# Guest Editorial: Recent Advances in AI Methods for Image Processing: Theory, Algorithms, and Applications

Shoulin Yin[1] and Mirjana Ivanović[2]

[1]  Shenyang Normal University, China
yslin@hit.edu.cn
[2]  Faculty of Sciences, University of Novi Sad, Serbia
mira@dmi.uns.ac.rs

The special section Recent Advances in AI Methods for Image Processing: Theory, Algorithms, and Applications is to contribute original researches on recent theoretical advances, algorithmic developments, and practical applications of the AI-based frameworks. Topics include new AI models, adaptive AI algorithms, robustness analysis, stability analysis, and imaging processing applications.

The rise of machine learning approaches, and in particular deep learning, has led to a significant increase in the performance of AI-based systems. Many current image applications also include at least one AI-based component. Images, video, sound, text-traditional multimedia data are now completed by a multitude of multimodal sources, on which the fundamental principles of image research are being applied.

For this special issue 58 submissions have been submitted where the corresponding authors were majorly counted by the deadline for manuscript submission with an open call-for-paper period of 6 months. All these submissions are considered significant in the field, but however, only one-third of them passed the pre-screening procedure by guest editors. The qualified papers then went through double-blinded peer review based on a strict and rigorous review policy. After a totally three-round reviews, 14 papers were accepted for publication. A quick overview to the papers in this section can be revealed below, and we expect the content may draw attentions from public readers, and furthermore, prompt the society development.

The first paper "GCN-LSTM: Multi-label educational emotion prediction based on graph Convolutional network and long and short term memory network fusion label correlation in online social networks" by Zhiguang Liu, Fengshuai Li, Guoyin Hao, Xiaoqing He, and Yuanheng Zhang, proposes a novel multi-label educational emotion prediction based on graph convolutional network and long and short term memory network fusion label correlation in online social networks. This model uses Word2Vec method to train word vectors and combines graph convolutional neural network (GCN) with long and short term memory network (LSTM). This paper aims to improve the accuracy of multi-label classification and to effectively learn the possible correlations between each label.

The second paper, "A multi-feature Fusion Model Based on Long and Short Term Memory Network and Improved Artificial Bee Colony Algorithm for English Text Classification" by Tianying Wen, proposes a multi-feature fusion model based on long and short term memory network and improved artificial bee colony algorithm for English text classification. In this method, the character-level vector and word-level vector representations of English text are calculated using a pre-training model to obtain a more comprehensive text feature vector representation. Then the multi-head attention mechanism is used to

capture the dependencies in the text sequence to improve the semantic understanding of the text.

The third paper, "A Novel Industrial Big Data Fusion Method Based on Q-learning and Cascade Classifier" by Xi Zhang, Jiyue Wang, Ying Huang, and Feiyue Zhu presents an improved Q-learning algorithm, which makes the improved algorithm randomly select actions in the early stage, and dynamically change in the late stage in the random selection of actions and actions with the highest reward value. It effectively improves the defects of traditional Q-learning algorithm that it is easy to fall into the local optimal and has slow convergence speed.

"Remora Optimization Algorithm-based Adaptive Fusion via Ant Colony Optimization for Traveling Salesman Problem" by Lin Piao, proposes a novel remora optimization algorithm-based adaptive fusion via ant colony optimization for solving TSP to enhance the local search ability of ACO, speed up the efficiency of ACO and avoid the premature problem. In addition, the initial solution is optimized by the k-opt strategy. Finally, the random recombination strategy is used to recombine the pheromone and random excitation to make the algorithm jump out of the local optimal as far as possible and improve the accuracy of the algorithm.

The fifth paper, "GAN-DNADE: Image Encryption Algorithm Based on Generative Adversarial Network and DNA Dynamic Encoding" by Xi Wang introduces GAN into random key generation and uses GAN to learn and train the random key generated by hyperchaotic system. A parallel chaotic system is used to generate two sets of pseudo-random sequences, and DNA dynamic encoding is introduced to further transform them to generate a new sequence. The pixel-level diffusion and scrambling of images within and between channels are carried out by using random sequences. The experimental results show that the randomness of GAN can significantly expand the key space, and the proposed algorithm has significant advantages in the security and anti-attack ability of ciphertext images.

Next paper, "Multi-frame Network Feature Fusion Model and Self-attention Mechanism for Vehicle Lane Line Detection" by Guang Zhu, Yajuan Liu, Jiyue Wang, proposes a lane parallel detection network based on multi-frame network feature fusion model and self-attention mechanism according to the scene characteristics that vehicles can obtain continuous images during normal driving. Firstly, a parallel feature extraction structure is designed. On the one hand, a single frame network with high precision is used to extract the features of the current frame. On the other hand, a lightweight multi-frame network is designed to extract features of low-resolution multi-frame temporal images. And the recurrent neural network module is used to fuse the extracted temporal features and obtain multi-frame features. Self-attention mechanism can effectively capture the relevant information of internal features. Then the fusion module of single frame feature, multi-frame feature and self-attention feature is designed. The feature map of lane line is output by up-sampling network. The experimental results show that the network in this paper has significant improvement in both objective detection accuracy and subjective effect compared with other methods.

