

TERRESTRIAL LASER SCANNING AS ROAD'S CADASTRE REVISION AND INTEGRATION SUPPORT

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ABSTRACT:

Topography and Photogrammetric Section of Civil Engineering Department of University of Pisa, in cooperation with Centre of Excellence TeleGeomatics of University of Trieste, is experimenting laser data's integration with collected data by MMS (Mobile Mapping System) vehicles. That vehicles are being used by the two research centres on road's cadastre.

Two different laser scanners are used for experiments, the Riegl LMS-Z210i and the Optec ILRIS-3D. The survey concern different kinds of road's elements and a pair of road's intersections.

Test have been carried out aiming at the review the potential and productivity of laser use in comparison with classic survey's technique. Some examples of data collection and processing are described. Survey are realised both with instruments on the ground both with laser located on top of VINCI'S (Vehicle Vehicle-borne Integrated Navigation and Cartographic Information Prime System), the MMS vehicle of University of Pisa.

1. INTRODUCTION

The aim of performed test is the evaluation of terrestrial laser scanner capability as support for revision and integration of road's cadastral data.

In fact, for some times Centre of Excellence Telegeomatics of Trieste University in cooperation with Topography and Photogrammetric Division of Civil Engineering Department of Pisa University, is involved in road's cadastral survey based on land survey.

MMS (Mobile Mapping System) vehicles are used for the survey by both university. These vehicles, covering continuously the path we have to survey, permit to get all the necessary geometric and descriptive information.

The using of laser technology for data collecting in cadastral application is significant especially in road's intersection survey, with regard to productivity and information completeness.

In fact, the description of complex road's intersection could be difficult target using only land vehicle, in particular we had significant problems where changing vehicle way wasn't really easy. For this kind of road's intersection we need to cover all the branch to have a complete information.

Using laser scanner instrumentation is possible to get a bigger quantity of data in a little time.

Experimental evidence displaying that the laser can be a valid solution both in detailed describing of road's geometry both in updating and validation of medium and large scale cartography. Besides is necessary to define reference points when we have to compare laser surveys with existing map.

2. INSTRUMENTATION

Two different laser scanners are used for experiments, the Riegl LMS-Z210i and Optec Ilris 3D. The first instrument is property of Topography and Photogrammetric Division of Pisa, whether

the second one was given by surveyor M.Barrancotto who had been involved in survey activity.

The Riegl laser has an higher accuracy than the Optec; for cadastral monitoring purpose the instrumentation can be used with a fairly low resolution without significant information loss. Consequently is possible to compare data series got by both laser instrumentation and perform analyses on surveys duration.

3. METHODS AND RESULTS

The choose area test is a section of Trieste's provincial road number 1, that includes two crossing one near the other. The same provincial road was already surveyed for cadastral purpose by the MMS Trieste's vehicle GIGI One.

The database realised using this vehicle is available for comparison with the evidence of new surveys.



Figure 1. laser and GPS position on crossings

Six different scanning are being used in describing the test area; in figure 1 we can see the position of laser source (marked with red squares) and the GPS static position (marked with cyan circles).

During survey the laser scanner wasn't standing on the ground but was fixed on the top of the vehicle. So it had been possible to increase the scanned area and to move faster from one station to the other.

Only one reference system is used for register all data series collected by laser.

The reference system is the one adopted by Friuli Venezia Giulia Country Map, Gauss Boaga (Roma40 datum). Four GPS static points are being used to refer the scanned data to the chosen system (figure 2)



Figure 2. Scanned data with GPS reference point

Then an automatic thinning of the data is implemented with particular respect to the area covered by more than one measure.

The second step remove all the points that refer to vertical geometry (traffic signs, trees, etc.) so, using this method of sampling, is possible to get an easier data editing starting from raw data.

In figure 3 is possible to see the output of sampling.

