Utilization and Quality Control of State-of-the-art Digital Elevation Data

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What's Up?

Case

The next version of the Danish Digital Elevation Model (DK-DEM) will be based on newly collected data which on all parameters surpasses what was the case for the original DK-DEM:

Data density is expected to be 8 times larger, while both planar and elevation accuracy will be significantly improved (see also poster by Rosenkranz et al).

Also, newer combined LiDAR and camera systems will be utilized. Hence color observations (RGB) will be assigned to each observation.

The systems also record continuous series of laser reflections, so the point reflections are complemented with sets of full reflection profiles ("Full Waveform Data", FW).

So far, FW and RGB primarily contributes to the data provider's post processing of the collected data (classification, etc.): Coming years will show the operational advantage of the new data types.

Problem

The greater data density, the increased accuracy, and the new data types has made it necessary to develop new quality control procedures at Geodatastyrelsen:

- Partly because the data provider's expected accuracy exceeds the accuracy of some of the control data available,
- Partly because new data types (FW and RGB) requires radically different control methods and
- Partly because the large amounts of data (about 100 terabytes uncompressed) places increased demands for efficiency and flexibility in both algorithms, data flow and reporting

Solution Architecture

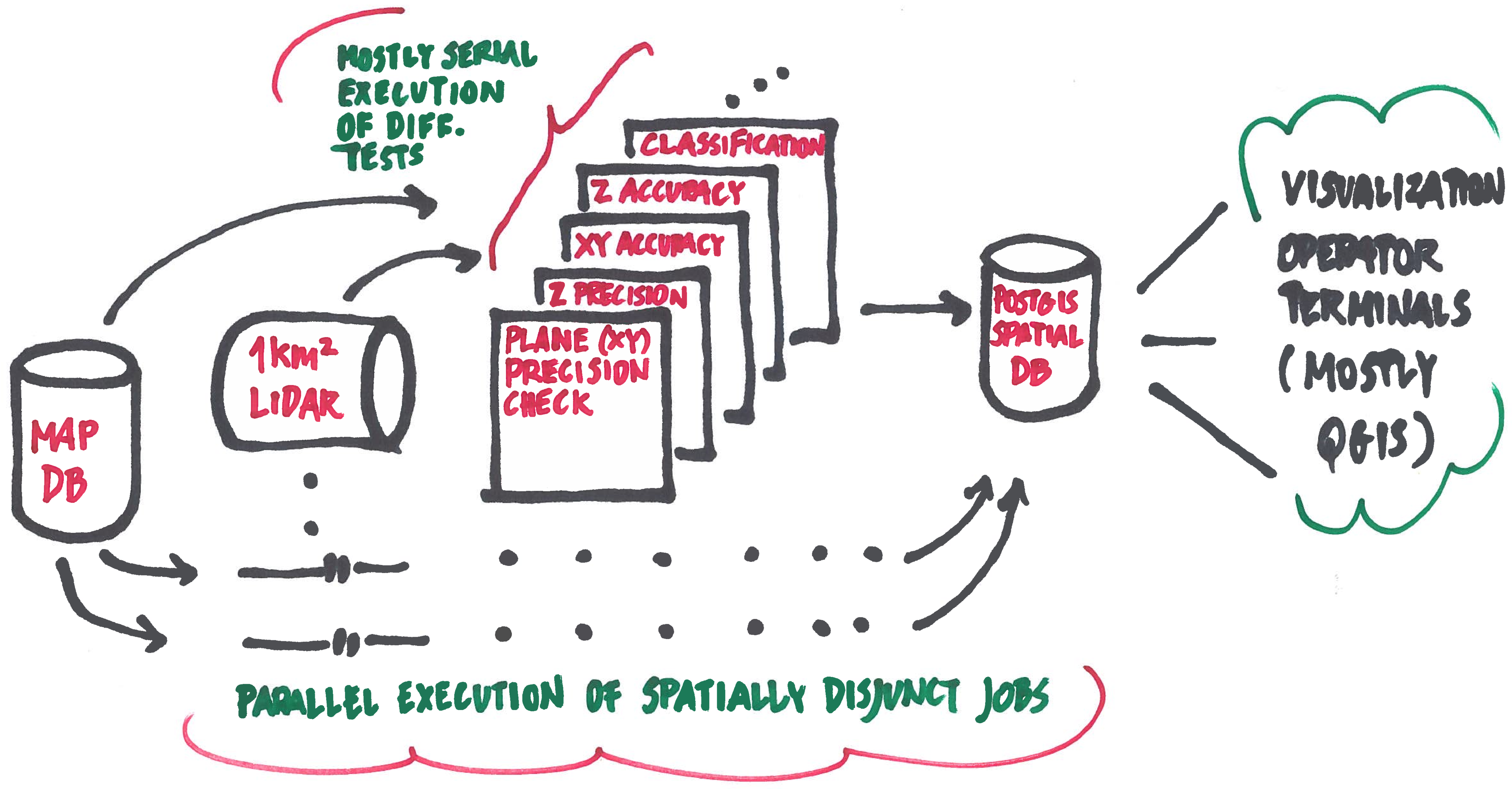
The new quality control procedures check the plane and level accuracy through calculation and adjustment of parametric models of road and roof surfaces. Considered as entire objects, they have a more well-determined geometry than the individual elementary observations.

