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EDITORIAL

IEEE ACCESS SPECIAL SECTION EDITORIAL: NEURAL ENGINEERING INFORMATICS

Given the important challenges associated with the processing of brain signals obtained from neuroimaging modalities, cognitive systems have been proposed as useful and effective frameworks for the modeling and understanding of brain activity patterns. They also enable direct communication pathways between the brain and external devices (brain–computer/machine interfaces). However, most of the research so far has focused on lab-based applications in constrained scenarios, which cannot be extrapolated to realistic field contexts. Considering the decoding of brain activity, biomedical engineers provide excellent tools to overcome the challenges of learning from brain activity patterns that are very likely to be affected by nonstationary behaviors and high uncertainty. The application of health and neural engineering to learning and modeling has recently demonstrated its remarkable usefulness for coping with the effects of extremely noisy environments, as well as the variability and dynamicity of brain signals. In addition, neurobiological studies have suggested that the behavior of neural cells exhibits functional patterns that resemble the properties of computational neuroscience to encode logical perception.

This paves the way for developing new computational neuroscience techniques in medicine and healthcare that foster the capabilities for modeling and understanding brain function from a quantitative point of view, which is also the basis of this Special Section in IEEE ACCESS. In this Special Section, we accepted 22 articles, all of which underwent a rigorous peer-review process. Here, we list each accepted article below with a brief introduction.

In the article "What are spectral and spatial distributions of EEG-EMG correlations in overground walking? An exploratory study," by Li *et al.*, the authors simultaneously collected EEG and EMG signals, while healthy participants were conducting four overground walking conditions without any constraints, and demonstrated a wide range of frequencies from delta band to gamma band involved in walking.

In the article "Design and implementation of an asynchronous BCI system with alpha rhythm and SSVEP," by Zhang *et al.*, the authors built an asynchronous BCI system based on SSVEPs that outputs continuous, stable, and smooth control commands in the up, down, left, and right directions.

In the article "A novel event-related potential-based brain–computer interface for continuously controlling dynamic systems," by Lian *et al.*, the authors addressed a novel event-related potential-based brain–computer interface to detect human intention for continuously controlling dynamic systems.

In the article "Fusing canonical coefficients for frequency recognition in SSVEP-based BCI," by Liu *et al.*, the authors proposed to fuse all the correlation coefficients of the CCA with a nonlinear weighting function when performing frequency recognition with CCA method, termed as FoCCA.

In the article "A survey on blockchain-based Internet service architecture: Requirements, challenges, trends, and future," by Yang *et al.*, the authors presented the blockchain-based Internet of Things (IoT) for neuroinformatics to illustrate the potential applications of blockchain architectures.

In the article "Sparse autoregressive modeling via the least absolute LP-norm penalized solution," by Bore *et al.*, the authors introduced a novel ADMM-based AR estimator termed LAPPS (Least Absolute L.P. ($0 < p < 1$) Penalized Solution), which employs the L1-loss function for the residual error to alleviate the influence of outliers, and another Lp-penalty term to obtain the sparse A.R. parameters while suppressing any spurious noise that may be present.

In the article "Identification of early vascular dementia patients with EEG signal," by Wang *et al.*, the authors developed a method to effectively discriminate early VaD patients from normal controls by combining EEG features with machine learning methods

In the article "A multi-class automatic sleep staging method based on long short-term memory network using single-lead electrocardiogram signals," by Wei *et al.*, the authors proposed an efficient multiclass automatic sleep staging method based on a long short-term memory network (LSTM) using single-lead electrocardiogram signals.

In the article "Motor imagery EEG signals classification based on mode amplitude and frequency components using empirical wavelet transform," by Sadiq *et al.*, the authors proposed a novel data-adaptive empirical wavelet transform (EWT)-based signal decomposition method for improving the classification accuracy of MI-based EEG signals.

In the article ''Identity authentication using portable electroencephalography signals in resting states,'' by Zhang *et al.*, the authors investigated the feasibility of using resting-state EEG signals recorded by single-channel portable devices for identity authentication. Single-channel EEG classifications are effectively improved by using mixed-method in three feature domains, feature selection, and classifier design.

In the article ''Multi-point temporal interference stimulation by using each electrode to carry different,'' by Zhu *et al.*, the authors introduced the concept of multipoint temporal interference (MTI) stimulation, which can simultaneously stimulate multiple nodes in the brain network to modulate its function.

In the article ''A complementary method of PCC for the construction of scalp resting-state EEG connectome: Maximum information coefficient,'' Tian *et al.* proposed to construct electroencephalography (EEG) connectivity utilizing maximal information coefficient (MIC). MIC could make up the weakness (i.e., linear associations) of Pearson correlation coefficient (PCC) and capture certain relationships that PCC failed to detect, which indicated that MIC could be a complementary method of PCC for the construction of scalp resting-state EEG connectome.

