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SITECO INFORMATICA

ROADSCANNER Z

THE NEW MMS GENERATION FOR THE INFRASTRUCTURE SURVEYS

CONTENTS

00. INTRODUCTION

Road-ScannerZ is the last generation Mobile Mapping and Scanning System developed by Siteco.
It comes from the consolidated technical competence of Siteco in the field of mapping and surveying applied to road inventories, infrastructure monitoring, Pavement Management System for roads and airports and any other service connected to Engineering and Constructions.

The development of the Road-Scanner Mobile Mapping technology started by Siteco in 2005 and went on in cooperation with the qualified Universities of Bologna and Parma:

- Department of Civil Engineering of Parma University for Geodetics and Photogrammetry,
- Department of Information Technology of Parma University for position and image acquisition,
- Department of Infrastructure of Bologna University for Pavement Management System,
- Department of Geodesy of Bologna for high grade surveys and control points correction technology,

In the last years Siteco has used its technology to survey more than 30.000 km of roads, by constantly improving and upgrading its equipment and software.

Siteco's Road-Scanner has been one of the first MMS to exploit mobile scanning. The system has been recently improved thanks to the introduction of the Z+F models, the flexible 5010, used both in mobile and static scanning, and the most powerful 9012 profiler, that can reach up to 200hz mirror rotation speed.
The last-generation system Road-ScannerZ can be equipped with 1 or 2 Z+F 9012 (or 5010) laser-scanners in order to obtain a dense environmental scanning with a full all-direction coverage.
Thanks to its compact design, the new equipment is completely portable, self-calibrating, and adaptable to any vehicle. The light and solid lodging hosts the cameras, the laser-scanners and the Inertial Navigation System, ensuring the calibration of all equipment, and consequently the geo-referencing of all the collected data.
Road-ScannerZ is the right answer to the growing demand of geo-referenced 3D data for both mapping and surveying purposes. The new applications developed by Siteco show the big potential advantages in the use of the Road-ScannerZ technology applied to the most specialized infrastructure inspection activities, like as-built drawings and defect analysis for PMS and BMS (Pavement Management System, Bridge Management System), and last, but not least, in the filed of PMS for airports.

02

01. EQUIPMENT

The Road-ScannerZ equipment includes a number of sensors perfectly synchronized and calibrated with the navigation system which provides the position and the attitude of the vehicle every millisecond.
All the data are collected with the acquisition time and are then located in the space, i.e. geo-referenced.

01.1 NAVIGATIONSYSTEM

The most advanced technology IXBLUE LANDINS INS (InertialNavigationSystem), includes:

- Double-phase high-accuracy GPS receiver and antenna;
- Inertial Navigator System (INS) for determining the vehicle position during GPS outages, based on high technology Fibre Optic;
- Odometer (DMI Distance Measurement Indicator) for surveying the distance.
- High performance post-processing software to calculate the system position and attitude, combining inertial and GPS data.

Road-ScannerZ can be equipped with a wide range of INS, starting from entry-level models, to allow gradual investments.

01.2 LASERSCANNERS

Road-ScannerZ can be equipped with be equipped with 1 or 2 Z+F 5010 or 9012 laser-scanners.
The Zoller&Froelich phase-difference laser-scanners are well known for their high accuracy and quality. The 5010 imager/profiler model, with 2 mm resolution and 180 m of range, can reach 100 mirror rotation per second, and can be used also for static scanning. The 9012 profiler, with 200 trotations per second and to the rate of up to 1.000.000 pps, gives the best performance for mobile mapping. The resulting data can be consulted using special applications for the management of the clouds of points and with the Road-SIT Survey application, i.e. contextually with the acquisition of the images with the cameras.

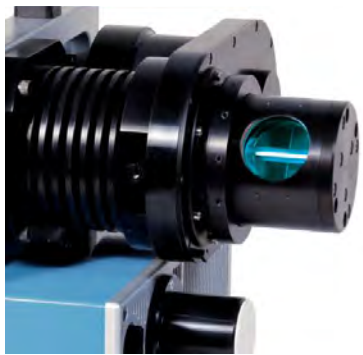
High Performance FOG TECHNOLOGY

The fibre optic gyros allow:

- Centimetric accuracy position, even after long GPS outages;
- 0,01° or better heading, roll, pitch at update rate;
- Precise timing and 1,000 Hz event markers.

Outage duration (sec)	15		60		120		300	
Mode	RTK	PPK	RTK	PPK	RTK	PPK	RTK	PPK
True heading (deg)	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Roll/Pitch (deg)	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Position X and Y (m)	0.07	0.05	0.20	0.10	0.30	0.25	0.70	0.60
Position Z (m)	0.05	0.05	0.10	0.07	0.25	0.20	0.50	0.40

Z+F 5010 – 9012 helical scanning



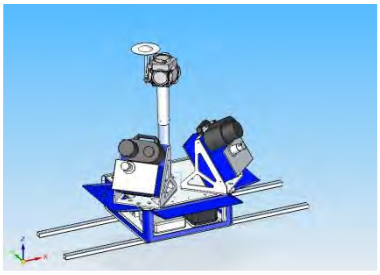
01.3 ACQUISITION SYSTEM

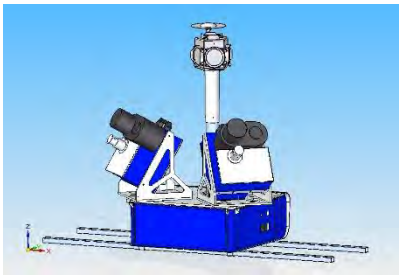
All the electronic components of the acquisition system are hosted in a compact box located in the trunk of the vehicle and connected to a standard laptop PC where the acquisition software is installed.
The acquisition software synchronizes all the sensors and acquires all the data. The User Interface allows you to set up and monitor all the equipment in an easy and effective way, and to avoid loss of data during the missions.

