DTM GENERATION IN FOREST REGIONS FROM SATELLITE STEREO IMAGERY

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ABSTRACT:

Satellite stereo imagery is becoming a popular data source for derivation of height information. Many new Digital Surface Model (DSM) generation and evaluation methods have been proposed based on these data (Zhang et al., 2005; d'Angelo et al., 2010; Tian et al., 2013). The resolution as well as the quality of the extracted DSMs is improving (Straub et al., 2013). However, not many specific methods extracting Digital Terrain Models (DTM) from DSM data have been proposed for these data, especially for forest areas. Directly filtering the DSMs is still a commonly used method (Pfeifer et al., 2001; Arefi et al., 2011), but in most cases no information from the original image data is included (Krauss et al., 2011).

A novel DTM extraction method also usable for forest regions is proposed in this paper. Instead of directly filtering the DSM, firstly a single channel based classification method is proposed. In this step, no multi-spectral information is used, because for some stereo sensors, like Cartosat-1, only panchromatic channels are available. The proposed classification method adopts the random forests method to get initial probability maps of the four main classes in forest regions (high-forest, low-forest, ground, and buildings). To cover the pepper and salt effect of this pixel based classification method, the probability maps are further filtered based on the adaptive Wiener filtering. Then a cube-based greedy strategy is applied in generating the final classification map from these refined probability maps. Secondly, these height distances between neighbouring regions are calculated along the boundary regions. This height distances can be used to estimate the relative region heights. Thirdly, the DTM is extracted by subtracting these relative region heights from the DSM in the order of: buildings -> low forest -> high forest. In the end, the extracted DTM is further smoothed using morphological filters.
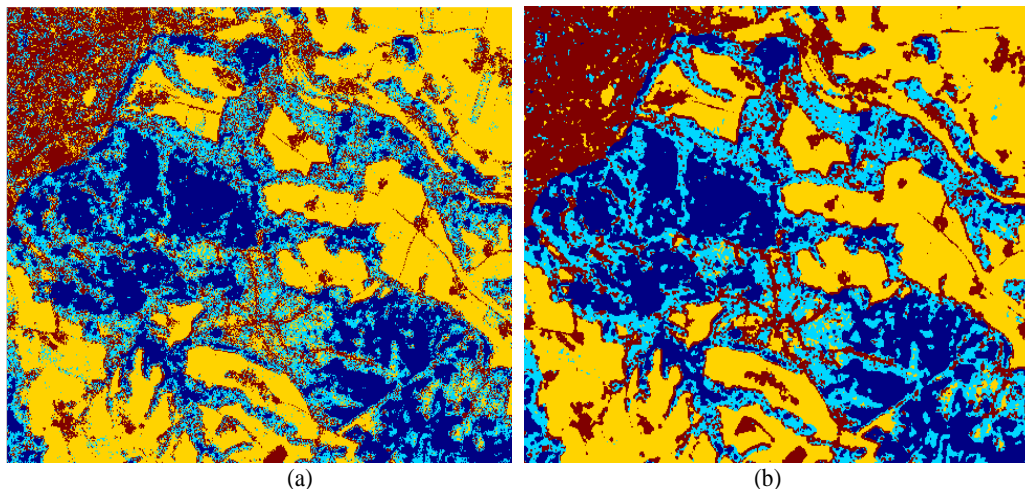
Figure 1. Comparison of the original classification map (a) and the refined classification results (b). (Dark red: buildings; Yellow: ground; Dark blue: high forest; light blue: low forest).

The proposed DTM extraction method is finally tested on satellite stereo imagery captured by WorldView-2, Cartosat-1 and ZY-3. Quality evaluation is performed by comparing the extracted DTMs with a reference DTM, which is generated from the last return airborne laser scanning point cloud. Based on the evaluation results, the advantages and disadvantages of the proposed method will be further discussed.

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