In the article ''Using brain network features to increase the classification accuracy of MI-BCI inefficiency subject,'' Zhang *et al.* proposed to employ the node degree and clustering coefficient of a task-related brain network to discriminate left- and right-hand motor imagery tasks to cope with brain–computer interface (MI-BCI) inefficiency phenomenon, which is one of the biggest challenges in MI-BCI research. Results of this study demonstrated that the accuracy of the MI-BCI inefficiency subject can be increased using the brain network feature.

In the article ''Remove diverse artifacts simultaneously from a single-channel EEG based on SSA and ICA: A semi-simulated study,'' Cheng *et al.* proposed an effective method, a combination of singular spectrum analysis (SSA) and second-order blind identification (SOBI) method, to successfully remove diverse artifacts simultaneously for the single-channel EEG case. It is a promising tool for biomedical signal processing applications.

In the article ''An efficient and robust muscle artifact removal method for few-channel EEG,'' Liu *et al.* proposed an efficient and robust muscle artifact removal approach by jointly employing the Fast Multivariate Empirical Mode Decomposition (FMEMD) and CCA for few-channel EEG.

In the article ''EEG signals denoising using optimal wavelet transform hybridized with efficient metaheuristic methods,'' Alyasseri *et al.* investigated using optimization methods for the wavelet transform (W.T.) parameter configuration in EEG signal denoising. Five powerful metaheuristic algorithms are proposed, and flower pollination algorithm (FPA) achieves the best performance.

In the article ''Prognosis of sleep bruxism using power spectral density approach applied on EEG signal of both EMG1-EMG2 and ECG1-ECG2 channels,'' by Lai *et al.*, the authors compared the differences of medical-informatics between bruxism patients and normal subjects by using the power spectral density of fusing EMG, ECG, and EEG signals. This study provided an effective diagnosis system for sleep bruxism and belonged to the application in the field of monitoring sleep disorders.

In the article ''A new paradigm for region-based P300 speller in brain–computer interface,'' Oralhan presents an audio-visual approach for an effective region-based P300 speller. The suggested method has the potential of improving the accuracy of brain–computer interfaces aimed at helping severely disabled people.

In the article ''Motor imagery EEG signals decoding by multivariate empirical wavelet transform-based framework for robust brain–computer interfaces,'' Sadiq *et al.* introduced a novel wavelet-based method for EEG signal classification. The algorithm obtains high classification accuracy with efficient computation in a reduced channel and feature space.

In the article ''An accurate sleep stages classification method based on state space model,'' Shen *et al.* presented a state-space model to automatically identify sleep stages, which resulted in accurate to highly accurate outcomes using two-stage to six-stage classification sleep states and two available datasets.

In the article ''Relational network of people constructed on the basis of similarity of brain activities,'' by Shinkuma *et al.*, the authors demonstrated, using a functional MRI-based relational network of people, that brain imaging data can be used to estimate user preferences.

Finally, in the article ''Automated detection of high frequency oscillations in intracranial EEG using the combination of short-time energy and convolutional neural networks,'' Lai *et al.* presented a convolutional neural network classification algorithm to detect high-frequency oscillations automatically, which are increasingly acknowledged as reliable biomarkers of epilepsy.

In conclusion, the Guest Editors hope that this Special Section will benefit the scientific community and contribute to the knowledge base and would like to take this opportunity to applaud the contributions of the authors to this Special Section. The efforts of the reviewers to enhance the quality of the manuscripts through their constructive comments and suggestions are also much appreciated. The Guest Editors would also like to acknowledge the guidance from the Editor-in-Chief and staff members.

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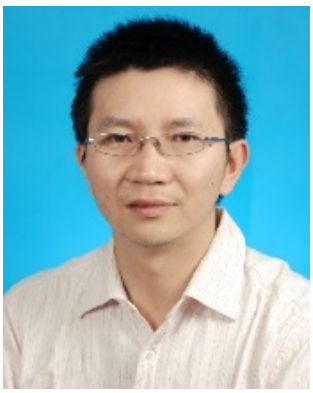

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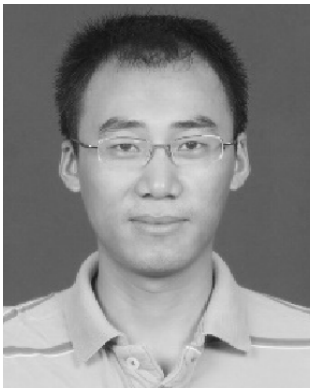

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