Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Editorial

Machine learning for health and clinical applications

In light of the recent normalization of the COVID-19, people have shown an increased concern on health. Recent developments in machine learning, wearable sensors and wireless communications have heightened the need for unobtrusive and lower power consumption health monitoring devices. The goal of this thematic issue on Machine Learning for Health and Clinical Applications is to provide a timely collection of novel methods and results on machine learning for intelligent health monitoring and clinical applications, which will benefit researchers and practitioners in the communities. Fifteen excellent articles covering various aspects of biomedical data analysis and clinical applications based on machine learning have been published in this thematic issue. In the following, these articles and their main contributions will be highlighted.

Sleep apnea is a pervasive sleep disorder and, as a chronic disease, can be very dangerous. The first paper [1] considers radar sensors as the way for non-contact real-time monitoring of a patient's respiratory status, which has a wide range of promising applications. Zhuang et al. [1] propose an accurate contactless sleep apnea detection framework with signal processing and machine learning method. Based on a small sample imbalanced dataset with a limited number of sleep apnea events, sleep apnea detection was effectively accomplished using feature engineering, oversampling, and a random forest classifier applicable to the imbalanced data. The obtained features can effectively distinguish sleep apnea segments from non-sleep apnea segments.

High-intensity exercise for a long time can hurt the human body and increase the chances of heart attacks, especially for people with suboptimal health status and high-pressure workload. To promote human safety during physical exercise, Zhu et al. [2] develop an end-to-end heart rate prediction system based on inertial data and historical heart rate data and then deploy it on mobile devices (such as smartwatches). Adaptive fitness training strategies are also recommended to users based on predicted heart rates. This work can help early notify the heart attack risks during fitness training and facilitate a more secure and scientific exercise environment.

Lv et al. [3] apply polysomnograph, event-related potentials and fast Fourier transformation technology in insomnia identification. In particular they employ contingent negative variation (CNV) and EEG to explain the cortical inhibition and habituation, presented with the theory of the "ceiling" as that cortical reactivity would be reduced after reaching a ceiling point due to habituation response. This research has shown that frontal lobe plays an important role in maintaining cognitive processing, which contributes to reduced cortical inhibition, represented as abnormal CNV. Brief therapy for insomnia (BTI) is a short-term cognitive behavioral therapy for insomnia. The study of Liu et al. [4] is attempted to digitize BTI (dBTI). The framework and course design of dBTI based on the WeChat mini-program are developed. Evaluation of the system shows individuals suffering from moderate insomnia had better adherence. Higher adherence leads to better improvement in symptoms for insomnia, especially in insomnia severity index (ISI) score and pre-sleep arousal scale (PSAS) somatic score. It provides a feasible digital treatment technology for acute insomnia patients.

Emotional and physical health are strongly connected and should be taken care of simultaneously to ensure completely healthy management. The work of Nandi et al. [5] contributes to emotional state classification from multimodal data streaming from various physiological measurements of users. It is able to address not only real time processing and emotional state classification at high accuracy, but also achieve scalability and data privacy through a federated learning framework. The proposed federated learning framework can be used in various emotional health scenarios. As an example, detecting the emotional state for patients of dementia can be crucial to detect and address as early as possible the states of anxiety and agitation. Emotional intelligence is also linked to clinical decision making beyond traditional clinical decision making as a rational and cognitive process. Chen et al. [6] utilize emotional visual images to evoke the neural responses by people with major depression group and found lower amplitudes in P1-N1 components. The results suggest the visually perceptual progresses are abnormal in patients with negative mood, which implicitly measure the emotional states through vision test and thus meets the requirement of undisturbed monitoring for active health. The method in this study also provided preliminarily data for the neural mechanisms of visual pathway modulated by negative emotions in depressive patients.

