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Special Section Guest Editorial: Airborne Hyperspectral Remote Sensing of Urban Environments

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Remote sensing is a very useful tool in retrieving urban information in a timely, detailed, and cost-effective manner to assist various planning and management activities. Hyperspectral remote sensing has been of great interest to the scientific community since its emergence in the 1980s, due to its very high spectral resolution providing the potential of finer material detection, classification, identification, and quantification, compared to the traditional multispectral remote sensing. With the advance of computing facilities and more airborne high-spatial-resolution hyperspectral image data becoming available, many investigations on its real applications are taking place. In particular, urban environments are characterized by heterogeneous surface covers with significant spatial and spectral variations, and airborne hyperspectral imagery with high spatial and spectral resolutions offers an effective tool to analyze complex urban scenes.

The objective of this special section of the *Journal of Applied Remote Sensing* is to provide a snapshot of status, potentials, and challenges of high-spatial-resolution hyperspectral imagery in urban feature extraction and land use interpretation in support of urban monitoring and management decisions. This section includes twelve papers that cover four major topics: urban land use and land cover classification, impervious surface mapping, built-up land analysis, and urban surface water mapping.

There are nine papers about urban land use and land cover classification. "Hyperspectral image classification with improved local-region filters" by Ran et al. proposes two local-region filters, i.e., spatial adaptive weighted filter and collaborative-representation-based filter, for spatial feature extraction, thereby improving classification of urban hyperspectral imagery. "Edge-constrained Markov random field classification by integrating hyperspectral image with LiDAR data over urban areas" by Ni et al. adopts an edge-constrained Markov random field method for accurate land cover classification over urban areas with hyperspectral image and LiDAR data. "Combining data mining algorithm and object-based image analysis for detailed urban mapping of hyperspectral images" by Hamedianfar et al. explores the combined performance of a data mining algorithm and object-based image analysis, which can produce high accuracy of urban surface mapping. "Dynamic classifier selection using spectral-spatial information for hyperspectral image classification" by Su et al. proposes the integration of spectral features with volumetric textural features to improve the classification performance for urban hyperspectral images. "Representation-based classifications with Markov random field model for hyperspectral urban data" by Xiong et al. improves representation-based classification by considering spatial-contextual information derived from a Markov random field. "Classification of hyperspectral urban data using adaptive simultaneous orthogonal matching pursuit" by Zou et al. improves the classification performance of a joint sparsity model, i.e., simultaneous orthogonal matching pursuit, by using *a priori* segmentation map.

Other techniques, such as linear unmixing and dimensionality reduction, are also investigated in conjunction with urban surface mapping. Among the nine papers on classification, two papers consider linear unmixing, which are "Unsupervised classification strategy utilizing an endmember extraction technique for airborne hyperspectral remotely sensed imagery" by Xu et al., and "Endmember number estimation for hyperspectral imagery based on vertex component analysis" by Liu et al. One paper studies the impact of dimensionality reduction (through band selection) on classification accuracy, which is "Ant colony optimization-based supervised and unsupervised band selections for hyperspectral urban data classification" by Gao et al.

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The study of impervious surfaces is very important due to their impact on urban ecosystems. "Modified multiple endmember spectral mixture analysis for mapping impervious surfaces in urban environments" by Tan et al. proposes a modified multiple endmember spectral mixture analysis (MMESMA) approach for more accurate impervious surface mapping. Different from the original MESMA that usually selects one endmember spectral signature for each land-cover class, the proposed MMESMA allows the selection of multiple endmember signatures for each land-cover class. It can better accommodate within-class variations and yield better mapping results.

The analysis of built-up land, which is one type of impervious surface, is provided by Liu et al. in "New normalized difference index for built-up land enhancement using airborne visible infrared imaging spectrometer imagery." In this paper, normalized difference built-up index for hyperspectral data (NDBIh), oriented to built-up land enhancement in hyperspectral remote sensing data, is proposed, which has the best ability to differentiate built-up land from other areas, compared to the conventional normalized difference built-up index (NDBI) and the index-based built-up index (IBI).

Mapping urban water bodies is investigated in "New hyperspectral difference water index for the extraction of urban water bodies by the use of airborne hyperspectral images" by Xie et al. Spectral water indexes have successfully extracted water bodies in multispectral images. However, applying a water index method to hyperspectral images is more difficult due to abundant spectral information in hundreds of bands. It is also a challenge to distinguish water from many shadowed regions in an urban scene. In this paper, a new hyperspectral difference water index (HDWI) is developed to improve water mapping accuracy in urban areas that include shadow over water, shadow over other ground surfaces, and low-albedo surfaces.

We wish this special section would inspire more ideas in utilizing high-spatial-resolution hyperspectral images in the study of urban environments. Finally, we would like to take this opportunity to sincerely thank all of the authors and peer reviewers for their efforts devoted to this special section.

Qian Du is Bobby Shackouls Professor in the Department of Electrical and Computer Engineering at Mississippi State University. She has served as associate editor for the *Journal of Applied Remote Sensing*, *IEEE Journal of Selected Topics in Earth Observations and Remote Sensing*, and *IEEE Signal Processing Letters*. She has published more than 80 journal papers on hyperspectral remote sensing.

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