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Special Issue: Artificial Intelligence in Environmental Automation Systems

GUEST EDITORIAL: ARTIFICIAL INTELLIGENCE IN ENVIRONMENTAL AUTOMATION SYSTEMS

Dong Ren* and Bin Li**

Artificial intelligence (AI) plays an important role in the automation field, which can contribute to intelligent decision-making of human beings. In recent years, AI has attracted wide attention from researchers and has been applied to almost all aspects of human life. A series of algorithms and models of AI have been used to promote the innovation of product/service in the field of environmental automation systems. On the other hand, in the field of environment and geology, remote sensing data and internet of things (IoT) sensing data are typically used for research and analysis. By combining big data with AI algorithms, issues such as environment change, ecological status assessment, geological disaster prediction, and data mining can be done to assist decision-making and other work.

The purpose of this special issue is to explore the current research direction of AI applied to environmental automation systems, including environment change monitoring, ecological status assessment, geological disaster prediction, and data mining. In this issue, seven papers regarding AI in environmental automation systems are selected by peer view. These papers present several theoretical and practical problems related to AI in environmental automation systems, as well as the analysis, new discoveries, and innovative ideas and improvements made in the field of AI in environmental automation systems.

Subjects of the seven papers include: AI models for ecology or geology (environment and hazardous), machine learning models for ecology or geology, expert systems for ecology or geology, deep learning for ecology or geology, intelligence image processing algorithms for ecology or geology, big data analytics for data processing from ecology or geology, applications of AI in ecology or geology, data fusion for change detection, geological disaster prediction, and forest deforestation monitoring.

* College of Computer and Information Technology, China Three Gorges University, Yichang 443002, P.R. China; e-mail: rendong5227@ 163.com

** School of Information Engineering, Yangzhou University, Yangzhou 225009, P.R. China; e-mail: lb@yzu.edu.cn
Correspondence author: Dong Ren

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With the increasing attention to environmental issues, wireless sensor networks have been widely used in the field of environmental monitoring. Routing plays a vital role in this application, but there are also some problems. In "Clustering Routing Protocol Based on Game Theory in Wireless Sensor Networks for Large-scale Environmental Monitoring [1]", Dong *et al.* address the imbalance energy of cluster heads via clustering routing protocol. The authors propose a clustering routing protocol on the basis of game theory. The optimal cluster heads are selected by Nash equilibrium probability, and then form the optimal path to sink through multi-round auction game among neighbour cluster heads. Feature extraction is an important step in AI algorithms, in "Feature Extraction of Motor Imagery electro encephalo graph (EEG) Signals Based on Multi-scale Recurrence Plot and stacked denoising autoencoders (SDA) [2]", Wang *et al.* address high classification accuracy for multiple types of motor imagery EEG tasks via neural network models. They propose a SDA network to extract more abstract category attribute features from multi-scale recurrence plot on the basis of synchrosqueezed wavelet transform (SWT) and construct a two-level feature extraction method for multi-class EEG. The average classification accuracy shows that the proposed method has good effectiveness and robustness.

Deep learning as an important branch of AI has received extensive attention in the field of remote sensing. Such as classifying the vegetation into subclasses is significant for some applications such as ecological protection and vegetation mapping. In "Vegetation Classification by Multi-scale Hierarchical Segmentation on GF-2 Remote Sensing Image [3]", Wugu *et al.* propose a new method for classifying vegetation into subclasses using GF-2 remote sensing image on the basis of multi-scale segmentation. The GF-2 remote sensing image is separated into objects in different hierarchical levels by using image features such as spectral, shape, texture and others. Experiment is performed with the image along the Yangtze River in the Dianjun District of Yichang City and shows the efficiency of the method. In addition, the application of deep learning in the field of target detection also shows its powerful function. In

"Research on the Application of RetinaNet Combined with Adaptive Learning Rate Attenuation Strategy in Vehicle Type Detection [4]", Xu *et al.* address the issues of accuracy and speed of the current target detection algorithm, by using deep learning model. They use RetinaNet as the basic framework for vehicle type detection and propose an adaptive learning rate attenuation (ALRA) on the basis of least squares. The experimental results demonstrated ALRA can improve model convergence effectively.

