Challenges for updating 3d cadastral objects using LiDAR and image-based point clouds

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Abstract:

Nowadays due to the increasing complex and multifunctional building environment in the urban areas it is required an accurate geometry and proper legal registration of the cadastral objects including third dimension and time aspect. 2D land-parcel data seems insufficient to address the variety of problems in high density residential areas. This fact motivates scientists worldwide to work on 3D Cadastral Data models for representation of 3D legal and physical information. Third dimension is important in cases of space subdivision with different owners and used for various purposes which requires its accurate registration. However, it is of great importance to maintain the 3D information up to date. With the rapid development in the fields of photogrammetry, laser scanning and computer vision high accurate 3D data can be obtained. However, numerous challenges appear while processing, transferring and visualizing. Currently, efficient management of "big data" is widely discussed. In this respect developed algorithms in support of automatization of data processing, segmentation and visualization can be very helpful. Current paper focuses on usage of photogrammetric data for updating 3D information. More specifically, we investigate the opportunities for updating 3D cadastral objects using precise multi epoch airborne laser scanning 3D data, point clouds derived from high resolution imagery from dense matching algorithms and maps used to provide semantic information about the land cover class and 2D special information of the boundary of the cadastral objects. In the paper we describe the type and size of uncertainties when updating 3D cadastral models. This includes the uncertainty of the initial model, caused by inaccuracies in the measurements when building the initial models. Next, a careful registration with the newly acquired dataset is necessary in order to better describe changes of objects, instead of changes in datasets. The benefits of 4D in cadastral information systems are also discussed in the paper. Different methods for detecting changes in time using airborne laser scanning (ALS) data have been used for various application such as map updating (Vosselman, et al., 2004), evaluation of damages as a result from a physical disasters (Murakami et al., 1999) etc. Usually change detection is done by segmentation, classification or implementation of specific mapping rules. In our paper we focus on detecting changes while comparing ALS dataset from different epochs and between point clouds obtained from ALS and high resolution images for same territory. We also discuss the difficulties in detecting changes of cadastral objects. The analysis is done for a common dataset located in Netherlands. In conclusion the opportunities of using high accurate point cloud data for keeping up to date 3D cadastral systems are presented and the challenges and problems are shown.

Murakami, H., Nakagawa, K., Hasegawa, H., Shibata, T., & Iwanami, E. (1999). Change detection of buildings using an airborne laser scanner. ISPRS Journal of Photogrammetry and Remote Sensing, 54(2), 148-152.
Vosselman, G., Gorte, B. G. H., & Sithole, G. (2004). Change detection for updating medium scale maps using laser altimetry. International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences, 35, 207-212.

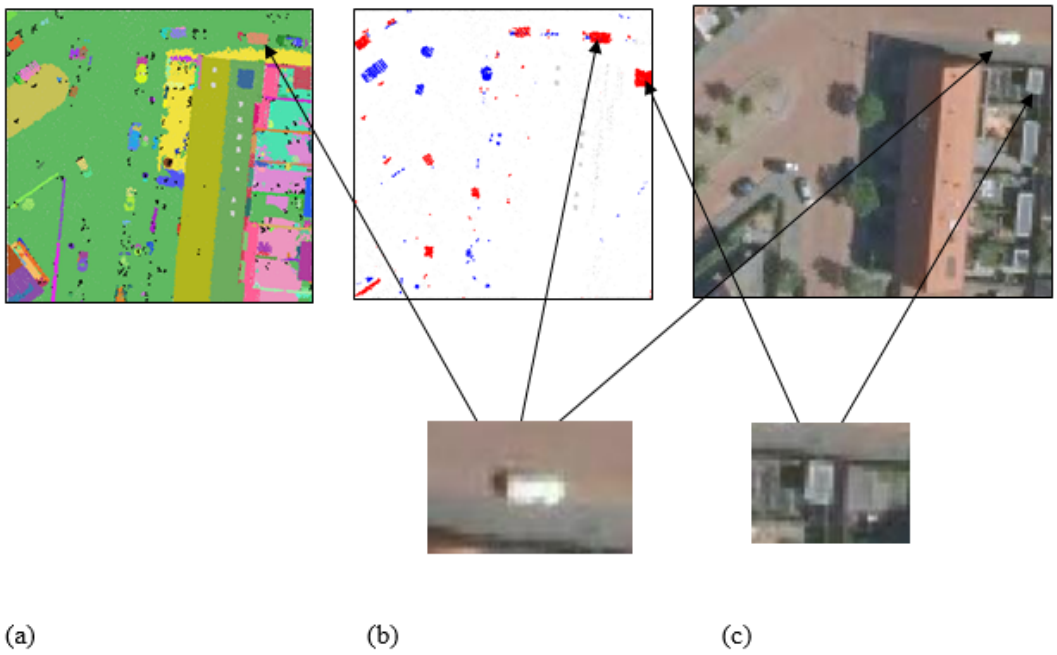

Figure 1. Detected changes while overlaying ALS point clouds from epoch1 and epoch 2

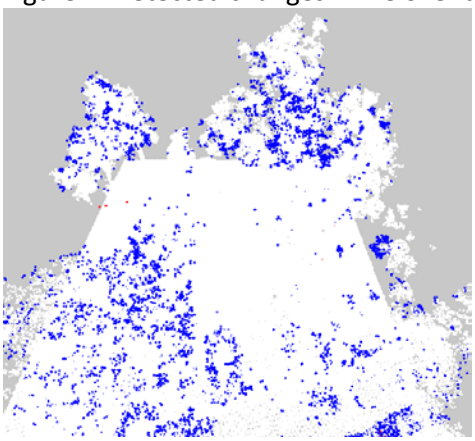

Figure 2. Effect of vegetation growth on change detection