The seventh paper, "Stacked Denoised Auto-encoding Network-based Kernel Principal Component Analysis for Cyber Physical Systems Intrusion Detection in Business Management" by Zhihao Song, proposes a stacked denoised auto-encoding network based on kernel principal component analysis for industrial cyber physical systems intrusion

detection. A multi-stacked denoised auto-encoding network model is used to classify and identify the data after dimensionality reduction by voting. Experimental results show that the proposed method has better classification performance and detection efficiency by comparing the state-of-the-art intrusion detection methods.

The eighth paper, "A Novel Image Enhancement Method Using Retinex-based Illumination Map Weighted Guided Filtering" by Su Chen, Dahai Li) try to solve the traditional defogging physical models. These models only enhance the images based on dark channels prior, resulting in different depths of field in local areas, and it can lead to some problems such as image overexposure and halo artifacts. To solve this problem, the method of combining light and dark channels is adopted to calculate the atmospheric light value and transmittance. For the problem that edge information is easily lost, the illumination gradient domain weighted guided filtering is utilized to improve the thinning transmittance. Experimental results with the proposed method have obvious improvement in denoising, halo elimination, brightness adjustment and edge preservation in the low-illumination image under different conditions.

Paper, "Underwater Image Denoising Based on Curved Wave Filtering and Two-dimensional Variational Mode Decomposition" by Lin Teng, Yulong Qiao, Shoulin Yin, proposes a novel underwater image denoising method based on curved wave filter and two-dimensional variational mode decomposition. Firstly, the noisy image is decomposed by two-dimensional variational mode decomposition, and a series of modal components with different center frequencies are obtained. The effective modal components are selected by correlation coefficient and structural similarity. And the effective modal components are processed by the curve-wave filter.

The tenth paper, "A Novel Deep Fully Convolutional Encoder-Decoder Network and Similarity Analysis for English Education Text Event Clustering Analysis" by Zhenping Jing, proposes a novel deep fully convolutional encoder-decoder network and similarity analysis for English education text event clustering analysis in online social networks. At the encoder end, the features of text events are extracted step by step through the convolution operation of the convolution layer. Compared to the supervised cluster model with the same pre-training, the clustering index of the proposed model is improved.

Paper, "Attitude Estimation of aircraft Based on Quaternion SRCKF-SLAM Algorithm" by Dandan Wang, Zhaokun Zhu, Liang Yu, Hongjie Li, and Kaituo Tan, takes the attitude quaternion error and the gyro drift error as the state quantity, and measures the attitude quaternion of SINS/SLAM navigation. The square root cubature Kalman filter algorithm is used for pose estimation, which not only solves the standardization problem of traditional quaternion, but also reduces the state dimension and complexity of the square root UKF algorithm of traditional quaternion, and improves the numerical stability.

The twelfth paper, "Spatio-Temporal-based Multi-level Aggregation Network for Physical Action Recognition" by Yuhang Wang, introduces spatio-temporal-based multi-level aggregation network (ST-MANet) for action recognition. It utilizes the correlations between different spatial positions and the correlations between different temporal positions on the feature map to explore long-range spatial and temporal dependencies, respectively, generating the spatial and temporal attention map that assigns different weights to features at different spatial and temporal locations. Additionally, a multi-scale approach is introduced, proposing a multi-scale behavior recognition framework that models various visual rhythms while capturing multi-scale spatiotemporal information. A spatial diversity

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constraint is then proposed, encouraging spatial attention maps at different scales to focus on distinct areas. This ensures a greater emphasis on spatial information unique to each scale, thereby incorporating more diverse spatial information into multi-scale features.

The thirteenth paper, "Multi-object Real-time Tracking for Intelligent Breeding of Animal" by Fei Wang, Bin Xia, Liwu Pan, proposes a new multi-object real-time tracking within deep framework for intelligent breeding of animal (MRT-IB), which consists of semantic feature extraction module, center point prediction module, and object and trajectory calibration module. MRT-IB reduces the difficulty of modeling animal trajectories by performing animal detection on consecutive frames, resulting in higher robustness in real farming scenarios compared to traditional multi-object tracking schemes that directly model animal motion trajectories.

The last paper, "MFE-Transformer: Adaptive English Text Named Entity Recognition Method Based on Multi-feature Extraction and Transformer" by Liuxin Gao, proposes an adaptive English named text entity recognition method based on multi-feature extraction and transformer. Experiments are carried out on five English datasets and CrossNER datasets, and compared with current cross-domain methods, the results show that the proposed method achieves better results in cross-domain tasks, indicating that learning and using structured knowledge can better promote cross-domain knowledge transfer.

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