SEMI-AUTOMATED BUILDING FOOTPRINT EXTRACTION FROM ORTHOPHOTOS

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Here we describe and apply a semi-automated, object-based method for extracting vector-building footprint polygons from aerial photographs (orthophotos) within urban settings. The approach integrates the use of high resolution orthophotos and image segmentation software and is compared with methods using Light Detection and Ranging (LiDAR) as the source data input. LiDAR data gives the best results with less processing, but is not widely used by municipalities due to the expense. Results from semi-automated image segmentation of the orthophotos showed a high accuracy between extracted building segments and reference building footprints for two study sites, comparable to those achieved using LiDAR data. We recommend image acquisition during summer months with a resolution of 10 cm by 10 cm. When data acquisition budgets are limited, combining ancillary GIS on roads with a semi-automated and object-based segmentation approach is a best practice strategy for land cover feature extraction and change quantification.

Ici, nous décrivons et mettons en application une méthode semi-automatisée basée sur les objets pour l'extraction des polygones d'empreintes d'édifices vectorielles à partir de photographies aériennes (orthophotos) en milieu urbain. L'approche combine l'utilisation d'orthophotos à haute résolution et d'un logiciel de segmentation des images. On la compare à des méthodes qui utilisent la technologie LiDAR comme source d'entrée de données. Les données LiDAR offrent les meilleurs résultats avec moins de traitement, mais ne sont pas grandement utilisées par les municipalités en raison du coût qu'elles engendrent. Les résultats de la segmentation semi-automatisée des orthophotos ont démontré une grande exactitude entre les segments d'édifices extraits et les empreintes d'édifices, exactitude comparable aux résultats atteints en utilisant les données de la technologie LiDAR. Nous recommandons les images recueillies pendant les mois d'été avec une résolution de 10 X 10 cm. Lorsque les budgets d'acquisition sont limités, la meilleure stratégie est d'avoir recours à une combinaison de données SIG auxiliaires sur les routes et de l'approche de segmentation semi-automatisée basée sur les objets pour l'extraction des éléments de la couverture terrestre et la quantification des changements.

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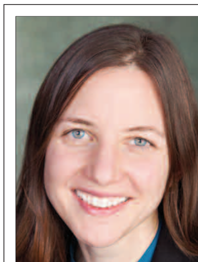

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1. Introduction

Accurate and up-to-date building footprints are an essential component of all municipal geographic information system (GIS) databases. Vector footprint data are used on a routine basis for multiple purposes in urban planning, utility management and general land development monitoring needs [*Schneider et al.* 2009; *Aldred and Wang* 2011]. Given the rate of global urban change, it is essential to devise reliable methods for systematic updating and maintenance of urban GIS databases and individual building locations [*Hermosilla et al.* 2011].

The current state-of-the-art method for building footprint or rooftop mapping, is to combine Light Detection and Ranging (LiDAR) data with multi-spectral imagery that has sub-metre spatial resolution. While LiDAR data provide the basis for extracting building structures in two and three dimensions (e.g., *Alexander et al.* [2009]; *Mongus et al.* [2014]), the multi-spectral data are used to differentiate rooftops from other impervious surfaces [*Hermosilla et al.* 2011] and to provide additional spatial context. The LiDAR data need to have a sufficiently high point density to define the planes of the roof. In previous work, a LiDAR point density as low as 1 point/m2 (e.g., *Rottensteiner and Briese* [2002]), or lower (e.g., 0.1 points / m2 [*Sohn and Dowman* 2007]) was sufficient, but typically higher point densities are preferred (e.g., 8 points/ m2 [*Niemeyer et al.* 2014]) to improve results. Analysis approaches that

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