

# MOBILE LASER SCANNING IN ENGINEERING REAL CASE SCENARIOS –A PERFORMANCE EVALUATION

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## 1. Introduction

In this paper we present 3 different real cases of Mobile Laser Scanning (MLS) surveys, discussing their results in an engineering context.

The intention is to evaluate how MLS performs when compared to the initial requirements of a real engineering survey project, and at the same time highlight the differences between the MLS approach and other more conventional surveying approaches for the same project.



The Mobile Laser Scanning system used in all projects referred in this work is the first Riegl VMX-250-CS6 (Figure 1) to be sold in Europe, owned and operated by Artescan, 3D Scanning.

Artescan is a company specialized in laser scanning surveys, which has been working with terrestrial laser scanning since 2003, and with mobile laser scanning since 2009.

The VMX-250 is a compact system composed of two Riegl VQ-250 laser scanners, an INS-GNSS position and orientation system, and an operating computer in a rugged portable box.

## 2. MLS IN ROAD DESIGN PROJECT

For the rehabilitation and construction of new access roads for Luanda, Angola, the project of approximately 120 km should be designed in order to ensure public safety on traffic and pedestrian travel, while minimizing the impact of the new roads on the existing terrain and environment.

### Requirements:

- 60 meters wide strip centred in the axis of the existing roads or paths
- Topographic plan at 1:500 scale
- 1 point per m<sup>2</sup> DTM generation
- Representation of infra-structures cadastre
- Identification of construction for compensation calculations

### Constraints:

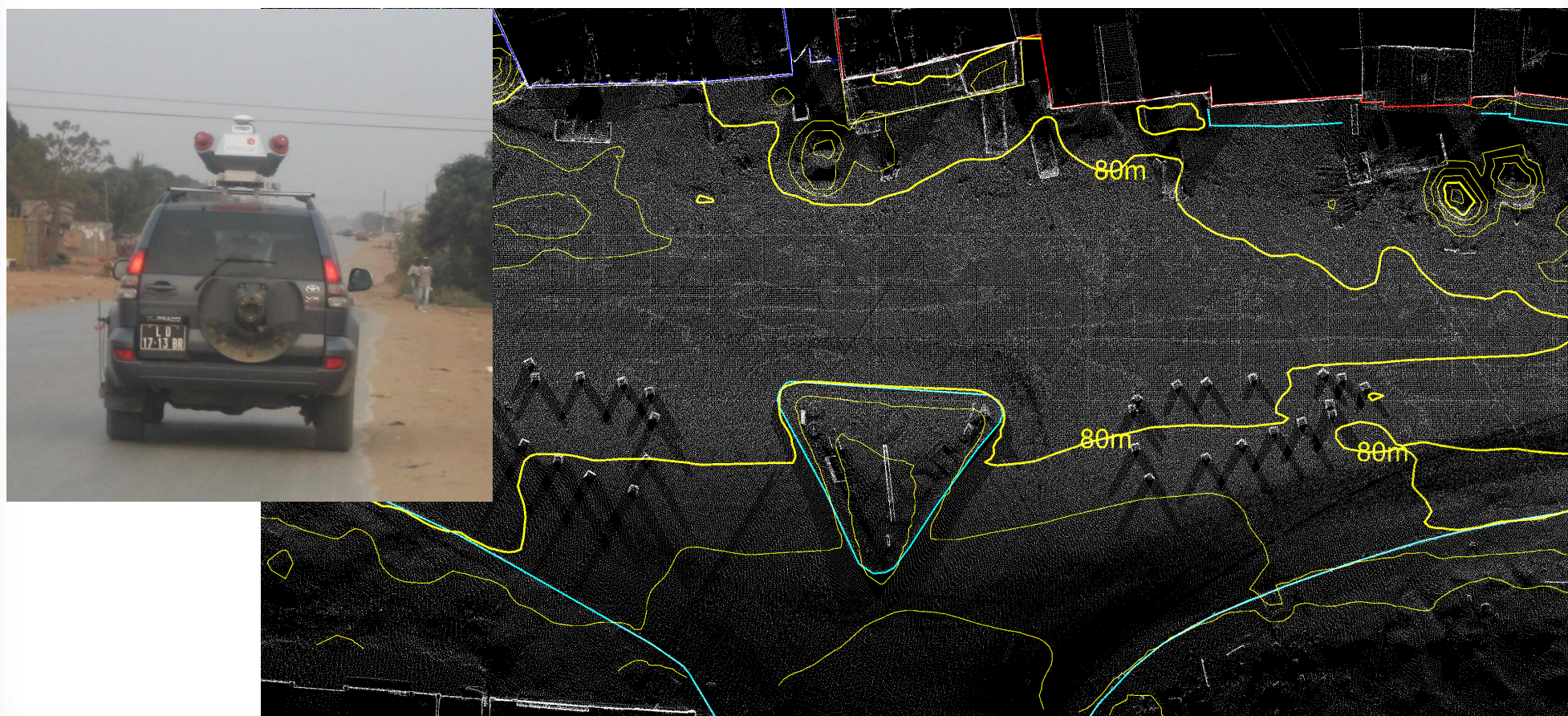
- Urgent need for survey data for designers
- Massive traffic on areas to be surveyed
- Safety issues on some areas to be surveyed
- Time consuming bureaucracies for aerial surveys

