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Editorial

Systems and Sensors in Geoscience Applications

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The science branch of geosciences encompasses various disciplines such as geology, geophysics, geotechnology, and computer simulations dealing with the planet Earth and aiming at understanding the Earth's history and its future evolution. Through fieldwork, Earth observations from space, modeling, and theoretical studies and geoscience applications provide essential information to further understand the developments in the Earth sciences and relevant environmental engineering aspects.

Various systems and sensors such as visible imaging, synthetic aperture radar (SAR), global navigation satellite system (GNSS), and laser scanning (LiDAR) are continually developing to acquire a broad range of data types about the Earth surface supporting new numerous applications. Major advances in geoscience applications have recently occurred, particularly with the development of new sensors of high accuracy and efficient technology, computing performance, new theories, and technical methods. Furthermore, based on the latest research in geoscience, more advanced sensors and both theoretical and technical methods offer new insights into solving difficult and multidiscipline challenges. Overall, those new developments in geoscience lead to a more systematic investigation using advanced geospatial technologies.

This special issue is aimed at bringing researchers to contribute in various methods for geoscience applications using Earth observation sensors and systems. New ways of data acquisition, data integration strategies, and processing with innovative methods and modeling continue to improve our understanding of the landscape elements and their interactions with the climate and the environment.

This special issue, which had opened for 10 months, is particularly dedicated to publish a set of high quality papers dealing with the up-to-date systems and sensor applications of state-of-the-art techniques and tools in various disciplines of geosciences and civil engineering to solve real-world problems.

An article by X. Wang et al. demonstrated about the compact polarized synthetic aperture radar (CPSAR) and investigated its capability using Souyris' and Nord's algorithms. Nord's algorithm was adapted to retrieve ocean wave information. The result from their study showed that Nord's algorithm has a better convergence ability than Souyris'. Ocean wave slope spectrum and other parameters of main wave were further calculated. Their finding also revealed that the buoy output and CP SAR-based wave field information clearly showed a good agreement.

F. Pu et al. presented an interesting case study on landslide displacement trend analysis using a multisensor: space-borne remote sensing methods such as synthetic aperture radar and wireless low-cost global positioning systems (GPS). They developed a framework of a dynamic linear model based on long short-term memory (DLM-LSTM) to extract and predict north-south land deformation trends from one meter accuracy GPS receivers. Authors used a Kalman filter to calculate the deformation trend with submeter-level accuracy. Their designed framework could be used in broader application such as geological disaster monitoring, earthquake deformation studies, and terrestrial mass movements.

G. Lv et al. applied an inversion model as a very fast and effective method to detect the defect in the building heritage using a ground-penetrating radar (GPR). They assessed image characteristics of hyperbolic curves with different depths and radii using finite-difference time-domain method (FDTD). Subsequently, they went on to establish inversion models of buried depth and radius of the point object with better accuracy. Their results demonstrated an important application of GPR to detect hidden defects in civil engineering.

An article presented by J. Park et al. proposed a fusion method by using IndoorGML core module to integrate and analyze various datasets and data formats. They proposed a novel geospatial data fusion model and the topological relation-based data fusion model (TRDFM), using topological relations among spatial objects to integrate different geospatial datasets and different data formats. They implemented the TRDFM in a geospatial application system to execute better information-based services without the need for reformatting the data or geometric data exchange. Authors used a 3D GIS software to describe the concept of the proposed TRDFM method.

In another paper, T.-S. Bae and M. Kim analyzed the effects of the ionospheric conditions on the GNSS Network-based Real-time Kinematic (NRTK), as well as the possibility of applying the mobile NRTK to drone navigation for mapping. Over the years, the NRTK systems are predominantly used for precision positioning in many fields such as surveying and agriculture mapping purpose. The success rate usually depends on the local environment and the ionospheric condition. Their results demonstrated that even though a submeter accuracy could be achieved, it is still important to understand the process of dealing with ionospheric disturbances.

A study by H. Alhichri et al. described an efficient tile-based semisupervised classification scheme for large-scale very high-resolution (VHR) remote sensing (RS) images where typical pixel-based classification methods are not feasible. Authors proposed a pretrained convolutional neural network (CNN) to extract descriptive features from each tile. They proposed a novel model that exploits the spectral as well as the spatial relationship. Finally, they tested the method with several experiments to check the classification accuracy. One of the most promising findings of their work is that, even with less than ten training samples per class, their proposed method performs extremely well in terms of classification accuracy.

S. Huang et al. described that their aim was to develop a supervisory system based on Global Navigation Satellite System (GNSS) technology, wireless data communication, internet of things technology, and computer technology. The basic goal of their system is to supervise the real-time roller compaction parameters of the working surface including rolling track, rolling times, rolling speed, thickness, and smoothness. Further, the authors described the conventional method used for quality control. The feasibility and robustness of their developed supervisory system were illustrated in a case study in the face rockfill dam of Shuibuya project in China. Their findings showed that their system indeed provides a new and effective method of process control that could be used for better construction quality.

M. I. Sameen et al. in their article described the classification of very high-resolution aerial photos using spectral-spatial convolutional neural networks. Their network is characterised by a convolution layer, a kernel of size 3×3, pooling size of 2×2, normalization, dropout, and a layer with Softmax activation. According to their results, the proposed model is effective with overall accuracy and Kappa coefficient of 0.973 and 0.967, respectively. Their proposed model demonstrated robustness especially for high-resolution aerial photo classification provided if the parameters are carefully selected.

F. H. Nahhas et al. applied the state-of-the art deep learning approach for building detection from aerial orthophotos. Authors utilized an object-based image analysis (OBIA) through their proposed model for creating objects, feature fusion, and autoencoder-based dimensionality reduction which was used for object classification. The architecture optimized for a grid search method and the sensitivity and parameters were also analyzed. Their results showed that the detection accuracy was 86.06% to 86.19% in the working area and 77.92% to 78.26% in the testing area. Finally, their results revealed that the use of an autoencoder in deep learning models could in fact improve the accuracy of recognition of buildings in fused data.

X. Zhou et al. described in their article the improvement of the accuracy of an inertial stabilized platform in the remote sensing applications using high-precision control scheme. They have used active disturbance rejection control (ADRC) to suppress the effects of disturbance on accuracy. According to the results of their study, ADRC has better capacity in disturbance rejection than a CPID controller through which the friction disturbance will be weaken and the stabilization accuracy can be improved.

Y. Gao et al. assessed wetland change detection using cross-fused- (CF-) based and normalized difference index (NDI) on multitemporal Landsat 8 images. Their main aim was to quantify the changes in wetland cover by using an image-to-image comparison change detection method. Normalized difference vegetation index (NDVI) and normalized difference water index (NDWI) were used to enhance the information on vegetation and water, respectively. Their proposed method performed well with reduced error and an overall accuracy of 97% and 93% for the interannual and seasonal datasets, respectively. The proposed method can be used as an effective tool for wetland change detection.

Y. Zhang et al. proposed an improved GNSS scheme using a finite element model to simulate the deformation. Further, the dam displacement warning standard was determined based on surface displacement and safety factor. Finally, the operation status was evaluated using the BDS/GPS deformation monitoring system. Their new proposed scheme was found to be effective and feasible.

In conclusion, we expect that this special issue provides important and new scientific pieces of evidence in sensors, tools, technical and theoretical methods, and computer simulations for obtaining and processing datasets and knowledge discovery in geosciences and civil engineering applications and that it makes a practical progress for improving geospatial information systems.

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