ALBATROZ Engineering
Research, Development and Innovation

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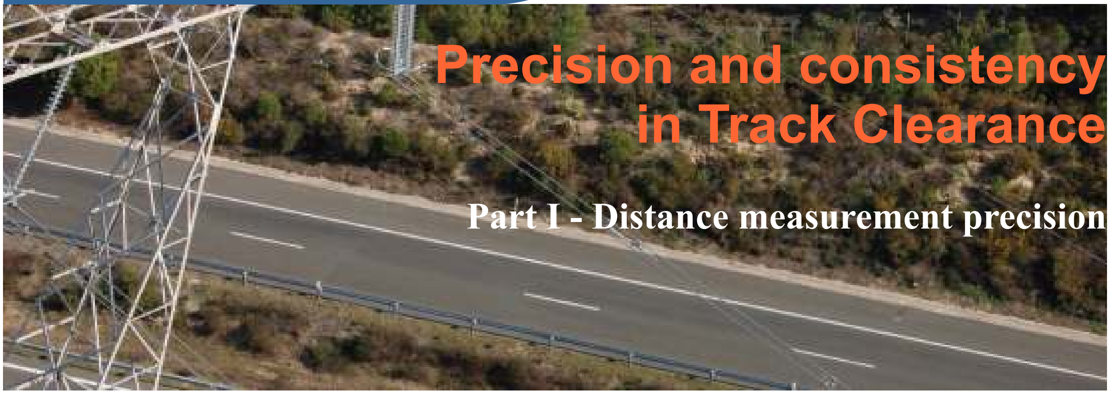


Precision and consistency in Track Clearance

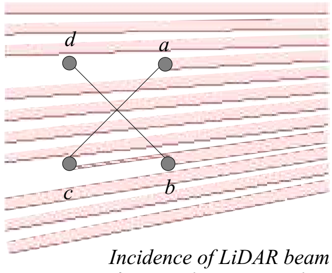
Part I - Distance measurement precision

Quality evaluation of the of the distance measurements made by the Power Line Maintenance Inspection System involves estimation of precision and consistency (i.e. result repeatability from different observation points).

The method used to evaluate the PLMI solution is based on the analysis of a single laser sweep of the LiDAR data. In this manner, measurement errors are comparable to the LiDAR sensor error since only one sensor is used and the speed of the aircraft is negligible compared to the speed of the laser ray. The manufacturer indicates that for solid objects with smooth surfaces larger than the laser beam diameter the error is approximately 0.02 m for a distance of 50 m.

Experiments in controlled environments or measurements of structures with known dimensions such as the highway shown above reveal a standard deviation of approximately 0.03 m. The results with greatest interest, however, are those obtained during flight. In flight conditions, the diameter of the laser beam is greater than the diameter of the power line conductors and greater than the vegetation surfaces which are rough, ductile and in constant motion. The sensor precision was studied for aerial and ground ranging applications on a 400 kV line with two conductors per phase and a 500 kV line with four conductors per phase, respectively. The results were similar in both applications and the latter was chosen to illustrate the detection limitations (see figure on the right).

Conductor **a**, within a laser beam cone, is the best detection condition. Conductor **b** is only in part within the laser beam cone, resulting in less incident energy. In addition, the laser beam cone that encompasses part of conductor **b** also encompasses part of conductor **c**. Therefore, two different incident energies generate two different echos which will produce a single object located between **b** and **c**. Conductor **c** is within two different laser beam cones, albeit with small incident energy, increasing the measurement error. Conductor **d** is not detected since it is in the shadow cone of conductor **a**. This phenomenon also occurs with ground cables that obstruct the line of sight of the sensor to the more distant conductors.



Incidence of LiDAR beam on four conductor powerline

Based on the data collected the 500 kV line has 4 conductors arranged in a square shape with side length of 47.3 cm (conductor centre to centre) with a standard deviation of 3.5 cm. The design value of 48 cm is within 1 standard deviation from the measured value. Though conductor detection limitations can be overcome with signal processing algorithms, distance measurements to vegetation include other sources of imprecision: leaves sway in the wind changing distance and incidence angle, pollen and humidity can be present on the surfaces of the leaves and translucent leaves refract the incident energy onto other leaves which repeat the refraction process. All these effects increase the measurement error and hinder a precision assessment model.

