Detection Building Point Clouds from Airborne LiDAR Data Using Roof points' Attributes

A flow chart (Fig.1) of detecting building point clouds is as follows:

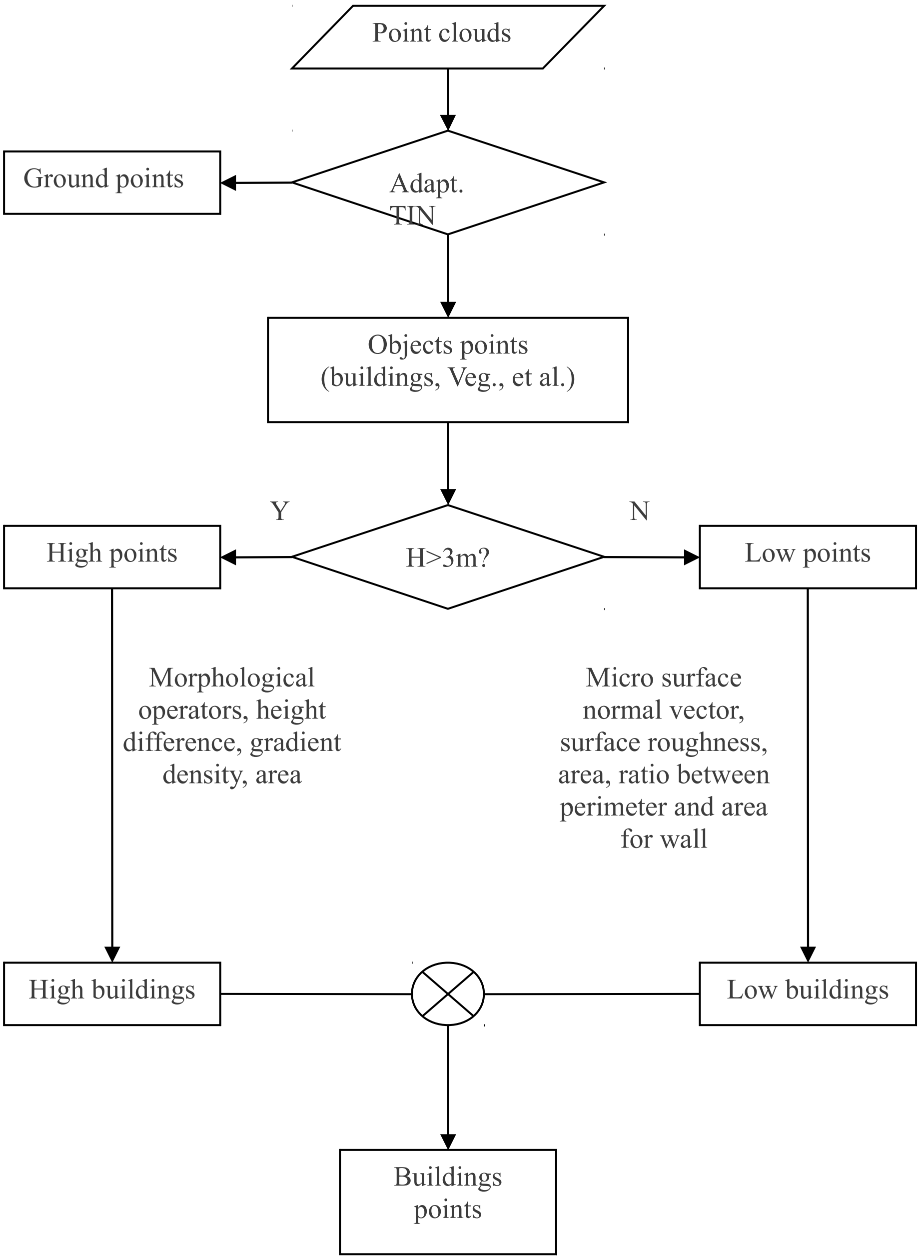

Fig.1 Flow chart of identifying building points based on its roof attributes

Note:

1. Adpt. TIN is a method to filter ground points developed by Peter Axelsson in 2000.

(Axelsson P. DEM generation from laser scanner data using adaptive TIN models [J]. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 2000,33(Part

B4/1):110-117.)

