remote sensing

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Editorial

Special Section Guest Editorial: Change Detection Using Multi-Source Remotely Sensed Imagery

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Received: 18 September 2019; Accepted: 20 September 2019; Published: 23 September 2019

Abstract: This special issue hosts papers on change detection technologies and analysis in remote sensing, including multi-source sensors, advanced machine learning technologies for change information mining, and the utilization of these technologies in a variety of geospatial applications. The presented results showed improved results when multi-source remote sensed data was used in change detection.

Keywords: change detection; multi-source remote sensing; deep learning; multi-scale; image segmentation

1. Introduction

A diversity of remote sensors is capable of providing high spectral and spatial resolution imagery with multiple viewing angles and dense time series, opening new era for change detection and multi-temporal land-cover monitoring [1]. Meanwhile, a number of state-of-the-art image processing techniques appear, e.g., convolutional neuron network, multi-scale image segmentation, cross-domain information fusion, in order to improve the accuracy of remote sensing change detection [2]. In this context, in pace with the developments in both sensors and processing methods, this special issue aims to cover the latest advances and trends in the field of change detection using multi-source remotely sensed imagery.

2. Overview of Contributions

Using multi-source data, the Special Issue includes papers focusing on deep learning [3–5], multi-angle image processing [6], multi-source image fusion in heterogeneous environments [2,3,5], and object-based image analysis [5,7,8]. These interesting techniques applied various change detection applications, while most of them simultaneously mined the change information from the spectral, spatial, and temporal domains.

Peng et al. [3] trained a nested U-shape network from scratch, which treated change/no change as a binary semantic segmentation task. In this work, co-registered image pairs were concatenated as input, and a nested deep architecture was designed to extract the spatial feature at multiple scales. From this study, the loss function addressing multi-scale features and the solution in dealing with data imbalance are valuable experiences for designing relevant change detection networks.

An advanced deep capsule network, which is a vector-extension version of convolutional neuron network, i.e., feature information is encapsulated in a vector form instead of a scalar form, was used in [4]. In this study, for heterogeneous synthetic aperture radar image and optical image change detection, a pixel-level mapping was designed to transform multi-source images in a uniform feature space and to collect candidate supervised samples, which were then used to train a capsule network to determine whether the land-cover was changed in the period.

With the aid of fully convolutional neuron network, Pang et al. [5] proposed a co-segmentation and superpixel-based graph cuts for building change detection. By modeling the characteristics of building in a 4-dimension feature space (i.e., horizontal, vertical, and temporal), this study can further identify the building change types (e.g., "newly built", "taller", "demolished", and "lower").

In addition to the airborne Light Detection and Ranging (LiDAR) /stereo aerial image (with extremely high spatial resolution) derived Digital Surface Model (DSM) [5], the space-borne multi-angle image derived DSM is also suitable for 3D building change and urban redevelopment patterns monitoring [6]. In the work of Wen et al. [6], the multi-temporal 3D dynamic monitoring was conducted in an automatic way, which is an efficient approach to understand how inner-city areas have changed under urban redevelopment.

The object-based automatic land-cover change detection proposed by Lv et al. [8] followed the unsupervised paradigm of bi-temporal feature difference. In this work, an object-level bin-to-bin histogram distance was adapted to measure the change magnitude between the pairwise objects of the bi-temporal images, which presented superiority to the current unsupervised spectral-spatial change detection techniques.

By considering bi-temporal land cover change detection as a binary classification, Tan et al. [7] designed an automatic technique, which was conducted by combining a change vector analysis based sample collection and a semi-supervised binary change/no change classification. The multi-scale characteristics of very high spatial resolution imagery were explored from various aspects, including segmentation, feature extraction, and classifier uncertainty. As seen from this study, taking full advantage of the characteristics of remote sensing data is beneficial to land cover change detection.

3. Conclusions

The contributions reported in this special issue highlight the recent researches on multi-source remote sensing change detection and its applications to a better monitoring and understanding of land-cover transition. The results showed that the integration of multi-source remote sensing data and the advanced image processing techniques provided superior interpretation results. In view of the explosive growth of remote sensing data and the rapid development of image processing techniques, change detection using multi-source data is worthy of continuous concern of the remote sensing community.

Author Contributions: The four authors contributed equally to all aspects of this editorial.

Acknowledgments: The Guest Editors would like to thank the authors who contributed to this Special Issue for sharing their scientific researches and for their excellent collaboration. Special thanks are due to the reviewers who dedicated their time for providing valuable and constructive recommendations, and to the editorial team of Remote Sensing for their support.

Conflicts of Interest: The authors declare no conflict of interest.

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