Considering the detection limitations of conductors and vegetation it is estimated that the precision is less than or equal to 10 cm which is more than adequate for track clearance maintenance inspections. Albatroz Engineering's innovative solution features real time inspection results at a significantly reduced cost with slightly greater precision than the technical sensor limits. This approach eliminates the weeks or months waiting for results while vegetation continues to grow.

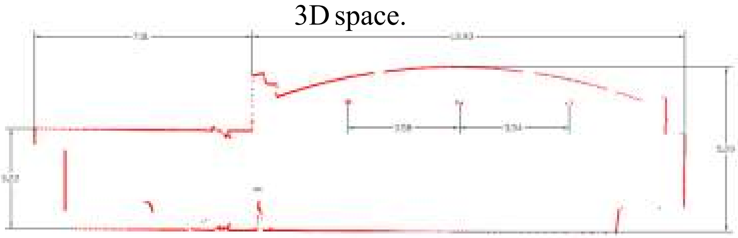
vegetation with different foliage , growth rate and wind flexibility

Innovation Marketplace in Lisbon

Civil Engineering solutions and 3D modelling

In response to the challenge of being present at an event where innovation can be seen and touched, Albatroz Engineering decided to showcase its latest spacial reconstruction tools in an environment full of common household objects that could be modelled on the spot by visitors at the Innovation Marketplace on the 28th of February 2007.

Modelling demonstrations took place all day long using both the LMT (Laser Measurement Tool) and GIM (Geometry in Motion) tools. Both tools have at their core a LiDAR laser used to instantaneously reconstruct objects or environments in 2D or 3D space.

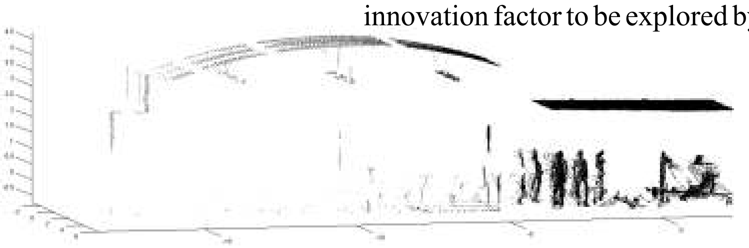


LMT data dimensioning in CAD software

The LMT's portability and wireless interface enabled several different areas of the fair pavilion to be modelled effectively demonstrating the LMT's capabilities and noteworthy efficiency. GIM, on the other hand, attracted the attention to the show stand. As GIM moved along a rail set across the stand, it generated 3D reconstructions with video images of the entire stand including the people who found themselves drawn to the scene and the nearby sections of the pavilion.

In addition to the exhibition, the event included several presentations regarding various aspects of innovation. Special mention goes to Dr. Darius Mahdjoubi's lecture on the role of re-engineering as an innovation factor to be explored by SMEE.

3D model generated in "real time" with GIM (geometry in motion)



T&D Europe 2008

Power Line Inspection Tools in Amsterdam, The Netherlands

Albatroz Engineering was present at Transmission and Distribution 2008 in Amsterdam, the Netherlands from the 11th to the 14th of March 2007. Showcasing the LMT and the GMI, the stand provided an appealing hands-on inspection simulation. Visitors, from a wide range of companies in the energy industry, showed great interest in exploring and discussing the innovative inspection equipment, inspection GUI and data integration strategies developed by Albatroz Engineering.

Providing exposure for the LMT and GMI inspection tools was only one objective. The main objective, however, was to gain feedback from those interested in these type of tools. Listening to the perspectives of visitors from across Europe greatly enriched our understanding of the energy market and the inspection needs of the companies operating in this industry.

We found that in addition to the value placed on quantitative data collected in the field, energy distribution companies are most keen in integrating this data with georeferenced asset management databases in order to optimize maintenance program efficiency.

Smooth data integration with numerous types of databases is inherent in Albatroz Engineering's design approach to inspection tools providing custom data integration features so that they can feed the databases of today and tomorrow.