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Special Section Guest Editorial: Advances in Deep Learning for Hyperspectral Image Analysis and Classification

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Remote sensing is a classical area of research that has been involved in many crucial applications, including urban development agriculture, scene interpretation, defense, weather, and other non-Earth observations. In the last decade, the analysis of hyperspectral images (HSIs) acquired by remote sensors has gained substantial attention and is increasingly becoming an active research discipline. However, there are some main challenges in hyperspectral data classification, such as ultra-high dimensionality of data, a limited number of labeled instances, and large spatial variability of spectral signature. These challenges degrade the ability to differentiate the pairwise distance between points and make it difficult to discriminate the most relevant features, causing the classification performance to give wrong or inaccurate results. Therefore, in processing hyperspectral images, the classification approaches have been proposed jointly by dimensionality reduction. Several feature extraction based HSI have been developed to solve the classification problem in hyperspectral images. These methods aim to reduce the dimensionality of the data while preserving the discriminative information of both spectral and spatial features.

Deep learning has become the de facto for many computer vision tasks. However, hyperspectral image classification and analysis is still in its infancy, so there are few works on the concept. In part, this is because remote sensing poses unique challenges, such as lack of labeled training data and diversity features (spectral–spatial). Whereas we are excited about the potential of deep learning for remote sensing, we are equally nervous about whether this technology can deliver. Furthermore, it is an analytics tool to help us better understand these sensors, platforms, and applications.

In this special section, we requested new application papers on hyperspectral imaging to show what has been done and what is being done. This special section includes seven high quality papers, which in particular address hyperspectral image classification and analysis. One paper is based on multispectral image fusion for HSI, in which the spectral and spatial information of HSI are fused into the same feature map. One paper uses a two-mode method to identify surface water in particular images. Two papers utilize spectral–spatial processing for hyperspectral image analysis. One paper uses multiscale segmentation-based CNN to increase the resolution of the HSI. Two papers are based on sparse representation to achieve temporal–angular fusion.

Since this special section is based on new deep learning methods in HSI, we focused on those papers that rely on new techniques and real datasets. We believe that all of these papers will attract both expert and nonexpert readers. We appreciate the effort of a large number of reviewers, whose work and dedication are here deeply acknowledged. We have special thanks to the following contributors for their great support.

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Wankou Yang is an associate professor in the School of Automation, Southeast University, China. His research interests include pattern recognition, machine learning, image processing, and computer vision. He has published more than 80 papers in international peer-reviewed journals, workshops, and conferences. He has served as a guest editor in several journals and also has been organizer and technical chair of several conferences.

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