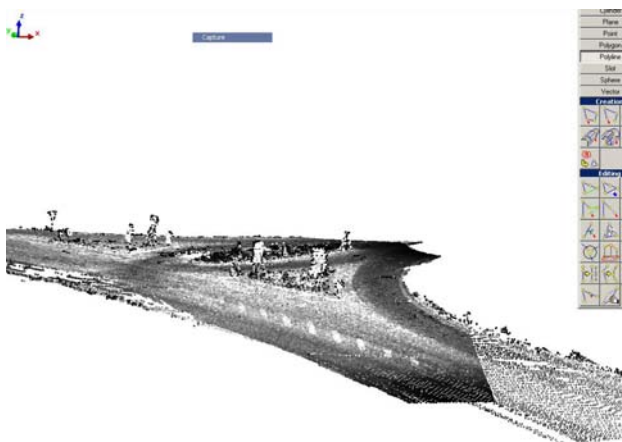


Figure 3. Simplified data by sampling

The image is more understandable and easier to handle for subsequent processing.

Starting from sampled data is possible to locate road's and traffic island's boundaries as well as centre line position.

The next step of analysis allows to get an optimised mesh with a better fitting of geometrical structures. We can see the output of this step on figure 4.

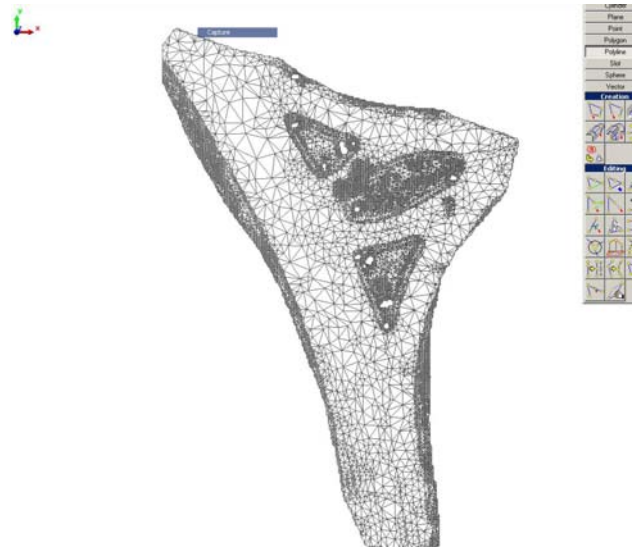


Figure 4. New mesh from simplified data series

Overlapping the mesh with the technical map (1:5,000 scale) we have a first evidence: laser scanning methodology can be used to check the technical map or to update it complying with certified map accuracy.

An example of this step is shown by figure 5, where the realised mesh is overlapped on the section of technical map that displays the two crossings.

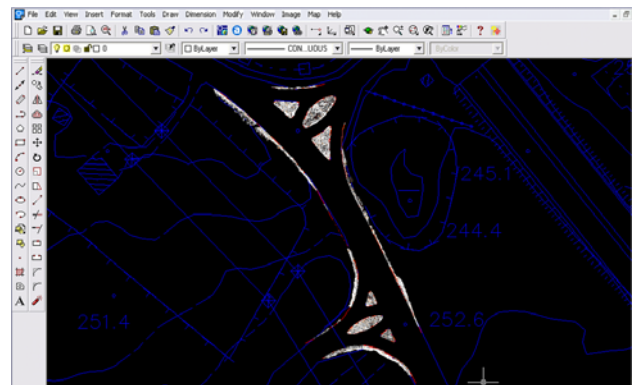


Figure 5. Mesh and map overlapping

Besides is possible to obtain a vectorial representation of the road's elements and perform measures of some geometrical parameters, as road's width.

Moreover this kind of representation could be imported by a software like Autodesk Map for processing it and integration in the cartography database.

In figure 6 is shown the north crossing drawn using edited vector and some measures of geometrical elements.

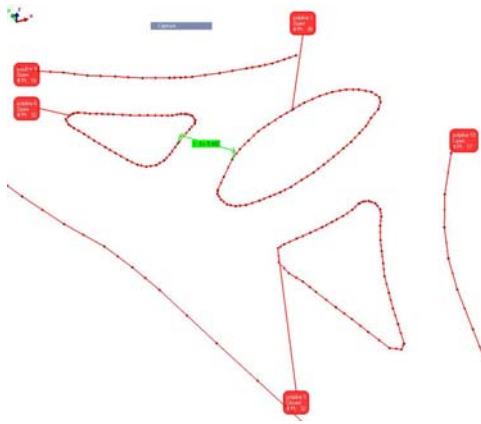


Figure 6. Vectorial representation of road's intersection

In figure 7 and 8 are shown the procedures to get automatically the road's sections from the mesh.