All tests run in spatially disjoint tiles of 1 km$\times$1 km. This makes parallel execution of the individual tests embarrasingly simple, so we typically run parallel test processes on as many kernels as available.

When all tiles have been through one of the tests, the overall process goes on to parallel execution of the next test.

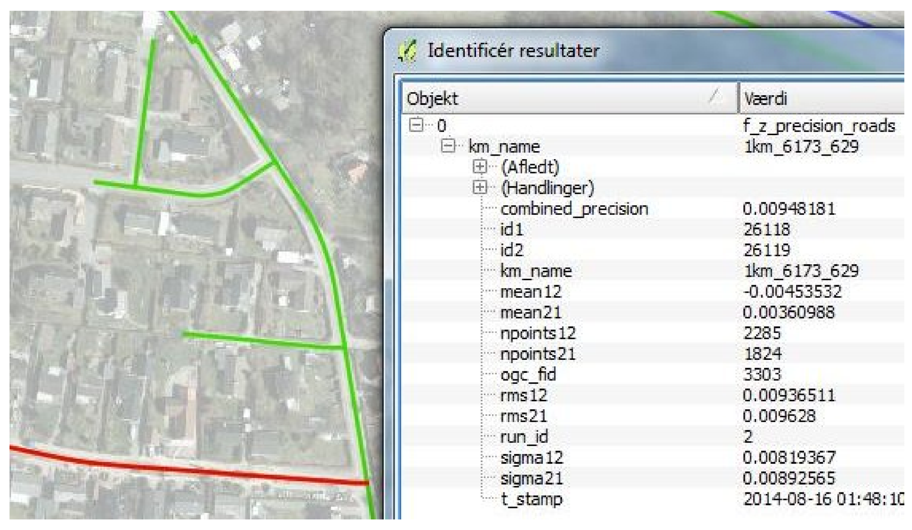
The results of all checks are stored continuously in a spatial database (PostGIS), so progress and quality can be observed in real time through a GIS interface.

Architectural Outline of the LiDAR Quality Control System



Above: The QC system works on individual 1 km^2 square tiles in parallel. The results are collected in a spatial data base.

Right: The QC operator investigates individual elements by accessing the database directly from QGIS, and can generate queries on demand.