### Deliverables:

- 80 m wide of 3D and 2D vectorization centred in road axis
- High definition plan, 0.25m contours
- 10 points per m<sup>2</sup> DTM – 10 x denser
- All infra-structures
- All construction lines
- High definition 3D point cloud

### Solutions:

- Data acquisition of 120 km in 4 days
- No need for traffic constraints
- MLS survey can be carried out safely from a moving vehicle
- No need for complex permits



## 3. MLS IN PAVEMENT SURFACE SURVEY

Within the context of road refurbishment and improvement, a section of 36 km of road in Alentejo, Portugal, was identified as needing pavement rehabilitation. Conventional surveying methods based on cross-section surveys were compared to MLS approach.

### Requirements:

- Survey of 36km road pavement
- Detailed representation from the pavement
- Altimetric accuracy better than 0.01 m and planimetric accuracy of about 0.02 – 0.03 cm in the surveyed points

### Deliverables:

- Complete and detailed survey
- High density DSM from the pavement surface – 10 points per m<sup>2</sup>
- Altimetric RMS = 0.006 and Planimetric RMS < 0.03 for all surface points

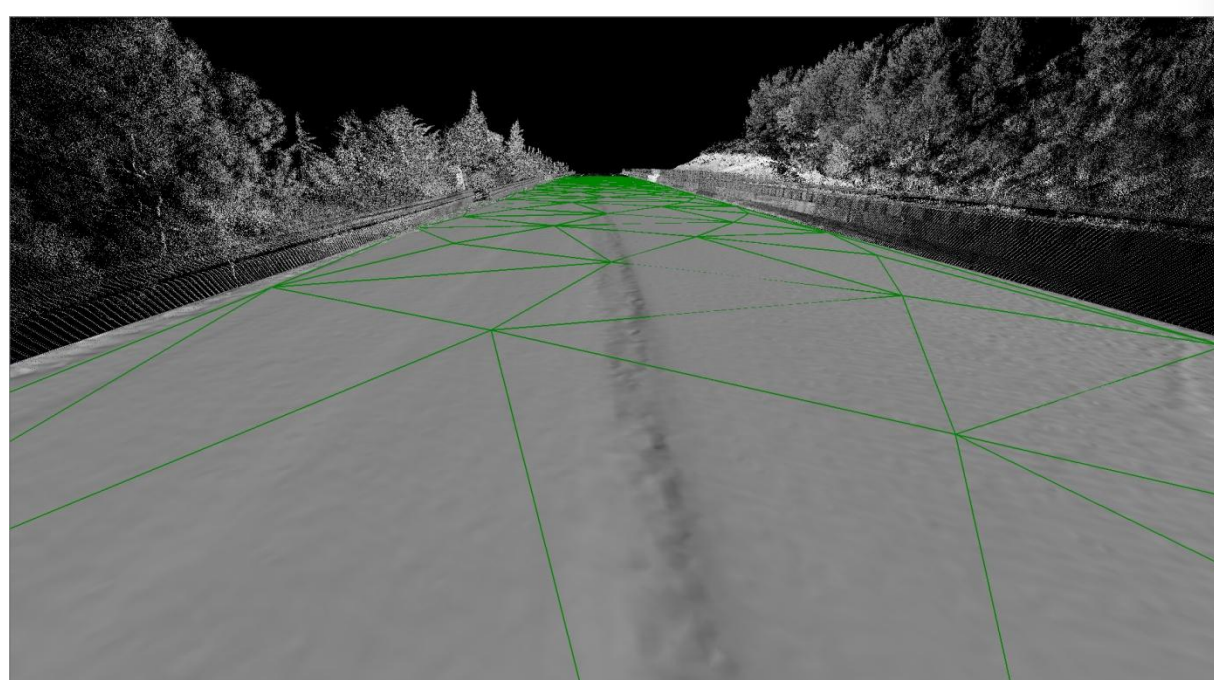
### Constraints:

- Heavy traffic during day/light time, not available for interruptions
- Tight schedule for paving and other construction works on the road
- Urgent need of information of pavement surface
- How to acquire dense and accurate information on the pavement surface



### Solutions:

- MLS survey can be carried out at night and don't need traffic constraint
- Data acquisition in 6 hours
- Deliverable after few days
- MLS survey can be considered as continuous



Pavement surface DSM: 5 cm mesh from MLS versus 5 m grid from conventional surveying

## 4. MLS IN TUNNEL SURVEYING

The aim was to verify the built geometry for 2 single-track tunnels, with a length of 25 km each tunnel for the new high speed railway in Pajares, Spain. The main goal was primarily tunnel clearance assessment and axis tunnel geometric verification.