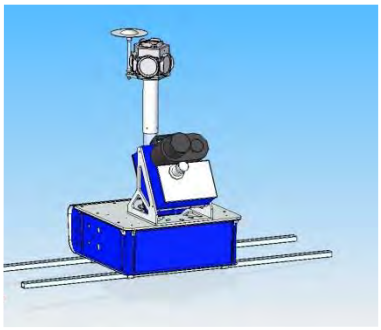
01.4 VIDEO SYSTEM

Includes the top quality Ladybug5 panoramic camera (6x5 mpx) and can be integrated with a set of last-generation high resolution 2 Mpixels Basler cameras connected through Gigabit Ethernet technology.
The cameras are solidly fixed to the lodging framework, and can be oriented in any direction to assure a full vision of the road and of the pavement. A simple procedure allows their calibration in a quick and easy way. The images are acquired at a constant distance step that can be set according to needs (generally 1 to 5 m.). Each frame is perfectly geo-referenced thanks to the synchronization with the Inertial Navigation System.

The Road-ScannerZ can be provided with a wide range of configurations in terms of video and LIDAR equipment. The version with 2 laser-scanners is provided in typical V-shape mounting. The single laser can be oriented in different positions depending on the survey needs.







02. ADDITIONAL EQUIPMENT

Road-ScannerZ can be integrated with additional equipment to improve the pavement inspection: the Ground Penetrating Radar and the Profilometer. The comparative analysis of all the collected data (GPS images, laser point-clouds, imagery and profilometer IRI index), allows a full inspection of the pavement conditions in terms of surface and layers. The Road-ScannerZ acquisition system is an open system and allows the integration of other equipment. They can be easily synchronized with the Inertial Navigation System to geo-reference all the acquired data while the post-processing software allows the access and display of additional data collected together with imagery.

02.1 GROUND PENETRATING RADAR

The 2-Ghz GPR (Ground Penetrating Radar) system is produced by the international leader IDS.

The georadar is the quickest and cheapest way to obtain a non-destructive survey of the pavement status. The 2-Gh antenna is located at 10-15 cm. from the pavement. The acquisition of the wave reflection allows the analysis of the asphalt and sub-base layers.

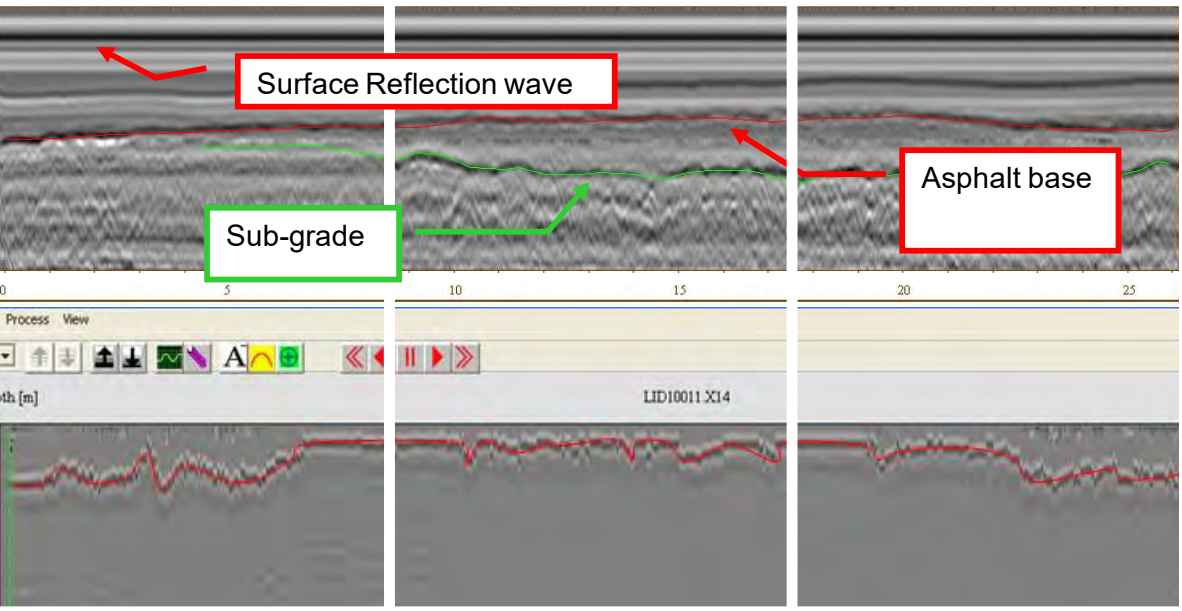
The post-processing software includes functions for the evaluation of the base and sub-base status.

