AUTOMATIC DETECTION OF BUILDINGS FROM LASER SCANNER DATA FOR MAP UPDATING

Leena Matikainen [a], Juha Hyyppä [a], Hannu Hyyppä [b]

[a] Department of Remote Sensing and Photogrammetry, Finnish Geodetic Institute,
P.O. Box 15, FIN-02431 Masala, Finland – Leena.Matikainen@fgi.fi, Juha.Hyyppa@fgi.fi
[b] Institute of Photogrammetry and Remote Sensing, Helsinki University of Technology,
P.O. Box 1200, FIN-02015 HUT, Finland – Hannu.Hyyppa@hut.fi

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ABSTRACT:

Automatic interpretation of laser scanner data for building detection and map updating was studied. Digital surface and terrain models (DSM and DTM) and an intensity image were created using a helicopter-borne TopEye system recording with 2–3 pulses per m^2. The DSM was segmented into homogeneous regions using a region-based segmentation method, and the segments were classified as "building", "tree" or "ground surface". Height differences between the DSM and DTM, textural characteristics of the DSM and intensity image, and shapes of the segments were used in classification. Building segments were compared with an old building map and further classified as "new building", "enlarged building" or "old building". Similarly, building segments derived from the old map were classified as "detected", "partly detected" or "not detected". Comparison with an up-to-date building map shows that about 80% of all buildings in the study area were detected from the laser scanner data. For buildings larger than 200 m^2, the detection percentage was about 90%. Pixel by pixel comparison of the classification result with the reference map shows that 90% of pixels covered with buildings in the map were correctly classified. 85% of building pixels in the classification result were buildings in the reference map. The accuracy measures of the pixel-based comparison also include errors caused by small location differences between the data sources. According to visual evaluation, the most important changes between the laser scanner data and the old map, e.g. new buildings, were detected in change detection. The most problematic buildings for automatic detection were small buildings surrounded by trees.

1. INTRODUCTION

Laser scanner data has proved to be a promising data source for various mapping and 3D modelling tasks. One of the most important application areas is extraction and modelling of buildings to create 3D city models. Several studies related to the topic have been published during recent years (e.g. Haala and Brenner, 1999a, 1999b; Maas and Vosselman, 1999; Morgan and Tempfli, 2000; Vögtle and Steinle, 2000; Vosselman and Suveg, 2001; Fujii and Arikawa, 2002; Rottensteiner and Briese, 2002). The building extraction and modelling process can typically be divided into two steps: building detection and building reconstruction. At first, buildings have to be distinguished from the ground surface and other objects, such as trees. After this, 3D models of buildings can be created.

Methods for building detection are often based on step-wise classification of the data to eliminate objects other than buildings. Some methods use aerial images in addition to the laser scanner data (e.g. Haala and Brenner, 1999b; Vögtle and Steinle, 2000). Classification can be pixel-based, but segmentation is normally applied in some stage of the process to obtain regions. Segmentation of laser scanner data has been studied by e.g. Geibel and Stilla (2000) and Gorte (2002). The building detection stage can be avoided if an up-to-date map is available as a basis for building reconstruction (see e.g. Haala and Brenner, 1999a, 1999b; Vosselman and Suveg, 2001).

Murakami et al. (1999) studied the use of laser scanner data in change detection of buildings. They used simple comparison between DSM data sets acquired at different occasions. Use of laser scanner data in "upvaluation" of map information to transfer 2D building data into 3D data was discussed by Hofmann et al. (2002).

The goal of our study is to investigate the feasibility of laser scanner data for updating of large-scale city maps and to develop automatic methods for the work. In the first stage of the updating process, which is discussed in the present article, the aim is to automatically recognize buildings from laser scanner data and to detect changes compared with an existing 2D building map. The results should provide a preliminary updated 2D building map that presents approximate building polygons associated with attribute information showing if the building has been built, removed or changed after the map was made. This preliminary updated map could then be used in further processing steps that can include verification of the changes, exact location and modelling of the buildings, updating of a map database and finally creation of a 3D city model. These further processing steps can be manual, semi-automatic or fully automatic.

Results of a previous study (Matikainen et al., 2001) showed that planimetric and height precisions high enough for large-scale mapping of buildings can be obtained with high-pulse-rate laser scanners. Promising results were also obtained in automatic building detection by using a region-based segmentation method and a simple classification procedure based on laser scanner data and an aerial colour image. The present article discusses results obtained when the study was continued in a larger study area, the building detection procedure was improved and change detection compared with an existing building map was included in the process.

Automatic Detection Of Buildings From Laser Scanner Data

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Automatic Detection Of Buildings From Laser Scanner Data:

Urban Remote Sensing Xiaojun Yang,2011-03-23 Urban Remote Sensing is designed for upper level undergraduates graduates researchers and practitioners and has a clear focus on the development of remote sensing technology for monitoring synthesis and modeling in the urban environment It covers four major areas the use of high resolution satellite imagery or alternative sources of image date such as high resolution SAR and LIDAR for urban feature extraction the development of improved image processing algorithms and techniques for deriving accurate and consistent information on urban attributes from remote sensor data the development of analytical techniques and methods for deriving indicators of socioeconomic and environmental conditions that prevail within urban landscape and the development of remote sensing and spatial analytical techniques for urban growth simulation and predictive modeling **Proceedings of the 25th International Symposium on Advancement of Construction Management and Real Estate** Xinhai Lu,Zuo Zhang,Weisheng Lu,Yi Peng,2021-10-11 This proceedings book focuses on innovation cooperation and sustainable development in the fields of construction management and real estate The book provides a detailed analysis and description of the disciplinary frontiers in the field of building management and real estate and how they can be promoted in the context of the epidemic A wide variety of papers provide a reference value for both scholars and practitioners The proceedings book is the documentation of the 25th International Symposium on Advancement of Construction Management and Real Estate CRIOCM 2020 which was held at the School of Public Administration Central China Normal University Wuhan China in 2020

Topographic Laser Ranging and Scanning Jie Shan,Charles K. Toth,2018-02-19 Topographic Laser Ranging and Scanning Second Edition provides a comprehensive discussion of topographic LiDAR principles systems data acquisition and data processing techniques This edition presents an introduction and summary of various LiDAR systems and their principles and addresses the operational principles of the different components and ranging methods of LiDAR systems It discusses the subsequent geometric processing of LiDAR data with particular attention to quality accuracy and meeting standards and addresses the theories and practices of information extraction from LiDAR data including terrain surface generation forest inventory orthoimage generation building reconstruction and road extraction Written by leaders in the field this comprehensive compilation is a must have reference book for senior undergraduate and graduate students majoring or working in diverse disciplines such as geomatics geodesy natural resources urban planning computer vision and computer graphics It is also vital resource for researchers who are interested in developing new methods and need in depth knowledge of laser scanning and data processing and other professionals may gain the same from the broad topics addressed in this book New in the Second Edition A comprehensive array of new laser ranging and scanning technologies Developments in LiDAR data format and processing techniques Regrouping of surface modeling representations and reconstruction Enhanced discussions on the principles and fundamentals beyond small footprint pulsed laser systems and new application examples

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