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Using Extremely High Resolution LiDAR Data for the Automated Extraction of Railroad Infrastructure Objects

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The quality of remotely sensed data in regards of accuracy and resolution has considerably improved in recent years. Very small objects are detectable by means of imaging and laser scanning, yet there are only few studies to use such data for large scale mapping of railroad infrastructure.
An approach is presented that integrates extremely high resolution ortho-imagery and dense helicopter-borne laser scanning point clouds. These data sets are used to reconstruct railroad objects.
A feature level data fusion is carried out in order to combine the advantages of both data sets and to achieve a maximum of accuracy and completeness for the extraction of railroad track centre lines as a first step. The workflow consists of three successive processing steps. First, object-based image analysis is used to derive a railroad track mask from ortho-imagery. This spatial location information is then combined with the height information to classify the laser points. Lastly, an adapted random sample consensus algorithm approximates the location of railroad track centre lines from these classified points. This workflow is tested on two railroad sections and was found to deliver very accurate results in a quickly and highly automated manner.
Further railroad infrastructure objects like masts and mounted catenary wires, railway signals, platform edges, and noise protection walls are extracted subsequently from the LiDAR data only using various knowledge-based approaches. Such spatial information is an important source for railway companies (like the Austrian Railways/Österreichische Bundesbahn ÖBB in this case study) for internal planning as well as for complying with international standards especially regarding railroad safety.
The approach is currently under development to make use of the capabilities of spatial databases (Oracle Spatial) for the extraction process. A further adaptation of the algorithms is underway to allow the analysis of data from mobile platforms, i.e. rail-borne laser scanners.
The presented study demonstrates that it is possible to extract even small objects from 3D point clouds in an automated way to gather accurate spatial information.