applied sciences

MDPI

Editorial

Special Issue on Remote Sensing Applications in Archaeology, Geography, and the Earth Sciences

Tung-Ching Su

Department of Civil Engineering and Engineering Management, National Quemoy University, 1 Da Xue Rd., Kinmen 892, Taiwan; spcyj@nqu.edu.tw

1. Introduction

Remote sensing has played a pivotal role in advancing the fields of archaeology, geography, and earth sciences, offering new perspectives and unparalleled opportunities for research, analysis, and interpretation within these disciplines. With the continuous development and refinement of sensors, these sophisticated tools can now be deployed on various aerial platforms like satellites, aircrafts, and drones. This enables researchers to acquire invaluable observational data that enhances our understanding of both the Earth's natural and cultural landscapes. These data sources encompass a wide array of information, such as multispectral images, thermal data, LiDAR, radar data, and more. By harnessing these diverse types of observational data, researchers can delve into the study of environmental shifts, land use patterns, and archaeological sites with accuracy and efficiency. This Special Issue comprises 11 papers that center around the pioneering applications and advancements of remote sensing technology in areas such as monuments, traditional architectural art, and environmental monitoring. Moreover, it explores the integration of cutting-edge deep learning techniques to aid researchers in the detection and identification of archaeological remnants. The papers presented in this collection showcase the innovative utilization and extraction of insights from remote sensing data, contributing to the expansion of knowledge and the refinement of methodologies in these domains.

2. Remote Sensing Applications in Archaeology, Geography, and the Earth Sciences

This Special Issue presents a comprehensive exploration of the latest advancements in remote sensing detection technology, focusing on its applications in restoring and preserving cultural relics, detecting landscape features, and recognizing landforms. Moreover, it delves into the development of innovative algorithms specifically designed to tackle challenges related to landscape feature observation and the establishment of guidelines for the restoration and preservation of cultural relics. This Special Issue features four papers focused on restoring and preserving cultural relics. The papers in this domain emphasize the utilization of 3D file production techniques for the preservation and restoration of cultural relics, particularly emphasizing the safeguarding of cultural assets and buildings. The primary objective is to introduce the concept of "Digital Twin" to develop a detailed historical building information model (HBIM) [1]. The production of 3D files for cultural heritage preservation can be achieved through photogrammetry (structure from motion) or Terrestrial Laser Scanning (TLS) techniques. Marín-Buzón et al. [2] conducted a comparative analysis of the accuracy of archaeological excavation achieved by these two production techniques. In the field of painting art preservation, Cozzolino et al. [3] employed ground-penetrating radar (GPR) to assess the condition of paintings, serving as the foundation for 3D reconstruction of the internal mosaic structure of the artworks. Recognizing the importance of preserving the original painting style crafted by artists, Su et al. [4] conducted a study that involved extracting texture characteristics from "door god" paintings, a prominent form of Oriental architectural art. Their research aimed to delve into

Citation: Su, T.-C. Special Issue on Remote Sensing Applications in Archaeology, Geography, and the Earth Sciences. *Appl. Sci.* **2023**, *13*, 7631. https://doi.org/10.3390/app13137631

Received: 25 June 2023
Accepted: 26 June 2023
Published: 28 June 2023

the genre of "door god" painting craftsmanship while striving to maintain the authenticity of the restoration process.

In regard to the detection of landscape features or the landform recognition, this Special Issue includes a total of five papers. Jiao et al. [5] proposed the utilization of shoulder lines to effectively capture the morphological characteristics of the Loess Plateau. However, the issue of maintaining continuous shoulder lines during the extraction process remains unresolved. To address this concern, they introduced a method that combines edge detection and regional growing algorithms, improving the extraction of shoulder lines. Furthermore, passive remote sensing systems are inadequate for effectively observing certain landscape features such as the distribution of underground military tunnels [6]. The application of deep learning techniques proves advantageous in enhancing the interpretability and resolution of 2-D Electrical Resistivity Tomography (ERT) data, enabling the clearer visualization of tunnel locations and paths. Bachagha et al. [7] effectively integrated the advanced technology of very-high-spatial-resolution satellite (PB1) and SAR data, showcasing the remarkable potential of satellite data and machine learning in uncovering hidden archaeological sites from an archaeological standpoint. In the realm of water remote sensing, Li et al. [8] presented a simulation method for generating a two-dimensional sea surface current field, aiming to overcome the challenge of limited trajectory crossings in spaceborne SAR data. Shi et al. [9] emphasized the significance of remote sensing reflectance as a crucial parameter in the remote sensing inversion of plateau inland water colors. They highlighted the necessity of conducting Field Radiometric Calibration of a Micro-Spectrometer to accurately measure the remote sensing reflectance in unmanned areas of plateau inland regions.

