remote sensing

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Editorial

Editorial for Special Issue "UAV Photogrammetry and Remote Sensing"

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1. Introduction

The concept of Remote Sensing as a way of capturing information from an object without making contact with it has, until recently, been exclusively focused on the use of earth observation satellites.

The emergence of unmanned aerial vehicles (UAV) with Global Navigation Satellite Systems (GNSS) controlled navigation and sensor-carrying capabilities has increased the number of publications related to new remote sensing from much closer distances. Previous knowledge about the behavior of the Earth's surface under the incidence of energy of different wavelengths has been successfully applied to a large amount of data recorded from UAVs, thereby increasing the special and temporal resolution of the products obtained.

More specifically, the ability of UAVs to be positioned in the air at pre-programmed coordinate points, to track flight paths, and in any case, to record the coordinates of the sensor position at the time of the shot and pitch, yaw, and roll angles have opened an interesting field of applications for low-altitude aerial photogrammetry, known as UAV Photogrammetry. In addition, photogrammetric data processing has been improved thanks to the combination of new algorithms, e.g., structure from motion (SfM), which solve the collinearity equations without the need for any control point, producing a cloud of points referenced to an arbitrary coordinate system and a full camera calibration, and multi-view stereopsis (MVS) algorithm that applies an expanding procedure of a sparse set of matched keypoints in order to obtain a dense point cloud. The set of technical advances described above allows geometric modeling of terrain surfaces with high accuracy, minimizing the need for topographic campaigns for the georeferencing of such products.

This special issue aims to compile some applications realized thanks to the synergies established between the new remote sensing from close distances and UAV Photogrammetry. The contributions are briefly described below in alphabetical order of the first author.

2. Overview of Contributions

In the paper [1], the authors carried out an interesting combination of UAV Photogrammetry and Large-Scale Airborne Lidar Data to monitor snow masses in a forested region in central Arizona, United States. They observed that in low dense forest conditions, both sources of data deliver similar snow depth maps while in high dense forest, lidar maps are more accurate. In the other hand, UAV Photogrammetry terrain model can be used to basin-scale snowpack estimation with a multi-temporal information with a lower cost that airborne lidar campaigns.

In [2], the authors stablish the optimal distribution and number of Ground Control Points (GCPs) to use in corridor maps applied to linear projects obtained in southeast Spain. They used UAV Photogrammetry based on SfM and SMV algorithms and concluded that

9–11 GCP distributed alternatively on both sides of the road, with a pair of GCPs at each end of the road yielded optimal results regarding fieldwork cost.

The paper [3] presents a valuable fusion of digital surface model (DSM) in an extremely challenging urban environment with high level detail, and UAV orthomosaic. The authors integrated three models: adaptive hierarchical image segmentation optimization, multilevel feature selection, and multiscale supervised machine learning. They concluded that the applied methodology showed an excellent potential for the mapping the selected urban landscape in Malaysia.

The quality assessment of UAV Photogrammetric products was the main concern of [4]. In this work, the geolocation procedure of UAV orthomosaics time series was optimized, obtaining a reproducibility of 99% in a grassland located in Germany and 75% in a forest area in the Spanish Pyreneess.

UAV Photogrammetry can model terrain surfaces with extreme or quasi-vertical morphologies [5]. In this work, several combinations of number of GCP, distribution and image orientation were tested in a dam belonging to Spain's hydraulic heritage, located in the Almería province, obtaining similar results than terrestrial laser scanner TLS. The authors advised that the results ostensibly improve including oblique images and break lines.

Vegetation used to be an obstacle for accurate DSM. The authors of [6] applied Deep Learning and Terrain Correction models in Chinese Loess Plateau to solve the restriction of UAV Photogrammetry in a vegetation-dense area with a complex terrain due to reduced ground visibility and lack of robust filtering algorithms. They detected the vegetation with overall accuracy of 95% and the mean square error of final DTM was 0.024 m.

In other cases, the target cover to be detected is precisely vegetation that frequently is modelled through standard vegetation indexes. In [7], the authors studied useful correlations between certain parameters of chemical analysis carried out in agriculture crops and vegetation indexes obtained from UAV-Photogrammetry assessments.

In the design process of a UAV photogrammetric project, the resolution of the images to be captured is established according to the minimum size of the smallest target to be detected. The user wonders how much information is lost when the imagery resolution decreases. In [8], the authors apply the deep convolutional neural network approach, based on a single image super-resolution, on low-resolution UAV imagery for spatial resolution enhancement. Using these high-resolution images in a SfM Photogrammetric process, they observed that the number of points in dense point cloud is about 17 times more than those extracted from a low-resolution image set.

In the paper [9], the authors carried out an interesting practical application for the 3D reconstruction of Power Lines based on UAV Photogrammetry. They stablished a 3D corridor around power lines and detected some objects inside this volume as obstacles that could threat safety of the infrastructure. They compared UAV Photogrammetry models with total station survey and terrestrial laser scanning, concluding that the accuracy is consistent.

UAV Photogrammetry can be used as a valuable source of data in architectural design process [10]. They proposed a virtual integration of UAV Photrogrammetry products and architectural design using building information modeling (BIM) technology, observing error reductions, and significate time and cost saving.

The implementation of GNSS-based UAV navigation capability in real time kinematic (RTK) mode has reduced or even eliminated the need for topographic campaigns to obtain GCPs. However, this technology implies systematic errors in elevation. In [11], the authors observed a linear relationship between these errors and the deviation in the focal length adjustment and proposed the combination of two flights with different image axis angles for their elimination.

One of the difficulties that large UAV projects present is the management of high quantity of images. In [12], the authors proposed an intelligent method for image selections in UAV-Photogrammetry projects that can be used to avoid the time-consuming manual image selection process, maintaining overlaps needed for point cloud extraction and avoiding reductions of products accuracy.

3. Conclusions

The set of contributions to this special issue points out that the possible scientific applications in the field of UAV Photogrammetry and Remote Sensing from close distances is very wide.

UAVs not only take advantage of the previous knowledge in Remote Sensing acquired over the years, but they also improve and expand its possibilities thanks to the control that users have over the sensors.

UAV photogrammetry has been shown as a previous process in all those remote sensing applications whose observed targets are spatially distributed along the terrain surface, obtaining orthomosaics and digital surface models with high spatial and temporal resolution.

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