### Requirements:

- Complete survey of two 25 km tunnels
- Cross-sections every 2 m
- Absolute accuracy better than 2 cm

### Deliverables:

- All requirements fulfilled
- High definition 3D point cloud for all the structure

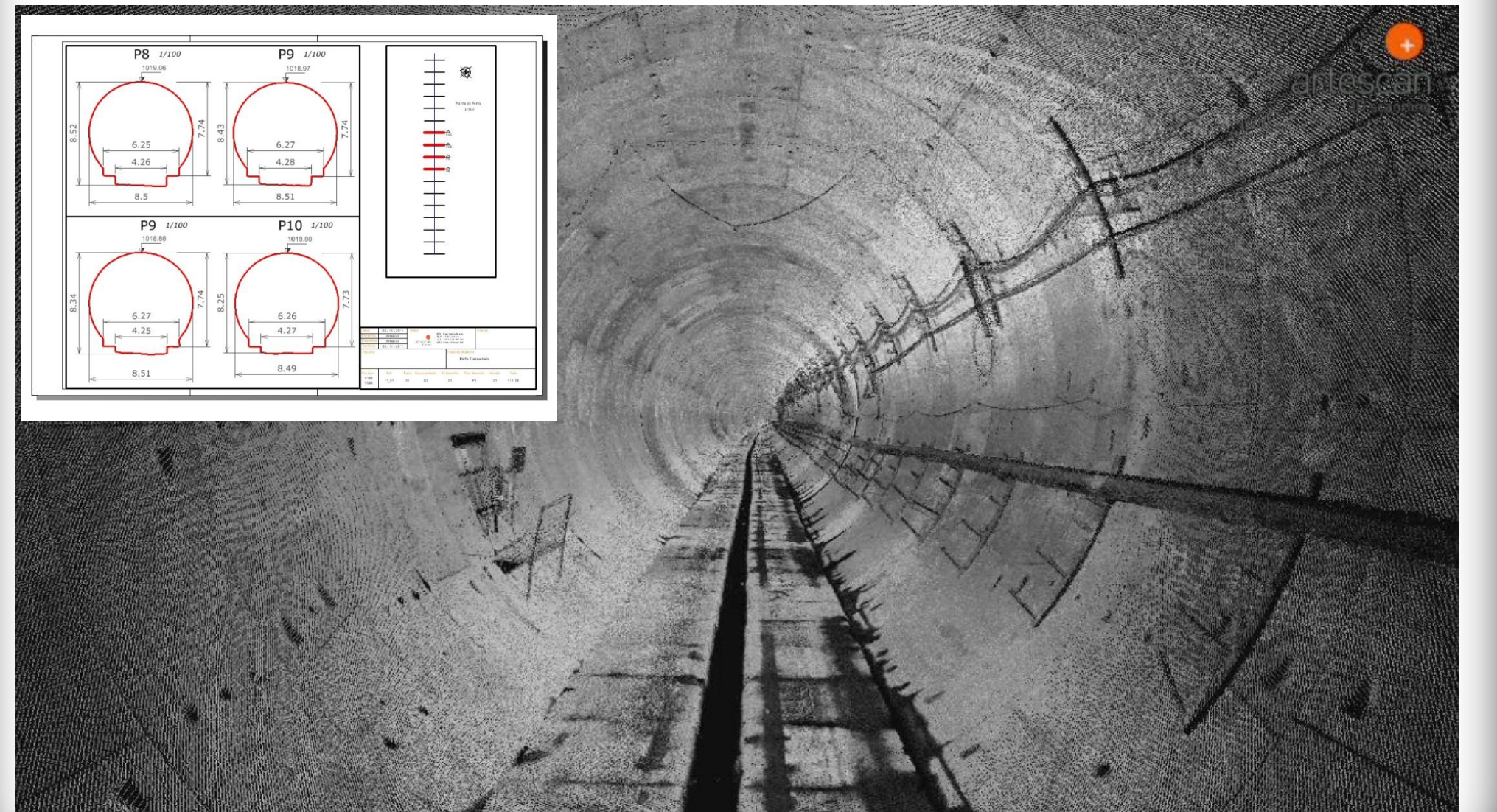
### Constraints:

- GPS signal outage - Underground environment and confined space
- Poor lighting conditions
- Available time inside without heavy machinery work
- Urgent need for geometric information



### Solutions:

- Trajectory adjustment using control points
- MLS doesn't need light
- MLS survey in a total of 8 hours divided in two days
- Fast processing and delivery of a huge quantity of data



## 5. CONCLUDING REMARKS

The performance evaluation as well as the comparison between these results and the ones achieved by other surveying methods show that Mobile Laser Scanning technology, if well applied and handled, is the most efficient way for high precision and global coverage survey of corridor lines.



Recently accomplished projects by Artescan in other fields of engineering, as a 585 KM ACCURATE MLS SURVEY OF RAILWAY, confirmed the efficiency and advantages of this technology, and that the possible applications are far from being documented.