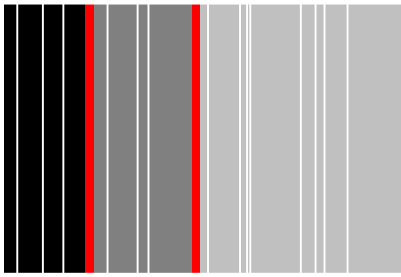
At 50 Km/h speed, the Georadar allows the acquisition of 10 positions per meter. For every position a full data-set is recorded with the thickness and the related propagation speed of the electromagnetic wave. The reflection speed is related to the physical layer features (porosity and granulometry).

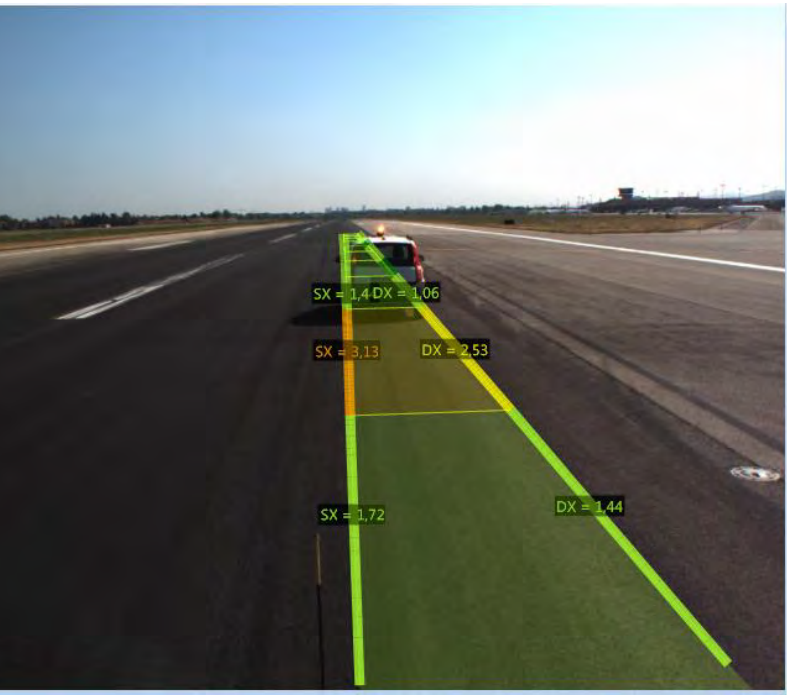
02.2 PROFILOMETER

The road roughness is surveyed with the Dynatest RSP IV profilometer

It allows the real-time recording of the IRI parameter (International Roughness Index), codified by the World Bank (ASTM E950 Class 1). The Dynatest profilometer is certified by this standard.







03. FIELDS of APPLICATION

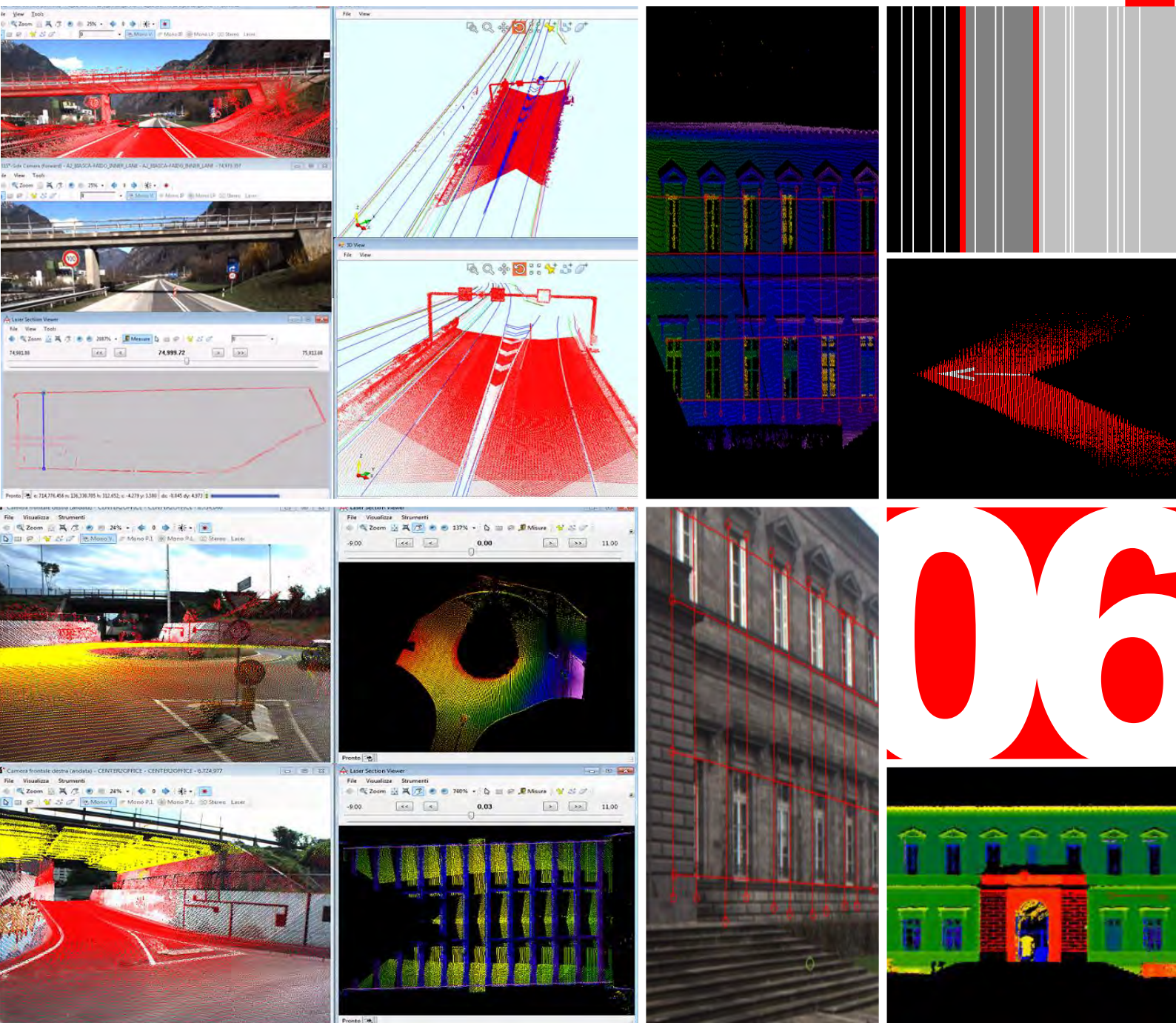
Road-ScannerZ is exploited in many fields of application: Engineering, constructions, as-built surveys, infrastructure monitoring, Pavement Management Systems for roads and airports, mapping, asset management, city modeling …