2. Defined morphological operators

See Fig.2.

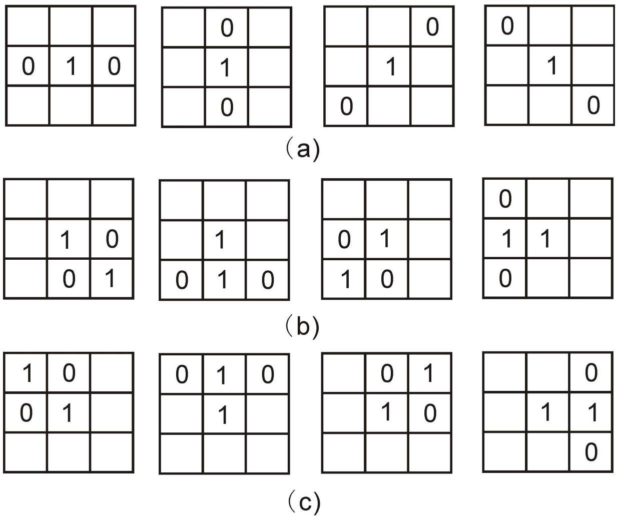

Fig.2 Three morphological operators for separating building and vegetation

3. Gradient density

Gradient density indicates density of point clouds’ gradients in some segmented range. If gradient density in a segmented region is larger than a threshold, then this region is adjusted as vegetation region; or else, this region is regarded as building region. See Fig.3.

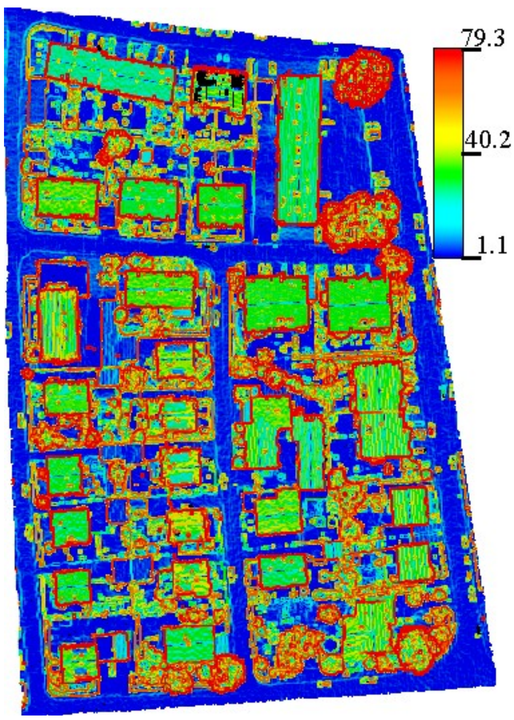

Fig.3 Gradient density map of LiDAR point clouds from Area3

4. Micro surface normal vector

Micro surface normal vector from a grid cell is defined as follows:

$$|n_{i,j}|=\{[\Delta y(z_{i,j+1}+z_{i,j}-z_{i+1,j+1}-z_{i+1,j})]^2+[\Delta x(z_{i,j+1}+z_{i+1,j+1}-z_{i+1,j}-z_{i,j})]^2+4(\Delta x\Delta y)^2\}^{1/2}$$

(1)

where Δx and Δy means sizes of a grid cell; $z_{i,j}$, $z_{i,j+1}$, $z_{i+1,j+1}$ and $z_{i+1,j}$ stands for point clouds heights in adjacent grid cells.

5. Surface roughness

Surface roughness in a grid cell is expressed as follows:

$$R_{i,j}=\frac{1}{2}|z_{i+1,j+1}+z_{i,j}-z_{i,j+1}-z_{i+1,j}| \quad (2)$$