Wu et al. [7] develop and evaluate the methods of detecting pediatric obstructive sleep apnea (OSA) using support vector regression, decision tree and multilayer perceptron (MLP) based on single-channel nocturnal oxygen saturation (SpO_2) with or without clinical data, which may be simpler, less-expensive compared with polysomnography. Finally, the author found that the diagnostic performance of MLP was optimal. The application of the MLP model using single-channel SpO_2 in children with snoring may be of great value in home care applications, enabling timely objective evaluation and treatment of pediatric OSA. Positive airway pressure (PAP) has excellent efficacy for controlling OSA, but its effectiveness is limited by variable adherence to therapy. Current wireless transmission technology advances are now possible to get objective PAP adherence tasks remotely. Yi et al. [8] confirm the feasibility of the wireless telemedicine management platform in monitoring adherence on PAP therapy. By using advances in this platform, early prevention and intervention of PAP therapy could be achieved. Besides, this method for collection and transmission of data also leads to a paradigm change in the way how we traditionally understand the management of other

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chronic diseases.

Cough event detection is the foundation of automatic cough behavior tracking and analysis, thus enabling pulmonary health monitoring and assessment. Wang et al. [9] present HearCough, a technique that allows continuous cough event detection on edge computing hearables using their built-in always-on active noise cancellation (ANC) microphones with on-chip machine learning methods. Through user evaluation studies, HearCough can track cough events with an accuracy of 90.0% every 0.5 s by consuming an additional 5.2 mW power. The HearCough can be used as a low-cost add-on for future hearables to enable continuous cough detection and pulmonary health monitoring.

A 3D reconstruction method discussed in [10] is to match the same grain or cell region of adjacent layers on the basis of 2D image segmentation. Traditional handcrafted features will introduce a large amount of errors in this process. The method in this paper transforms the original problem into a binary classification problem by judging whether the overlapping regions between adjacent layers belong to the same grain or cell through a neural network. The proposed method, adjacent similarity based deep learning tracking method (ASDLTrack) outperforms traditional methods on three datasets.

The relationship between structural connectivity (SC) and functional connectivity (SC) is intriguing yet not well evaluated in Alzheimer's disease (AD). Zhou et al. [11] found the disrupted SC and FC within the default mode network in AD patients for the first time. More importantly, several SC and FC couplings were associated with the cognitive ability of patient groups. Notably, the results were cross-validated in two independent datasets. These results offer a valuable reference and provide deep insights into the neural substrates of dysfunction in AD for future research.

In the mild cognitive impairment (MCI) conversion prediction field, most previous studies suffer from overfitting issues and ignore interpretability issues in medical practice. Zheng et al. [12] propose a transformer-based prediction model, which fuses cortical features containing rich ROI level information to alleviate the overfitting issues and introduces occlusion analysis to improve the model interpretability. This method can aid in the clinical prediction of MCI conversion and can assess the impact of different brain regions on model decisions.

While normal people can extract interesting speech streams from complex acoustic scenes, it is difficult or impossible for hearing-impaired patients to do so. Xu et al. [13] design an AAD-transformer model for EEG based auditory attention decoding. This model includes an attention module between EEG channels and a temporal self-attention module based on the speech envelope according to the top-down and bottom-up regulation attention mechanism between EEG and speech information. The model is data-driven and does not require preprocessing of the raw data. In addition, the model requires a shorter decoding time window to achieve comparable or even better performance than the linear model. This will make it possible to improve the listening ability and sound information processing ability of patients with hearing impairment, and provide theoretical support and method reference for future clinical applications.

Despite the progress recently made towards automatic sleep staging for adults, children have complicated sleep structures that require attention to the pediatric sleep staging. Li et al. [14] propose a semi-supervised pediatric sleep staging solution with single-channel EEG. An adversarial learning strategy is employed in two-stream networks of Student and Teacher branches. This work, by training networks with both labeled and unlabeled data, greatly reduces the burden of epoch-by-epoch annotation for physicians.

Autonomic nerve regulation imbalance is the cause of many diseases. But accurate quantitative measurement of the inner state is exceedingly difficult. Cui et al. [15] propose a measurement method of autonomic nerve regulation in rhythmic deep breathing scene. A physiological and pathological mathematical model of the whole process of autonomic nerve cardiopulmonary regulation is established. Autonomic regulation parameters (CARP) are obtained. In exploratory clinical trials, CARP characterize the different neurophysiological characteristics of patients with hypertension and coronary heart disease. This would play a role in auxiliary diagnosis and etiology of cardiovascular diseases which is great significance for biological medicine and precision medical treatment.

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