The Road-ScannerZ technology has been successfully implemented in different fields :

- Road inventory, mapping and facility management;
- Hi-grade survey for roads and infrastructures (bridges, tunnels, tramways, retaining walls, etc.);
- Pavement inspections for roads and airports Pavement Management Systems;
- As built surveys;
- City modeling.

The perfectly geo-referenced imagery and point clouds can be viewed altogether and processed with the Road-SIT photogrammetry software, an application integrated with the most commonly used CAD, GIS and database management systems.

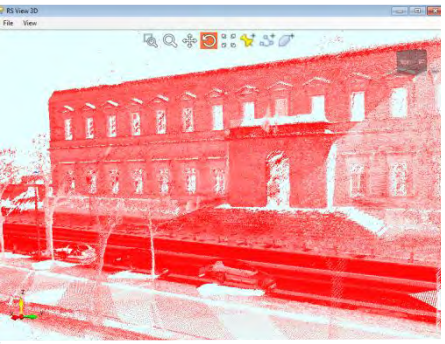
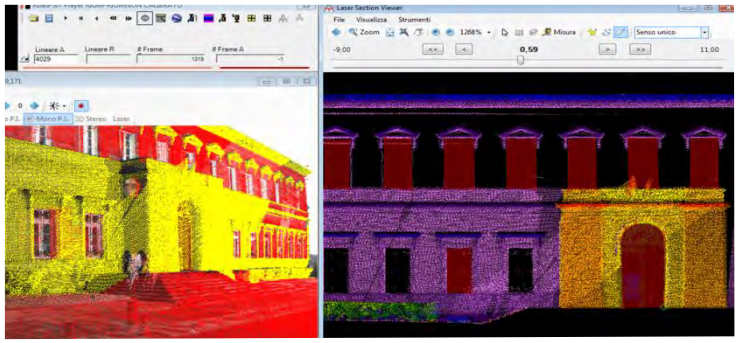
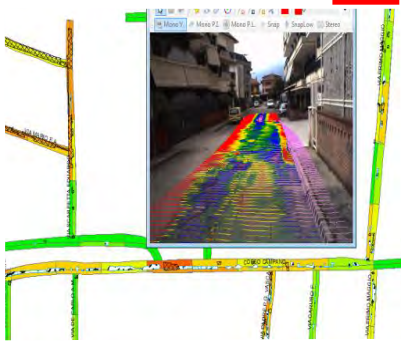
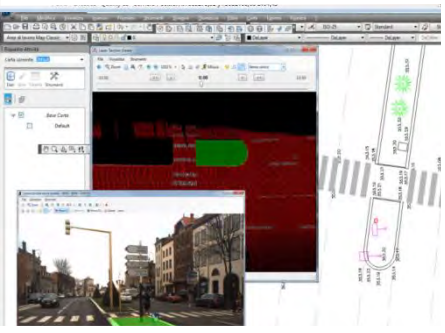
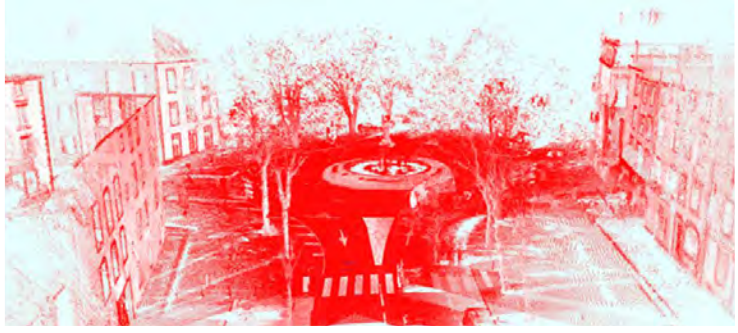
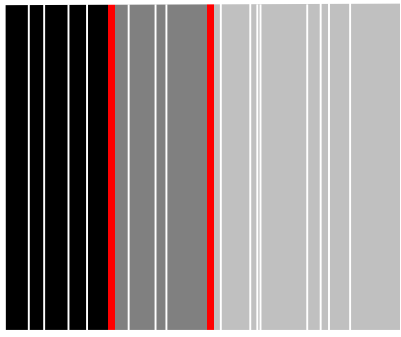
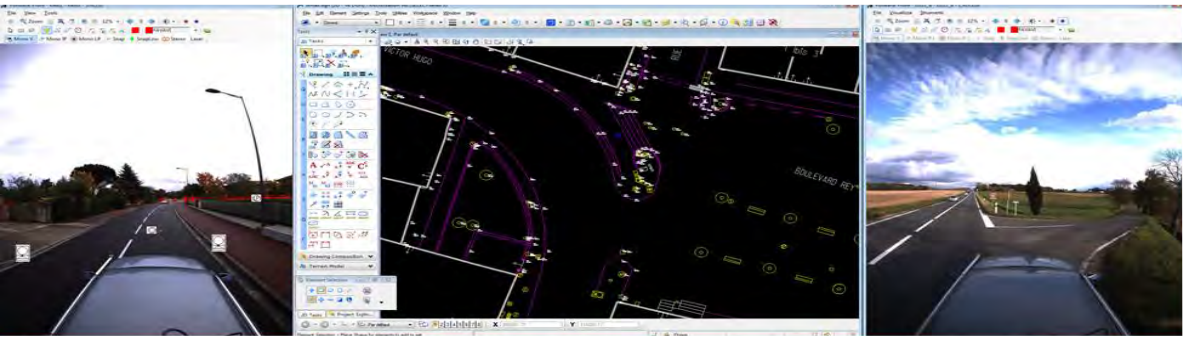
Special features allow the data processing, and the production of very simple way cross sections, profiles, etc.