Non-destructive testing of heavy metals is an application of AI in environmental automation systems. In "Application of Backpropagation Neural Network for Soil Heavy Metal Modelling [5]", Li *et al.* build accurate models for rapid detection of heavy metal pollution in soil with X-ray fluorescence (XRF) spectrometer. A novel error back-propagation artificial neural network learning (BP-ANN) algorithm optimized by Levenberg–Marquardt (LM) algorithm is selected to establish accurate models for quantitative detection of soil heavy metal XRF. Experimental results demonstrated the promising performance of BP-ANN-LM. To improve the accuracy of heavy metal detection, in "An Improved Boosting-BiPLS Models Based on Weight Adjustment for Soil Heavy Metal Content Prediction [6]", Ren *et al.* propose an improved Boosting-BiPLS model to detect the heavy metal content in soil. From bias oriented, the weights of samples are adjusted on the basis of the relative deviation of the samples and the weights of base models are dynamically calculated by the spectral similarity. The results show the improved Booting-BiPLS model is more precise and stable than previous models. Non-destructive rapid detection of apples is an another application of AI in environmental automation systems. In "A Proprietarily Developed Bionic Olfactory System Used for Rapid Detection of Deteriorated Refrigerated-Stored Apples [7]", Tian *et al.* design a high-sensitivity, low-cost portable electronic nose detection system, using rapid detection and early-warning of apple deterioration. And a non-destructive detection model for refrigerated-stored apples is constructed on the basis of PCA/KPCA and BPNN/SVM.

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We hope that the special issue will help researcher's present novel contributions in a related field in the future. And we thank Prof. Simon X. Yang, the Editor-in-Chief of the *International Journal of Robotics and Automation*, for his support during the SI production process.

References

[1] P. Dong, B. Gong, P. Chen, and W. Wu, Clustering routing protocol based on game theory in wireless sensor networks, *International Journal of Robotics and Automation*, *36*, 2021, 1–7.

[2] W. Wang, L. Sun, and G. Chen, Feature extraction of motor imagery EEG signals based on multi-scale recurrence plot and SDA, *International Journal of Robotics and Automation*, *36*, 2021, 1–10.

[3] Y. Wugu, T. Weixin, and M. Lei, Vegetation classification by multi-scale hierarchical segmentation on GF-2 remote sensing image, *International Journal of Robotics and Automation*, *36*, 2021, 1–7.

[4] Y. Xu, P. He, H. Wang, T. Dong, and P. Shao, Vehicle type detection based on RetinaNet with adaptive learning rate attenuation, *International Journal of Robotics and Automation*, *36*, 2021, 1–8.

[5] F. Li, A. Lu, J. Wang, and T. You, Back-propagation neural network–based modelling for soil heavy metal, *International Journal of Robotics and Automation*, *36*, 2021, 1–7.

[6] D. Ren, J. Shen, S. Ren, K. Ma, and X. Yang, An improved Boosting-BiPLS models based on weight adjustment for soil heavy metal content prediction, *International Journal of Robotics and Automation*, *36*, 2021, 1–7.

[7] H. Tian, W. Jia, J. Ma, J. Wang, and J. Hao, A proprietarily developed bionic olfactory system used for rapid detection of deteriorated refrigerated-stored apples, *International Journal of Robotics and Automation*, *36*, 2021, 1–7.

Biographies

Dong Ren received his Ph.D. degree in Jilin University. He is a Professor in the College of Computer and Information Technology at China Three Gorges University, Yichang, China. His research interests include artificial intelligence, pattern recognition, and 3S technology.

Bin Li received the B.S. degree from Fudan University, China in 1986, M.S. and Ph.D. degrees from Nanjing University of Aeronautics and Astronautics, China in 1993 and 2001, respectively. He is now working as a Professor at Yangzhou University. His main research interests include artificial intelligence, multi-agent system, and service-oriented computing.