Morphological Building Index: Automating Building Extraction from High-Resolution Remotely Sensed Imagery

Xin Huang

The State Key Lab. of Surveying, Mapping, and Remote Sensing, Wuhan University,

#129, Luoyu Road, WuChang District,430079, Wuhan, China

(Phone: 86-27-68778525; Email: huang_whu@163.com)

In this paper, an innovative morphological building index (MBI) is presented for automatic building detection from high-resolution remotely sensed imagery. Buildings are of interest since they are one of the most important and dynamic urban structures, playing a key role for investigation on urbanization, landscape, environment, residence, etc.

In recent years, the availability of the high-resolution remotely sensed data provides an efficient approach for monitoring of urban buildings. However, most of the existing building detection methods are subject to 1) selection of training samples or 2) complicated constraints (e.g., geometrical properties, shadows). The supervised methods need visual interpretation or field work for collection of training samples, which do not support rapid and near real-time processing. On the other hand, geometrical properties (e.g., compactness, rectangularity) can not represent the diversity of urban buildings, meanwhile, the accuracy of the shape analysis is strongly dependent on the image segmentation quality.

Therefore, we propose an innovative morphological building index (MBI). Its basic principle is to construct the relationship between the spectral-spatial characteristics of buildings and the morphological operators:

Property 1: Brightness. Buildings have a high reflectance due to its high altitude and smooth surface. In addition, a large number of roofs in urban areas are made of bricks and concrete, resulting in high brightness in images. The local maximum and the top-hat by reconstruction are used to describe the brightness of buildings.

Property 2: Contrast. The high reflectance of roofs and the spatially adjacent shadows lead to a high local contrast. Accordingly, the differential morphological profiles are used to model the local contrast of buildings.

Property 3: Isotropy. Buildings are isotropic compared to roads. Thus, a set of linear structural elements (SE) are jointly utilized for representation of directionality. Moreover, in order to enhance the robustness, the linear SE is carried out in a multiscale manner since buildings should present a multiscale isotropy due to its shape.

In this way, the morphological building index (MBI) can be defined as a one-dimensional feature image, where large values indicate high possibility of presence of buildings. In experiments, its effectiveness is verified with a series of high-resolution satellite datasets, including GeoEye-1, WorldView-2, QuickBird, Ikonos. The accuracy

of the building detection is assessed based on a large number of reference samples that are chosen by visual interpretation and field investigation. The MBI gives satisfactory results since the accuracy scores are more than 85% in all the experiments. In addition, we compare the MBI-based automatic building detection with the support vector machine (SVM) supervised method. Results show that the proposed MBI approach is able to achieve comparable accuracy to the SVM-based machine learning. This result is promising considering that MBI is carried out automatically without training samples and supervised learning.
Keywords: High-resolution, Building Detection, Morphological, Recognition.