Simultaneous calibration of ALS systems and alignment of multiview LiDAR scans of urban areas

Abstract:
Tasks such as city modeling or urban planning require the registration, alignment, and comparison of multiview and/or multitemporal remote sensing data. Airborne laser scanning (ALS) is one of the established techniques to deliver these data. Regrettably, direct georeferencing of ALS measurements usually leads to considerable displacements that limit connectivity and/or comparability of overlapping point clouds. Most reasons for this effect can be found in the impreciseness of the positioning and orientation sensors and their misalignment to the laser scanner. Typically, these sensors are comprised of a global navigation satellite system receiver and an inertial measurement unit. This paper presents a method for the automatic self-calibration of such ALS systems and the alignment of the acquired laser point clouds. Although applicable to classical nadir configurations, a novelty of our approach is the consideration of multiple data sets that were recorded with an oblique forward-looking full-waveform laser scanner. A combination of a region-growing approach with a random-sample-consensus segmentation method is used to extract planar shapes. Matching objects in overlapping data sets are identified with regard to several geometric attributes. A new methodology is presented to transfer the planarity constraints into systems of linear equations to determine both
the boresight parameters and the data alignment. In addition to system calibration and data
registration, the presented workflow results in merged 3-D point clouds that contain information
concerning rooftops and all building facades. This database represents a solid basis and reference
for applications such as change detection.

Stichworte: Airborne laser scanning, boresight calibration, data alignment, registration, urban areas

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