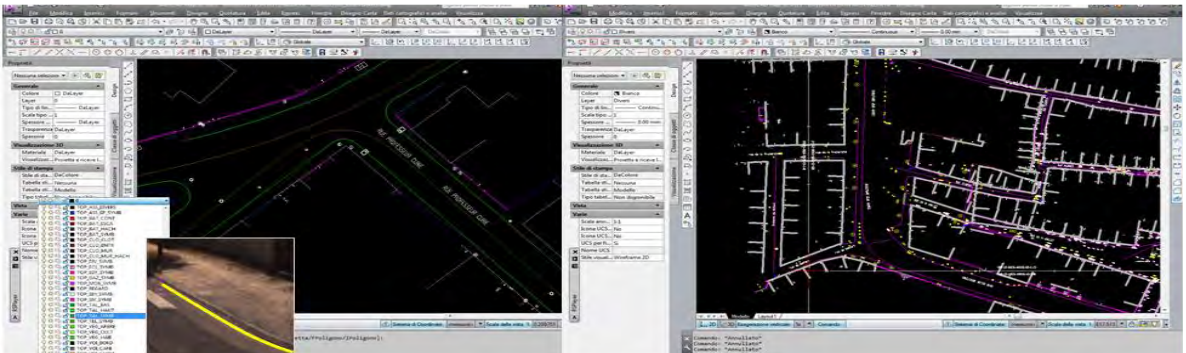
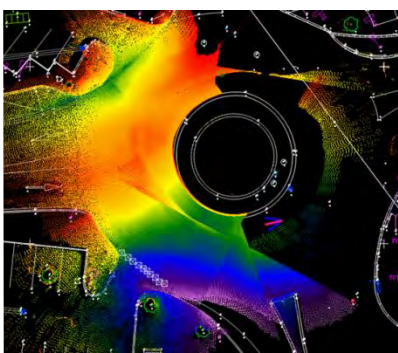


04. SURVEY DELIVERABLES

The following products can be obtained with the Road-ScannerZ surveys and the post-processing application :

- Point clouds generated with the Z+F laser-scanners, with the highest available accuracy, and a full coverage of the whole infrastructure in any direction. They can be processed with the photogrammetry application Road-SIT Survey, or with other independent software for mobile mapping data management (Topodot, Orbit GIS; etc);
- Imagery acquired with the video system in JPEG or AVI format, ready for the post-processing phase, and for virtual inspection of the road network. The imagery and the point clouds can be displayed together in the photogrammetry software to obtain perfect measurements of the infrastructure;
- Facility management database, containing all the road components: road size, signs, markings, posters, lamps, pavements, sidewalks, guard-rails, tunnels, retaining walls, etc.
- Survey of the Pavement defect and Condition Index (PCI) for Pavement Management System;
- Pavement roughness (IRI – International Roughness Index), surveyed with the Dynatest Class 1 profilometer;
- GPR (Ground Penetrating Radar) data to inspect the asphalt layers conditions, with up to 10 points of survey per meter.

