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# Guest Editorial: Satellite Data Compression

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With the advances in modern active and passive sensor technologies with higher spectral and spatial resolutions as well as faster scanning speeds, more powerful satellite instruments are being developed for remote sensing of the atmosphere, oceans, lands of the Earth, and other planets. These advanced technologies result in a significant increase in data volume. The explosion in the amount, size and dimensionality of current and future remote sensing data collected on a daily basis presents new challenges to satellites with limited access to an increasingly congested radio frequency spectrum. Data compression techniques provide useful tools for efficient and effective downlink and rebroadcast over a limited-bandwidth error-prone satellite channel. Considerable savings in data storage and transfer in satellite data centers can be also achieved using data compression methods. Various satellite data may have different data characteristics. Data compression methods which explore specific data characteristics may lead to better compression gains. Furthermore, data compression can be lossless or lossy, depending on available satellite bandwidths and mission requirements. Lossy compression needs an impact study to balance between data fidelity and scientific tolerance. The goals of this special section of the *Journal of Applied Remote Sensing* (JARS) are to explore state-of-the-art methods and techniques for compression, transmission, and storage of contemporary and future satellite remote sensing data. After an extensive peer review, one review paper [1] and thirteen research papers [2-14] were accepted for publication in the special section, covering various aspects of satellite data compression, including lossless or lossy compression of ultraspectral, hyperspectral and multispectral data, onboard compression chip development, onsite GPU-accelerated data compression, and error-correcting coding for satellite error-prone transmission. As guest editor, I would like to thank the authors for their contributions and the reviewers for their service. A brief synopsis of each accepted paper is provided below.

Shen-En Qian [1] reviewed the research and developments in the last decade on near lossless satellite data compression techniques at the Canadian Space Agency (CSA). The hardware developments of two vector quantization-based near lossless hyperspectral data compression techniques were presented.

Martin et al. [2] studied the impact of JPEG2000-based lossy compression of hyperspectral images on the quality of the endmembers extracted by three different

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algorithms, namely, orthogonal subspace projection (OSP), automatic morphological endmember extraction (AMEE), and spatial spectral endmember extraction (SSEE).

Zabala et al. [3] enhanced the JPEG2000 coding performance for images that contain regions without useful information or without information at all. They proposed two approaches that address this issue; the first technique (average data region, ADR) is carried out as simple pre-processing and the second technique (shape-adaptive JPEG2000, SA-JPEG2000) modifies the coding system to avoid the regions without information.

Paul et al. [4] applied a quasi-optimal spectral transform, called exogenous OrthOST, to lossy and lossless compression of MERIS hyperspectral images, and showed promising performances compared to the ones of the Karhunen-Loeve transform (KLT).

Wu et al. [5] proposed an embedded satellite image compression method using weighted zero-block coding (WZBC) and optimal sorting. Their results show good coding performance compared with those of SPECK, SPIHT, and JPEG2000.

Portell et al. [6] developed a quick outlier-resilient prediction error coder (PEC) and its fully adaptive version (FAPEC) as a reliable alternative to the CCSDS Rice coder whose performance rapidly degrades in the presence of outliers.

Shi et al. [7] introduced a joint coding and modulation system that comprises a powerful non-binary low-density parity-check (LDPC) code, a quadratic amplitude modulator and a modulation diversity operator that can provide efficient and reliable wireless transmission as well as power- and bandwidth-efficient diversity gain.

Li et al. [8] proposed a novel adaptive compression algorithm based on the combination of feature-based image matching (FBM), area-based image matching (ABM), and region-based disparity estimation for adaptive compression of remote sensing stereo image pairs.

Mielikainen et al. [9] adopted NVIDIA graphics processing units and CUDA parallel computing architecture to accelerate a time-consuming data compression method called linear prediction with constant coefficients (LP-CC) for lossless compression of ultraspectral sounder, and achieved an 86x speedup compared to a single threaded CPU version.

Fisher et al. [10] developed a progressive band selection (PBS) method to prioritize individual spectral bands by assigning a priority score based on its information content measured by a certain criterion. Then, bands with certain priority scores are selected for compression and transmission in a progressive fashion to meet the application's requirements.

Chang et. al. [11] introduced a simulated annealing band selection (SABS) approach, which takes sets of non-correlated bands for high-dimensional remote sensing images based on a heuristic optimization algorithm.

Lee et al. [12] introduced two discriminant-enhanced lossy hyperspectral compression methods, one with a pre-processing step to enhance the discriminant features prior to compression, the other with a feature extraction step to obtain discriminately dominant feature vectors for determining the bit allocation for each spectral band.

Chang et al. [13] introduced various exploitation-based approaches to spectral/spatial compression which include virtual dimensionality (VD) for data reduction and the use of PCA and/or ICA for spectral compression, in order to tackle object information loss issues encountered in hyperspectral-subpixel and mixed-pixel exploitation when lossy compression is performed at low bit rates..

He et al. [14] investigated a band regrouping-based lossless compression (BRLlC) method for hyperspectral images. It comprises affinity propagation for adaptive band clustering, context-based linear prediction for each cluster, and arithmetic coding. Experimental results show more compression gain than those of JPEG-LS, CALIC and M-CALIC for AVIRIS hyperspectral data.

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