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Editorial

Editorial Paper for the Special Issue "Algorithms in Hyperspectral Data Analysis"

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This Special Issue contains four papers focused on hyperspectral data analysis. The data acquired through hyperspectral sensors (i.e., the hyperspectral images) are used for several purposes and fields. For instance, hyperspectral images are used in surveillance, archeology, historical research, monitoring of environmental hazards, environmental sciences, assessment of food quality, Earth imaging, forensics, counterterrorism, and so on. As a result, hyperspectral images are a rich source of information since they contain precious spatial and spectral contents differently than traditional images. In detail, a hyperspectral sensor acquires information by considering the portion of the electromagnetic spectrum that varies from the visible part to the near-infrared. Thanks to the continuous evolution of sensor technologies for hyperspectral imaging, there is a high demand for the design of algorithms, techniques, and methods for the analysis of hyperspectral images.

The present Special Issue covers a range of algorithms and techniques for hyperspectral data analysis.

In their work, Ismail et al. [1] have dealt with hyperspectral image classification, which has been increasingly used in the field of remote sensing. This work proposes a new clustering framework for large-scale hyperspectral image (HSI) classification. The proposal consists of a four-step classification approach that uses the global spectral information and local spatial structure of hyperspectral data for HSI classification. More precisely, the proposed clustering using binary partition trees (CLUS-BPT) framework starts by obtaining an over-segmented image partition of the input HIS. In detail, the framework applies an adapted watershed segmentation algorithm on the input HSI in order to obtain a segmented map. Subsequently, the obtained initial partition is used to build the binary partition trees (BPT). Therefore, the output of the previous phase is a BPT. It is important to point out that this BPT represents the hyperspectral image and incorporates its spatial and spectral features. After that, the principal component analysis (PCA) is applied to the input HSI cube. The results of the PCA are then combined with the final segmentation map produced by BPT. In the last step, the framework applies a filtering algorithm for k-means clustering to the refined segments to achieve the cluster map.

By taking advantage of the extreme learning machine (ELM), Li et al. [2] outline a novel framework incorporating ELM and dimensionality reduction techniques to solve the inverse problem in spectral data analysis. As outlined by the authors, ELM is a randomization-based learning algorithm that provides a fast solution for different classification and regression problems. The authors provide several experiments of the proposal, and the achieved results outline that their proposal can achieve prediction inaccuracies of less than 1%. In addition, the proposal is also suitable for real-time spectral data analysis by integrating it into a spectroscopic data collection system.

Markgraf et al. [3] show another valuable perspective for the usage of hyperspectral images and investigate the feasibility of such images in an interesting scenario. In particular, the hyperspectral images in the wavelength range of 500–995 nm are used to determine tissue water content (TWC) in kidneys. Again, as highlighted by the authors, the preservation of kidneys using normothermic machine perfusion (NMP) before transplantation has the potential for the predictive evaluation of organ quality. The authors use multivariate data

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analysis to establish a quantitative relationship between the obtained spectral information of the kidney and its reference TWC values. The achieved results are encouraging and highlight that the HSI could be used for non-invasive and accurate TWC prediction in kidneys. In the future, this approach could be used to assess the quality of kidneys during the preservation period.

Manda et al. [4] propose an infrared image thresholding method based on the functional approximation of the histogram. More precisely, the proposed method considers the one-dimensional histogram of the image and performs an approximation to the transient response of a first-order linear circuit. The authors perform several experiments on the standard databases. The achieved experimental results highlight that the proposal is well suited to perform infrared image thresholding.

Editing of the present Special Issue has been a stimulating experience since we dealt with very interesting and innovative contributions. We would like to warmly thank all the authors for the innovative research outlined in their papers, assessed with a rigorous peer-review procedure.

Finally, we hope this SI provides researchers with new algorithms and techniques concerning hyperspectral data analysis. The guest editor would like to thank the authors, reviewers, etc.

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