Among the included papers, the sole review explores the intricacies of geographic scene understanding in high-spatial-resolution remote sensing images, providing insightful analysis on methodological trends and addressing the present challenges in the field [10]. They indicated the prevailing challenges associated with the utilization of high-spatial-resolution remote sensing images in understanding geographic scenes. The main challenge stems from the use of high-spatial-resolution remote sensing data, which provides finer landscape details but simultaneously exacerbates the complexity of data processing for intelligent image interpretation.

3. Future Applications

Although this Special Issue includes 11 papers on the applications of remote sensing in archaeology, geography, and the earth sciences, there is still a future expectation for more investigations on the integration of multi-sensor remote sensing data (such as LiDAR, radar, and satellite imagery) with artificial intelligence and machine learning algorithms [11,12]. Besides assisting scientists in enhancing the efficiency of exploring landscape features in the mentioned applications, these approaches can also help them gain a better understanding and interpretation of the spatial distribution, interrelationships, and interactions between archaeological sites/landscape features and the geographical environment.

Acknowledgments: I would like to express my sincere appreciation to all the authors and the editorial team of this Special Issue for their exceptional contributions to the publication of *Applied Sciences*. Through your dedicated efforts and extensive expertise, this Special Issue has become an invaluable resource, offering valuable insights and information for research in the field of remote sensing applications in archaeology, geography, and the earth sciences. Finally, I would like to offer my special thanks to the section managing editor of this Special Issue from MDPI Branch Office, Beijing.

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

References

1. Palčák, M.; Kudela, P.; Fandáková, M.; Kordek, J. Utilization of 3D Digital Technologies in the Documentation of Cultural Heritage: A Case Study of the Kunerad Mansion (Slovakia). *Appl. Sci.* **2022**, *12*, 4376. [CrossRef]
2. Marín-Buzón, C.; Pérez-Romero, A.M.; León-Bonillo, M.J.; Martínez-Álvarez, R.; Mejías-García, J.C.; Manzano-Agugliaro, F. Photogrammetry (SfM) vs. Terrestrial Laser Scanning (TLS) for Archaeological Excavations: Mosaic of Cantillana (Spain) as a Case Study. *Appl. Sci.* **2021**, *11*, 11994. [CrossRef]
3. Cozzolino, M.; De Simone, A.; Gentile, V.; Mauriello, P.; Piezzo, A. GPR and Digital Survey for the Diagnosis and the 3D Representation of the Battle of Issus Mosaic from the House of the Faun, Pompeii (Naples, Italy). *Appl. Sci.* **2022**, *12*, 6965. [CrossRef]
4. Su, T.-C.; Wu, T.-C.; Wun, M.-H.; Wang, C.-W. Style Recognition of Door God Paintings by Hypothesis Testing for Texture Features of Painting Patterns. *Appl. Sci.* **2022**, *12*, 2637. [CrossRef]
5. Jiao, H.; Li, F.; Wei, H.; Liu, W. An Improved Shoulder Line Extraction Method Fusing Edge Detection and Regional Growing Algorithm. *Appl. Sci.* **2022**, *12*, 12662. [CrossRef]
6. Hung, Y.-C.; Zhao, Y.-X.; Hung, W.-C. Development of an Underground Tunnels Detection Algorithm for Electrical Resistivity Tomography Based on Deep Learning. *Appl. Sci.* **2022**, *12*, 639. [CrossRef]
7. Bachagha, N.; Elnashar, A.; Tababi, M.; Souei, F.; Xu, W. The Use of Machine Learning and Satellite Imagery to Detect Roman Fortified Sites: The Case Study of Blad Talh (Tunisia Section). *Appl. Sci.* **2023**, *13*, 2613. [CrossRef]
8. Li, Y.; Chong, J.; Li, Z. A Simulation Method of Two-Dimensional Sea-Surface Current Field for Trajectory Crossing Spaceborne SAR. *Appl. Sci.* **2022**, *12*, 5900. [CrossRef]
9. Shi, J.; Shen, Q.; Yao, Y.; Zhang, F.; Li, J.; Wang, L. Field Radiometric Calibration of a Micro-Spectrometer Based on Remote Sensing of Plateau Inland Water Colors. *Appl. Sci.* **2023**, *13*, 2117. [CrossRef]
10. Ye, P.; Liu, G.; Huang, Y. Geographic Scene Understanding of High-Spatial-Resolution Remote Sensing Images: Methodological Trends and Current Challenges. *Appl. Sci.* **2022**, *12*, 6000. [CrossRef]
11. Masini, N.; Lasaponara, R. Satellite Remote Sensing in Archaeology: Past, Present and Future Perspectives. *J. Archaeol. Sci.* **2011**, *38*, 1995–2002.
12. Resler, A.; Yeshurun, R.; Natalio, F.; Giryes, R. A Deep-Learning Model for Predictive Archaeology and Archaeological Community Detection. *Humanit. Soc. Sci. Commun.* **2021**, *8*, 295. [CrossRef]