After editing of centre line is possible to trace the intersection with the mesh of a set of planes that are perpendicular to the centre line. The distance between two near plane can be set to a defined value.

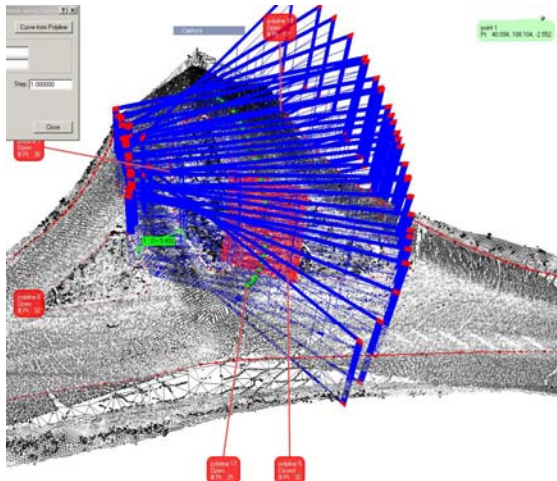


Figure 7. Intersection of mesh by plane

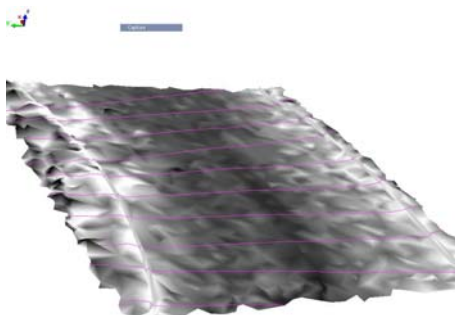


Figure 8. Road's section

The last laser scanning application on road's cadastre is the analysis of vertical geometry with particular respect to vertical traffic signs. To perform this processing is necessary don't remove vertical geometry from raw data with sampling. So the mesh we can get is the one shown in figure 9.

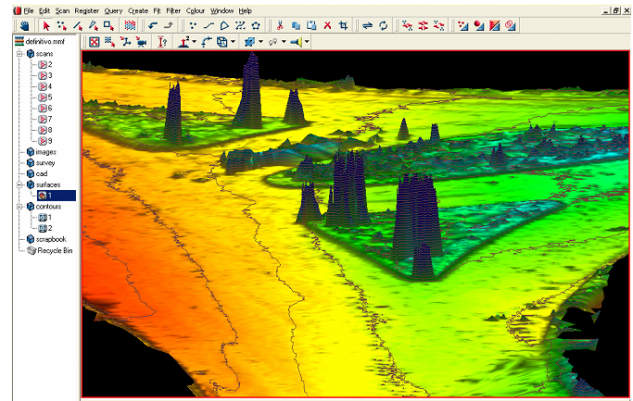


Figure 9. Vertical geometry in the mesh

With data series processing is possible to simplify traffic signs by cylinder shapes and get the position of these by intersection of cylinder centre axis with road's plane.

In figure 10 is shown an example of this processing step.

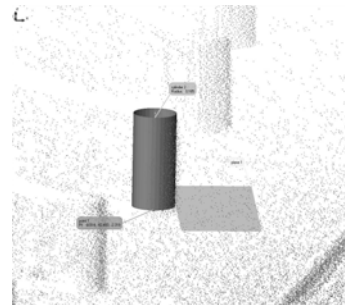


Figure 10. Traffic signs positioning

4. CONCLUSIONS

The realised tests show us that land laser scanner can be used successfully in road's cadastre with particular respect to road's intersection survey.

With laser instrumentation we can get all the necessary geometry and the time requested to perform survey is quite comparable with the other measure method.

In our example were necessary three source of scanning to get a complete description of one crossing; the time requested for the three measures is about forty-fives minutes. To have a similar database with another measure method the time required is sure like this one or longer. Moreover, the very detailed database given by laser could be stored and processed in a second time when other measure's necessity come out.

5. REFERENCES

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