Brief Description of *Automated Detection of Building Region from Airborne LiDAR Data based on Perceptual Organization*

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Study Area:

Vaihingen (area 2)

Detection Target:

Buildings

Data Used:

Only LiDAR data

Export of Results:

Binary Geo-TIFF file (tif) along with World file (tfw)

Brief Description of the Proposed Method:

1. High objects extraction

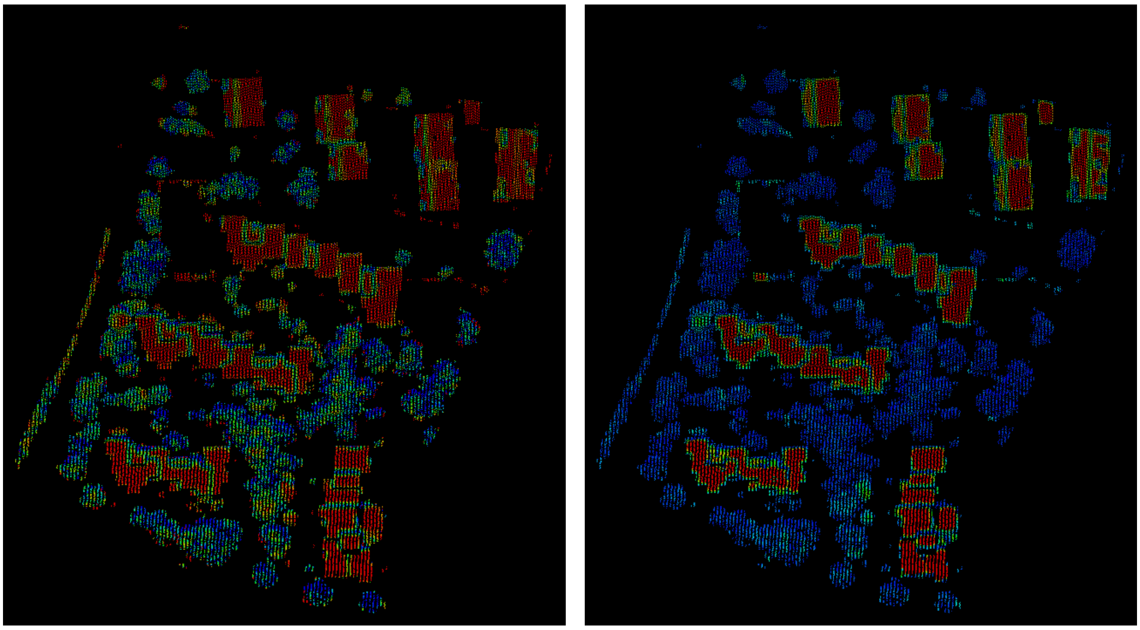
LiDAR points are firstly classified into terrain and non-terrain groups by the classic adaptive TIN filter algorithm (Axelsson, 1999). High objects (buildings, vegetation etc.) are extracted from the non-terrain group if they are at least 2m higher than the local DTM. The DTM is generated from the ground points.

2. Candidate building region detection

Firstly, a significant parameter for local transparency and surface roughness, slope-adaptive Echo Ratio (sER), is calculated for each point (Jochem, 2012). Objects with low surface roughness such as building roofs result in a high ER value and vegetation that is usually characterized by a vertical distribution of points lead to a low ER value.

Then, each point will receive the sER values from points in its neighborhood through a voting process. The voting algorithm fully considers the proximity, continuity, and similarity between points. For example, the voting value decreases with the increase of the two points' distance, the angle between their normal vector and some other factors. This procedure promotes the communication between points in a neighborhood, and the sER value of each point is replaced by the sum of original value and the received ones. In this way, the feature (sER) used to distinguish between buildings and vegetation is enhanced.

Finally, a threshold of sER is set to extracted candidate building points from the high objects.



a) sER b) sER after voting

Figure 1: sER before and after voting

3. Building region refinement

Candidate building regions are refined in this procedure based on multi-feature analysis. Local roughness is calculated and estimated from the eigenvalues of the covariance matrix of the k nearest neighbors. Regions with high average roughness values (most probably vegetation) are rejected. Then, the number of points in a single building and the area of it are calculated to eliminate small and non-building regions. Finally, a buffer area is created for each detected building to guarantee that roof parts that appear as penetrable surfaces and hence are characterized by low sER values are also included. Points in the buffer zones are added to the buildings if they are in the slope adaptive neighborhood (Filin and Pfeifer, 2005) of original building points.

4. Building outline extraction

The modified convex hull algorithm (Sampath and Shan, 2007) is used to trace the building boundary points. Then, critical points are detected by analyzing the angle between their neighbor lines. These critical points hence form the final building outlines.

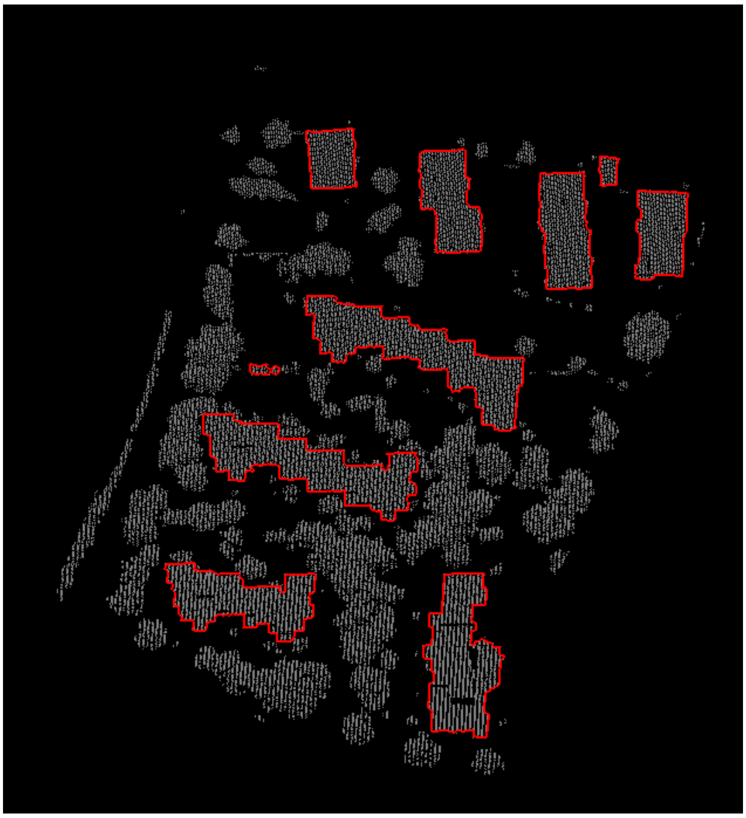


Figure 2: outlines result of area-2

Reference

[1] Axelsson P. DEM generation from laser scanner data using adaptive tin models[C]. Proceedings of the Xixth Isprs Conference Iaprs, 2000.

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[3] Filin, S. and Pfeifer, N.. Neighborhood systems for airborne laser Data[J]. Photogrammetric Engineering & Remote Sensing, 2005, 71 (6):743–755.

[4] Sampath A. and Shan J.. Building boundary tracing and regularization from airborne LiDAR point clouds[J]. Photogramm. Eng. Remote Sens., 2007, 73(7): 805-812.