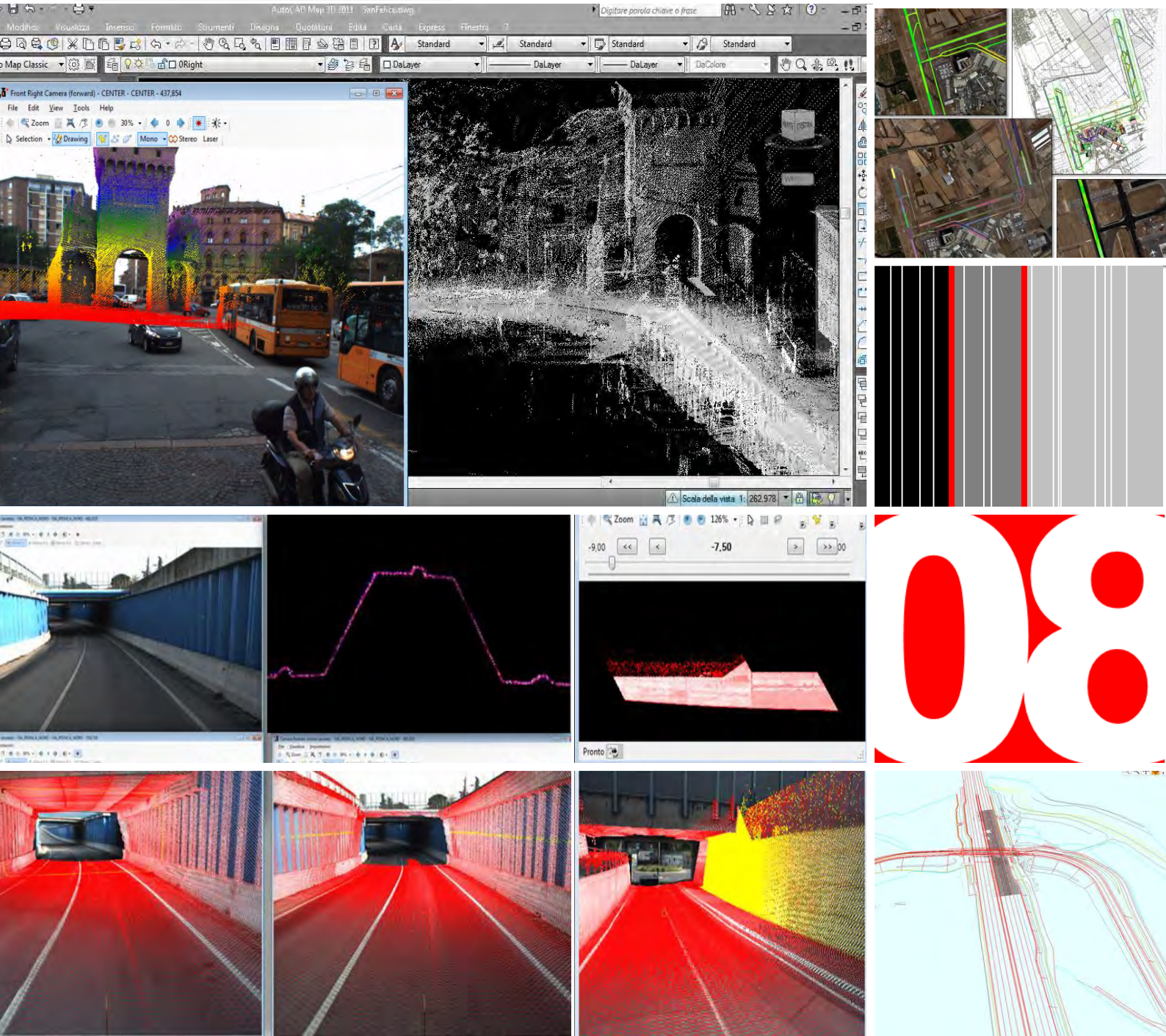



05. SCALABLE TECHNOLOGY

Road-ScannerZ allows a consistent reduction in times and costs versus the previously used systems, by increasing the data reliability and the work efficiency, and ensuring a high precision as well.
The Road-ScannerZ architecture is based on standard components that can be easily upgraded following the technological evolution.
The flexibility and scalability of the system allows a wide range of configurations, from entry level models to top solutions ensuring the highest accuracies and performances.

Here is the list of the main advantages offered by the implementation of the Road-ScannerZ technology:

- Quickness and safety of the route execution without holding up the traffic;
- Reduction in costs;
- Data results with high accuracy and information reliability thanks to the best performing equipment;
- Supply of a full road inventory and roadside assets to the public administration;
- Efficient workflow and integration with the mapping data by means of CAD-GIS programs;
- Simultaneous acquisition of position data and related information;
- Advanced automation;
- Archiving inside the Road Information System database, Road-SIT, providing specific functions for the data consultation and updating;
- Post-processing efficiency increased by powerful tools.



06. POST Processing APPLICATIONS

06.1 ROADSIT SURVEY

Road-SIT Survey is the photogrammetry application expressly developed for Road-ScannerZ, in collaboration with the Engineering Department of the Parma University

Road-SIT Survey has been conceived to obtain a full control on the photogrammetric and laser scanning measurements. Special functions allow the calibration and the orientation of the cameras, and of the LIDAR with reference to the origin of the navigation system. An accurate calibration is required to obtain precise measurements each time it is necessary to set the cameras position.

