experiments, the authors show that the proposed method can effectively extract the contour of the object from complex background.

3 VLSI Design Techniques and Wireless Communication Learning Algorithms and Models

In the first paper under this category, Shunmugathammal et al. introduce a new optimization algorithm, namely the B*tree crossover simulated annealing algorithm for fixed outline floorplan design in VLSI physical design. The algorithm aims to minimize the dead space to optimize the area and wire length. The results have been validated by conducting experiments on the Microelectronics Center of North Carolina benchmark circuits.

The second paper deals with the controllability and stabilizability of linear time-invariant systems containing neutrosophic uncertainty in the sense of both indeterminacy parameters and functional relationships. Nguyen et al. define various properties and operators between neutrosophic numbers via horizontal membership function of a relative-distance-measure variable. The proposed system is validated with an RLC circuit and DC motor system as to the efficiency of the system.

The third paper is concerned with bufferless chip architecture to eliminate the restriction of power utilization and area. In this paper, Venkataraman et al. investigate a low power specific network on chip using ant lion optimized bufferless routing algorithm. The authors claim that the ant lion optimized buffered routing achieves an operational frequency of 426.995 MHz and 0.750 mW for speed and power, respectively.

In the fourth paper, Murugesan et al. introduce a Lagrangian-based state transition algorithm for an effective computer-aided controller design for a nonlinear process. Simulation results indicate that the proposed controller exhibits optimum transient and tracking performance.

In the fifth paper, Al-Makhadmeh and Tolba present an intelligence-based recurrent learning scheme for optimal channel allocation and selection for device-to-device communication of mobile users. The proposed technique minimizes the communication delay and improves the throughput.

In the next paper, Tolba and Al-Makhadmeh present a learning-based localization method to minimize localization errors due to variations in the received signal strength in wireless communication. Through simulations, the authors show

that their scheme improves localization coverage with decreased localization error, detection time and energy.

In the seventh paper, Sumathi and Manivannan develop a spectrum handoff algorithm to channel select the best possible cognitive radio network channel using machine learning techniques, wherein the queueing model of the preemptive resume priority is used. The authors claim that the performance of the proposed algorithm is better than that of the multiuser greedy channel selection scheme.

In the eighth paper, Karras et al. present an FPGA system-on-chip-based architecture, which supports the acceleration of machine learning algorithms in an edge environment. The described system exhibits competitive performance while requiring a reasonable amount of resources on the hardware.

In the ninth article, Arun and Umamaheswari propose a method of detecting attacks in cognitive radio networks by adaptive learning. The introduced learning process has the ability to adapt the cyclo-stationary features to predict the attacks with low power in cognitive radio communications.

In the tenth paper, Soundari and Jyothi device an effective system for collecting smart data in the wireless communication process using an energy-efficient machine learning algorithm. The developed device in this paper is disseminated by a fuzzy inference mechanism.

In the eleventh article, Nagarajan et al. present a system that would generate multi-model nonparametric Bayesian model and multilayered probability latent analysis based visual dictionary. The paper concentrates on the creation of visual dictionary for basketball. The feature extracted from sport event images is utilized in creating a visual vocabulary for semantic understanding.

The next article deals with a study on spectrum characteristics and clustering of acoustic emission signals from rock fracture. In this article Zhang et al. use the short Fourier transform to analyze the acoustic signals emanating during rock fracture to obtain the peak frequency, based on which the authors classify the acoustic emission signal into four types using fuzzy c-means clustering algorithm. The results indicate that different types of acoustic emission signals correspond to different strengths of rock fracture.

In the thirteenth article, Alarifi et al. present a multi-model learning optimization technique to ensure optimal channel usage in a wireless communication system. Through experiments, the performance of the technique is studied and assessed using various metrics such as throughput, latency, channel access delay, access probability and usage ratio.

In the fourteenth paper, Yao et al. present a multivariate sparse learning model for decomposing multivariate signals that partially and arbitrarily overlap and is based on the multivariate extension of the chirplet transform. The effectiveness of the scheme is validated from decomposing many multicomponent signals that overlap in the time frequency domain.

In the final paper in this category, AlZubi et al. present channel analysis for user concentric optical switching networks using machine learning techniques. The proposed method successfully minimizes the asynchronous selection by blocking rates in optical networks to improve the throughput rate and to leverage the performance of optical switching networks.

Collectively, all these papers illustrate a diverse range of issues being addressed in the design and development of leading-edge integrated machine learning algorithms and signal processing systems. We are grateful to all the authors for their excellent research contributions to this issue and their patience during the revision stages. We take this opportunity to give our special thanks to the Editor-in-chief, Dr. M.N.S. Swamy, for all the support and competence rendered to this special issue on recent advancements in machine learning algorithms and signal processing.

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