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EDITORIAL

Applications of surveying in land management

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The origin of Surveying has a close connection with the designation of the land boundary, and cadastral surveying is the basis for a country's land management, serving as an important tool to gather, assess, and update geographical spatial data (Schofield and Breach 2007). In the contemporary era, Surveying is more widely used in different branches of land management. Moreover, the number of techniques and data acquisition methods has dramatically increased in the last 30 years. On the one hand, traditional optical instruments have developed thanks to the integration to computers and electronic devices. On the other, new sensor techniques became available to be used from ground-based stations, mobile terrestrial vehicles, and low-altitude aerial platforms (e.g., helicopters and Unmanned Aerial Vehicles – UAV, see Eisenbeiss and Sauerbier 2011). The diffusion of Global Navigation Satellite Systems (GNSS – see Hofmann-Wellenhof et al. 2008) for precise positioning and navigation has not only completely changed the approach to land surveying, but also had an impressive impact on day-by-day life and the entire society. Mobile mapping technology (Tao and Li 2007) allowed an increase in the productivity of high-resolution mapping of communication roads and urban environments, thanks to the integration of different sensing and positioning systems. Digital photogrammetry (Luhmann et al. 2013) and laser scanning sensors (Vosselman and Maas 2010) can be used for fast acquisition of dense point clouds useful to model terrain, buildings, civil constructions and infrastructures, as well as any other natural or man-made objects. While some main surveying instruments were used for the full data collection process in the past, data and sensor integration play a fundamental role today. In particular, the availability of digital data has changed the operational workflows for data acquisition, production, distribution, and management of surveying outputs.

On the other hand, the concept of land management also developed its content, going in several other directions rather than traditional cadastral and topographic applications. Detailed 3D digital mapping is now more important because more aspects of buildings and the urban environment have to be considered, for example the ones related to energy efficiency. Also changes of buildings and land over time have attracted great interest in the mapping process, not only to have up-to-date three-dimensional spatial databases, but also to keep record of the evolution process in 4D digital maps. In some cases and when available, historical maps are integrated in the archives. Geographic data need to be accessible to a wider number of users through the Internet, where web services have been developed to allow people to interact with maps and geo-coded data. In addition, the availability of several online map services allowed to create added value by supporting commercial applications and location based services (LBS). Crowdsourcing information (Heipke 2012) can be continuously uploaded by the users in order to validate, integrate and update existing geographic data. The development of large facility management networks requires the precise survey for their geo-referencing and overlap to other digital map archives adopted for land management. In such applications,

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geographic information systems (GIS), real-time GNSS and ground penetrating radar systems are used in an integrated way to survey objects in the underground. Modern surveying techniques are also adopted for security issues in land management, including assessment of land safety, emergency management, forensics (Zlatanova and Li 2008).

This Special Issue entitled 'Applications of Surveying in Land Management' presents different applications based on some of the technologies illustrated above. Six articles have been accepted for publication after blind review process.

The majority of papers deal with the application of digital photogrammetry in the so called 'terrestrial' environment. Thanks to the recent development, digital photogrammetry has fully demonstrated to be a powerful and cheap tool for 3D data acquisition and modelling of complex objects. The availability of low-cost digital techniques extended its use to a large community of people, although the knowledge of the basic theoretical principles is still necessary for a correct use.

In the article by Forlani et al. (2014), a system integrating a digital amateur camera and a geodetic GPS receiver is presented, whose peculiarity is the capability to work without any external constraints, typically ground control points having independently known coordinates. This solution may provide oriented images which are suitable for 3D reconstruction in absolute coordinates at accuracy level about 10^{-5}. The paper describes the procedure adopted for calibration of the integrated camera-GPS system and its validation. In Scaioni et al. (2014) photogrammetry is used again, this time for measuring deformations in tunnels. Two approaches are presented: the first for measuring transversal deformations in tunnel cross-sections, the second for measurement of vertical changes along the longitudinal profile of a tunnel on the basis of "photogrammetric levelling." The application of UAV-photogrammetry is the subject of Sona et al. (2014). Here different commercial and scientific software packages for image orientation and surface reconstruction from UAV images have been tested and compared. The last paper presenting a photogrammetry-based application is the one by Previtali et al. (2014). Here ground-based digital photogrammetry is used as cheaper alternative to terrestrial laser scanning for modelling the surface of mountain slopes and cliffs. Also the comparison of data sets gathered at different times for computing deformations is shown. In Shirzad et al. (2014) the topic is closer to traditional applications of surveying in land management. In this case the authors describe the framework for developing the Exploration and Mining Cadastre system in Iran. In this case, the emphasis is given to the design of spatial data infrastructure. A similar topic is discussed in the last paper by Garnero (2014) who deals with transformations between maps in different reference systems. Thanks to the use of NTv2 transformation, coordinates can be mapped from one coordinate system to another "on-the-fly," avoiding the duplication of the archives.

In the end, all guest editors would like to thank people who have contributed to this Special Issue: all the authors of submitted papers, the reviewers who gave valuable support, and the Editorial Office of Earth Science Informatics for conducting a high-quality review and editing process for all the published papers. A special mention goes to the Editor-in-Chief, Dr Hassan Babaie, who carefully assisted and supervised the organization ot the Special Issue and the revision process.

We hope that this Special Issue will further promote research on the application of modern surveying techniques in the wide field of land management, which probably is going towards a further extension of its scope in the close future.

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