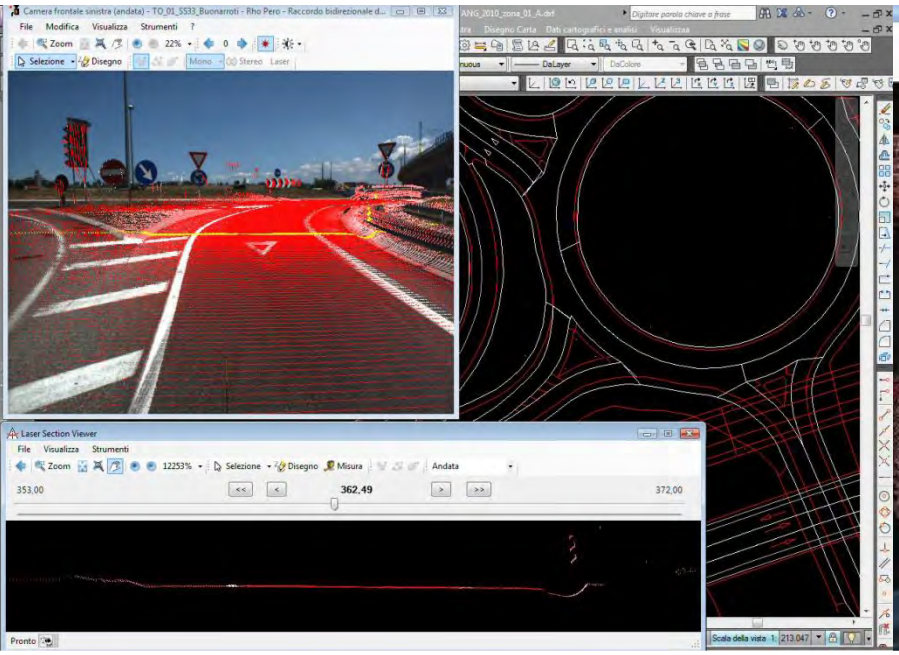
Road-SIT Survey is fully integrated with the Road-SIT facility management package. All the data are collected in a well-structured relational database. The output format is suitable for the post-processing, and consistent with the public administrations' requirements.

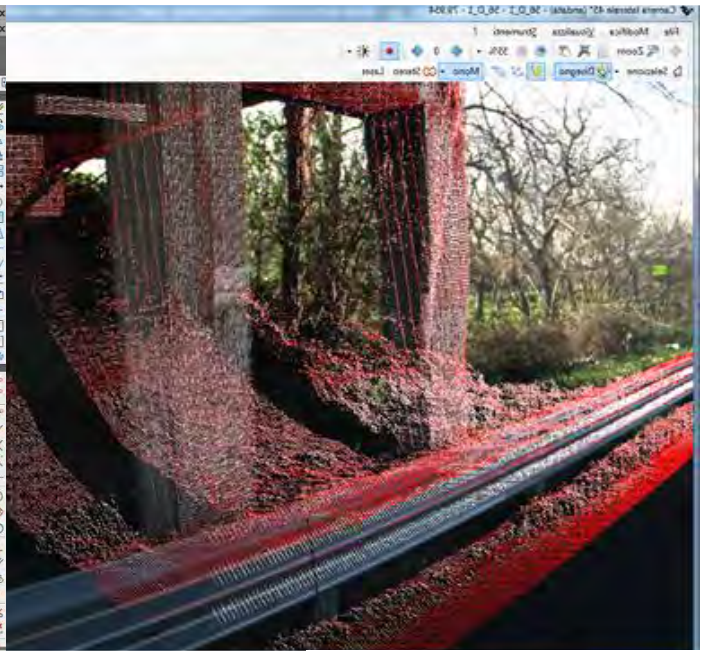
06.2 ROADSIT CAD

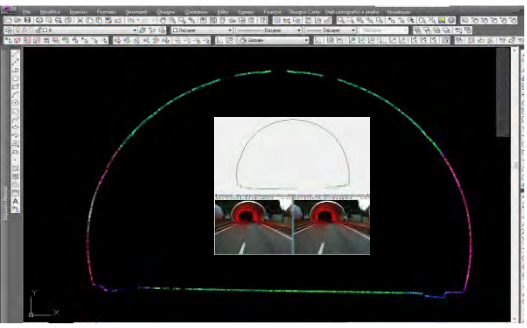
Road-SIT CAD offers all the display and photogrammetry functions commonly available in the most widespread AutoCAD 2009 or ESRI ArcGIS environments.

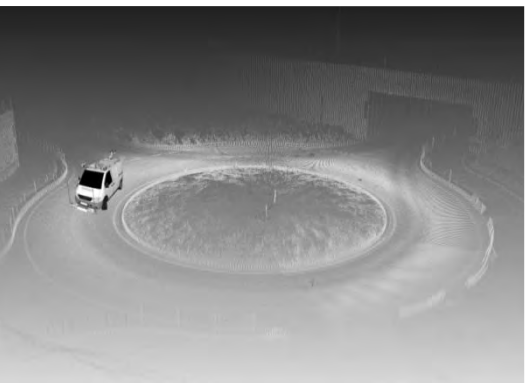
With Road-SIT CAD you can draw points , lines and polygons directly in your Autocad drawing or in your ArcGIS database.