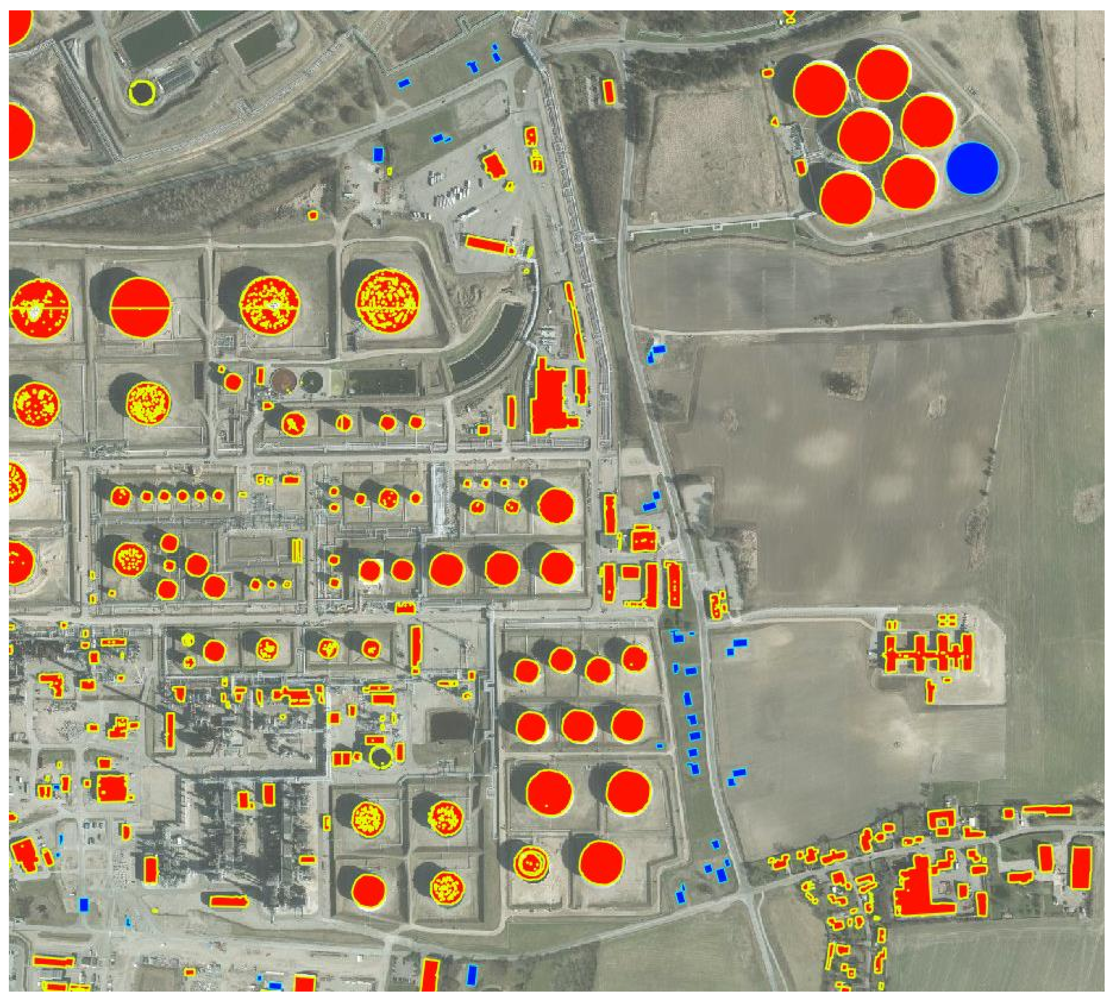


Automatic Roof Ridge Detection

Above: Plane precision by dual ridge detections. The offsets observed with respect to the orthophoto background are as expected, since the orthophoto processing is based on a terrain model, which does not include the building heights.

Below: The general view appears in the overlap zones.

LiDAR QC System Detects Errors in Existing Map Data



When combining existing map data with new LiDAR data, synergistic potentials show up.

Here, we show in yellow the building registrations from the map database which are confirmed by LiDAR registrations, while in blue, we show existing registrations that are not confirmed by the new LiDAR data.

Hence, we can use the new LiDAR data to generate pinpointed signalling of areas where the map database needs updating.

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