Automatic Feature Extraction from Mobile Laser Scanning Data and Aerial Imagery

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Abstract:

3D point cloud acquired by mobile laser scanning (MLS) system is dependent on the GNSS and IMU based position estimation for global referencing. Unfortunately, large building structures in an urban canyon can lead to the inaccurate position estimation and thereby the generation of an inaccurate 3D point cloud. Usually, for 3D point cloud correction, manual intervention is needed which is done by utilizing the ground control point (GCPs) collected by labour intensive field work. Yet manual correspondence selection of GCPs in the 3D point cloud can introduce errors, and at the cost of an expensive final product for both data providers and customers.

We developed an automatic 2D feature extraction from 2D image of MLS Point Cloud (MLSPC) and corresponding nadir aerial images (as a reference data set). Features extracted with developed method serve as the (correction) GCPs for the MLSPC. The developed method comprises five steps (see Figure 1); data preprocessing, image feature detection, image feature description, image feature matching and GCPs calculation. In the data pre-processing step the MLSPC is patch-wise cropped and converted to ortho images, furthermore, related aerial image patches are also cropped from the raw aerial images. For feature detection, we implemented an adaptive variant of Harris-operator to automatically detect corner feature points on the vertices of road markings. In feature description phase, we used the LATCH binary descriptor. For outlier removal from set of matched features, we developed an outlier filtering method, which exploits the arrangements of relative Euclidean-distances and angles between corresponding sets of feature points, (see Figure 2 for an example result). In the last step, 3D positions of the GCPs in the absolute coordinate system are calculated by the triangulation between the extracted features from only the different aerial image patches.

We found that the positioning accuracy of the computed 2D correspondence has achieved the pixel level accuracy, where each pixel represents 12cm on ground surface. Evaluation of the 3D accuracy in absolute coordinate system is part of our future work. We conclude that in urban areas, the developed approach can automatically extract reliable features necessary to achieve the desired accuracy in MLSPC.

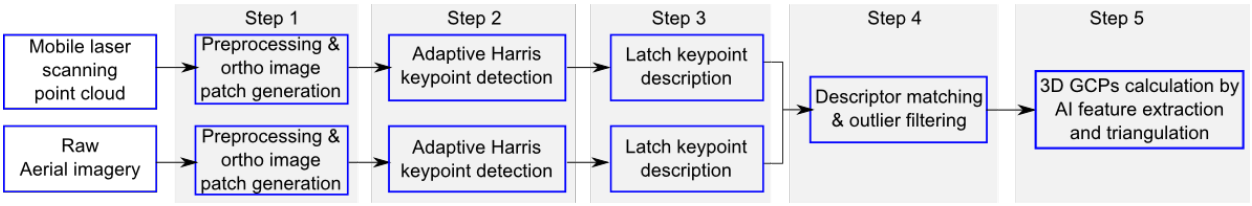

Figure 1: Work flow of the developed method.

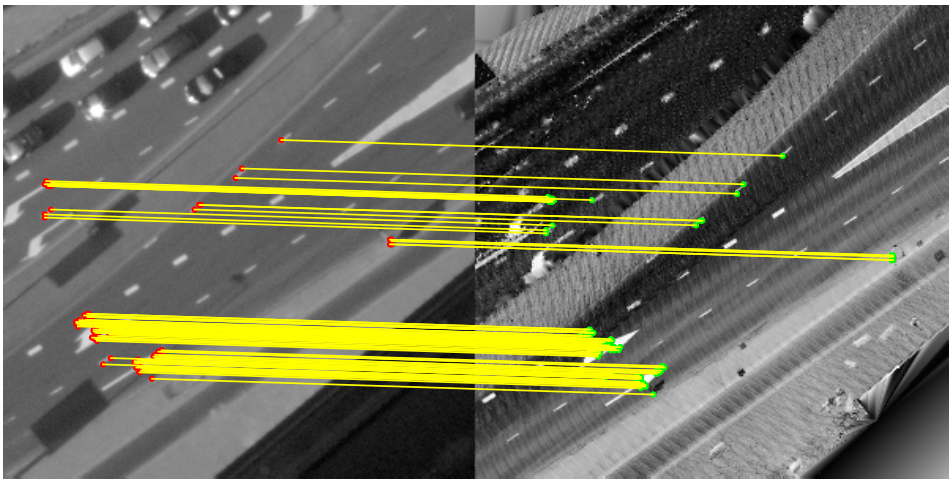

Figure 2: Matched features between a MLSPC and aerial image patches.