Special Section Guest Editorial: Management and Analytics of Remotely Sensed Big Data

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As we have entered the era of "big data," the capability of Earth observations has been dramatically increased and reached an unprecedented level by widely accessible remotely sensed big data. The current remote sensing systems collect several terabytes of Earth observation data per day and enable the measurement of objects at the submeter level. Moreover, with the rapid development of imaging and earth observation technologies, the collected data volumes are predicted to be amplified quickly. Efficient management and analytics for such remotely sensed data are critical in the applications of Earth observations, but present great challenges due to data complexity, diversity, and volume. Actually, there exists great imbalance between the capacity of data management and analytics and the capacity of data acquisition in remote sensing. Thus, it is an urgent demand to develop effective data management tools and advanced analytical techniques for the best use of remotely sensed big data. Meanwhile, streaming and online real-time algorithms are required for quick and intelligent decision making.

The objective of this special section of the *Journal of Applied Remote Sensing* is to provide a snapshot of status, potentials, and challenges of handling big data in remote sensing. This special section includes ten papers that cover topics mainly on parallel computing, and efficient and scalable algorithm design. These papers discuss various applications (e.g., classification, target detection, change detection, image fusion) using multispectral, hyperspectral, and synthetic aperture radar (SAR) images.

There are three papers about graphical processing unit (GPU)-based high-performance computing. "Rapid three-dimensional detection approach for building damage due to earthquakes by the use of parallel processing of unmanned aerial vehicle imagery" by Z. Hong et al. presents a parallel-processing approach for accelerating the speed of automatic three-dimensional (3-D) building damage detection, using a preseismic digital topographical map and postseismic images taken by sensors mounted in an unmanned aerial vehicle (UAV), which can produce a damage detection map of the 2013 Ya'an earthquake in Baoxing County, Sichuan province of China ten times faster than using a single-core central processing unit (CPU)-based implementation. In "Highly efficient synthetic aperture radar processing system for airborne sensors using CPU +GPU architecture" by Z. Wu et al., a comprehensive and effective parallel airborne SAR processing system with an architecture of CPU and GPU is proposed, including motion compensation, subaperture chirp scaling algorithm, phase gradient autofocus, and visualization. "Graphics processing unit–accelerated computation of the Markov random fields and loopy belief propagation algorithms for hyperspectral image classification" by Y. Wu et al. implements a spectral-spatial classification framework with massively parallel computing capability to dramatically improve computation speed.

Four papers propose low-complexity classification and detection algorithms that can be easily implemented in parallel. In "Classification of levee slides from airborne synthetic aperture radar images with efficient spatial feature extraction" by D. Han et al., a fixed-weight low-pass spatial filtering process is introduced for SAR image classification, which can offer comparable

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performance as sophisticated gray level co-occurrence matrix operators. In "Optimizing extreme learning machine for hyperspectral image classification" by J. Li et al., an empirical linear relationship between the number of training samples and the number of hidden neurons in kernel extreme learning machine (ELM) is proposed, whose performance is comparable to the popular support vector machine (SVM) with much lower computational cost. "Decision fusion for dual-window-based hyperspectral anomaly detector" by W. Li and Q. Du proposes an automatic framework to determine the best window size in Reed-Xiaoli (RX) anomaly detection, whose parallel nature makes its parallel implementation straightforward. In "Hyperspectral image classification for mapping agricultural tillage practices" by Q. Ran et al., a simple Gaussian low-pass filter with a traditional k-nearest-neighbor (kNN) classifier can offer similar classification accuracy as the sophisticated SVM with composite kernel.

In addition, "Three-dimensional terrain model multiview quality assessment considering the human visual system" by F. Zhang et al. provides an integration of structural similarity and human visual system from multiview angles for fast image quality assessment. A low-complexity pan-sharpening technique is proposed in "Enhanced hyperspherical color space fusion technique preserving spectral and spatial content" by B. Wu et al. to significantly preserve spectral characteristics and enhance spatial details simultaneously. An efficient subpixel mapping technique is investigated in "Subpixel land cover change mapping with multitemporal remote-sensed images at different resolution" by K. Wu et al. to improve the accuracy of change detection maps of spatial distribution in a subpixel scale.

Finally, we would like to take this opportunity to sincerely thank all the authors and peer reviewers for their efforts devoted to this special section.

Liangpei Zhang is the head of the Remote Sensing Division, State Key Laboratory of Information Engineering in Surveying, Mapping and Remote Sensing, at Wuhan University in China where he is also a professor. He is also a Chang-Jiang Scholar Chair Professor appointed by the Ministry of Education of China. He is currently a principal scientist for the China State Key Basic Research Project (2011–2016) appointed by the Ministry of National Science and Technology of China to lead the remote sensing program in China. He has more than 360 research papers and holds holds 15 patents. His research interests include hyperspectral remote sensing, high-resolution remote sensing, image processing, and artificial intelligence. He is an associate editor for *IEEE Transactions on Geoscience and Remote Sensing*. He is a fellow of the Institution of Engineering and Technology.

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Mihai Datcu has been with German Aerospace Center (DLR), Oberpfaffenhofen, Germany, where he is currently a senior scientist and an image analysis research group leader in the Remote Sensing Technology Institute (IMF). He is developing algorithms for analyzing very-high-resolution synthetic aperture radar (SAR) and interferometric SAR data. He is engaged in research related to information theoretical aspects and semantic representations in advanced communication systems. He is a fellow of IEEE.