Introducing a new approach for 3D building reconstruction

Asghar zarea[1], Ali mohammadzadeh[2], Mohamad javad valadan zoej[3]

1, 2, 3. Geodesy and Geomatics Engineering Faculty, K.N.Toosi University of Technology

Our method in seven steps:

1. 2D Building Boundaries Production

2D building boundaries are produced by raster to vector operation on building detection result. Then produced boundaries are generalized and unnecessary line segments are removed. After generalization, a new approach is used to build orthogonal buildings. This approach uses buildings baseline and angels between line segments of building boundary.

2. Normal Vector Image Production

We used processed DSM to produce this image as a plane with Eq. 1 fitting to points set (points inside the kernel) with least squares method. Parameters of this plane (a,b,c) are considered as normal vector components. Each component is considered as a feature, so normal vector image will be an image with 3 bands (a,b and c).

$$ax + by + cz = 1 \quad (1)$$

3. ISOData Clustering

Normal vector image is classified by ISO-DATA clustering algorithm. classes number are selected between 5 and 9 classes. The algorithm starts classification employing maximum number of classes and after each epoch, the classes which have low pixels number are removed. Also, the classes are merged while centers of classes are close enough. Then the algorithm repeat clustering process with new number of classes. Finally, the clustered image is improved by morphological closing and opening operations.

4. Detection of Plane Parameters of Roof Patches

First, inside each building, the classes (planar surface) are discovered and then a plane with Eq. 1 is fitted to each class (planar surface) with least squares method. We normalized X,Y,Z of DSM between 0 and 1 ,so, Normalized spaces are used to fit planes to classes. The parameters of fitted planes are considered as plane parameters of roof patches.

5. Merging Neighbor and Similar Roof Patches

Within the boundaries of each building, roof patches which have similar plane parameters are merged. Plane parameters of integrated roof patches are determined as mentioned method in section 4.

6. Intersection of Roof Patches

Within the boundaries of each building, close roof patches are intersected and 3D lines parameters are obtained.

7. Vertex Points Production

This is done in three level:

7.1. Buildings that have One Roof Patch

In this state, 2D points of building boundaries are substituted in related plane equation and elevation of each point is obtained.

7.2. Buildings that have Two Roof Patch

First, the 3D Line (that are obtained from intersection of two roof patches) is intersected with two 2D line segments of building boundary. For detection of these line segments, we used plumb criterion between projection of 3D line (projection on XY plane) and line segments. So, 2D line segments are selected that are roughly perpendicular to the direction vector of projection of 3D line and have specified minimum length. Finally, 2D points of building boundary and intersection points are substituted in related plane equation and then elevation of each point is obtained.

7.3. Buildings that have Three Roof Patch or more

In this state, projection of 3D lines (projection on XY plane) of each building are intersected together and intersection points, that are not inside the 2D building boundary, are removed. Intersection points which are very close together are merged (averaged). Then, projection of 3D lines are intersected with 2D line segments of building boundary that are close to two planes which are producer of intended 3D line.