AERIAL IMAGE BASED GEOMETRIC REFINEMENT OF BUILDING MODELS DERIVED FROM AIRBORNE LIDAR DATA

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ABSTRACT:

Airborne laser scanning has proven to be a strong basis for the automatic generation of 3D building models. A drawback, however, is in the point spacing of typical datasets. As a consequence, the precision of roof plane and ridge line parameters is usually significantly better than the precision of gutter lines. To cope with problem the paper presents a novel approach for geometric refinement of building models reconstructed from airborne laser scanning point clouds using edges extracted from high resolution digital photographs. The basis idea of modeling improvement it to obtain refined model edges by intersecting roof planes accurately extracted from ALS data and 3D planes derived from building edges in a single image. The underlying methodology so far assumes that the roofs reconstructed from ALS data are topologically correct – so the research is focused on the improvement of the geometric accuracy.

The implemented algorithm starts with a projection of the wireframe roof model (obtained from ALS data) into the image space. Then, edge pixels are extracted from the image using Canny edge detector. The binary edge image serves as an input for straight line detection, performed by Hough transform. Each building edge reconstructed from ALS is substituted by its best match chosen from the line segments extracted by image processing. The matching algorithm involves the following criteria to choose the correct line: (i) proximity of both lines defined by the distances between both end-points of a candidate segment and a reference line, (ii) similar orientation defined by the angle between reference and candidate line, (iii) if there is more than one line fulfilling both requirements the closest line is chosen. Newly extracted roof edges are subject to regularization according to the orientation of a ridge line derived from ALS. Each outer line extracted in the image is projected back into object space resulting in a 3D plane. The refined building model is reconstructed by intersecting the image-based edge planes and already known roof planes. In the final step, regularization is apply again, this time taking into consideration features of a 3D model, i.e. horizontal alignment of ridge and gutter lines as well as horizontality and perpendicular of building walls.

In order to evaluate the presented refinement procedure, we generate two sets of reconstruction results, before- and after correction. The modeling performance is compared and assessed based on reference data provided by the ISPRS benchmark for 3D building reconstruction.

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