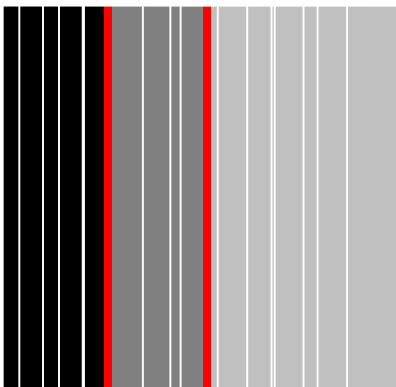
ROADSCANNERZ











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07. ROAD-SIT PMS for ROADS

Road-SIT PMS is the Pavement Management System conceived to manage all the issued linked to the road pavement (distress survey, rating analysis, maintenance and rehabilitation planning). Road-SIT PMS is integrated with the ESRI ArcGIS package. The mapping features allow an immediate and synthetic control of the pavement conditions and of the planned maintenance activities.

With the special post-processing features you can detect and measure all the pavement distresses according to the ASTM D 6433/2003 specifications. The sophisticated Road-ScannerZ system allows a millimetric measurement of the pavement irregularities, thanks to the accuracy of the Z+F laser-scanner. All the distress geometries are stored in the GIS model and can be displayed on he imagery.

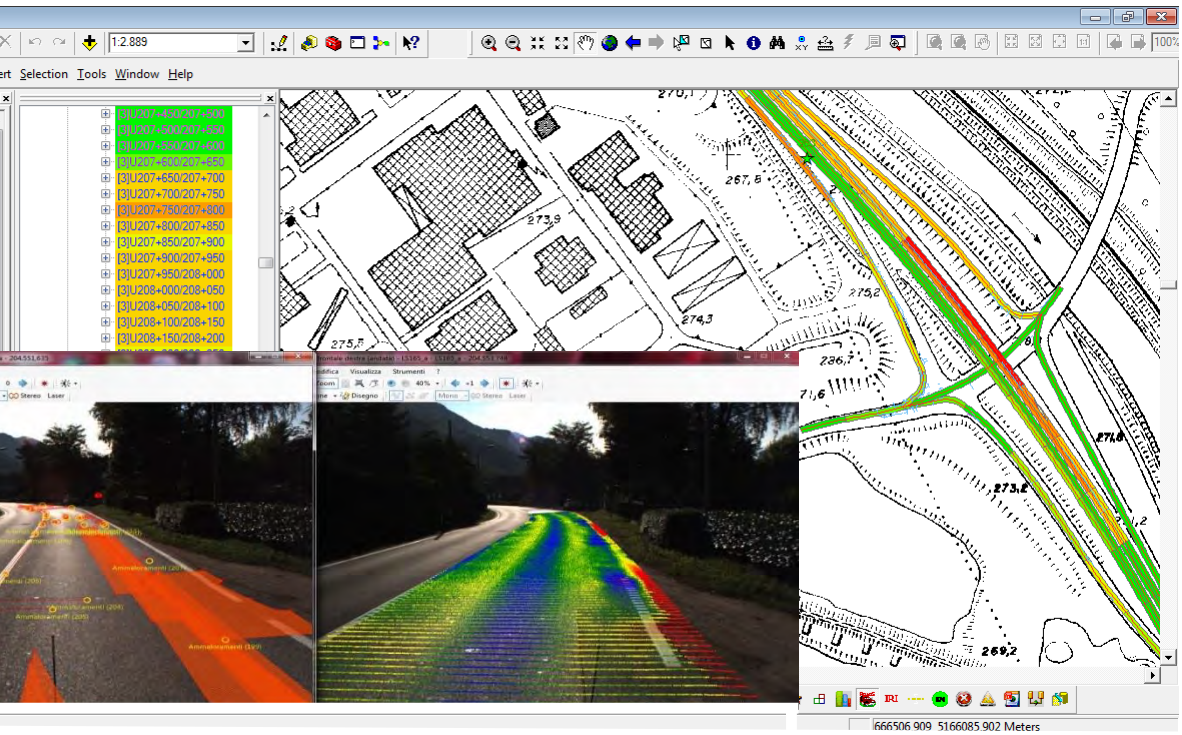
The whole pavement network is organized in a Pavement Grid Map divided into homogeneous sections and sample units, for the calculation of the PCI index. The Pavement Condition Index (PCI) allows to determine the current status of the pavement network and to predict its future conditions, on the base of the curves of decay.

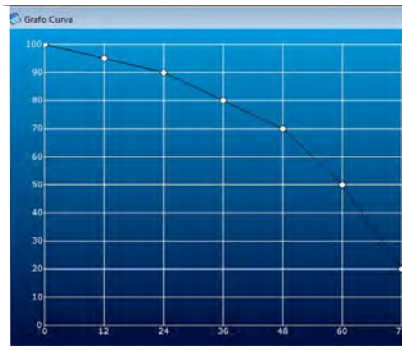
Detailed reports and summaries help the road engineers to analyze the pavement conditions and to plan the most effective maintenance and rehabilitation activities, according to the distress typology and severity.

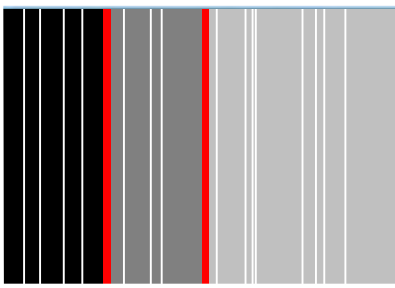
Road-SIT PMS allows to predict the evolution of the pavement conditions on the base of the decay curves and of the maintenance activities.

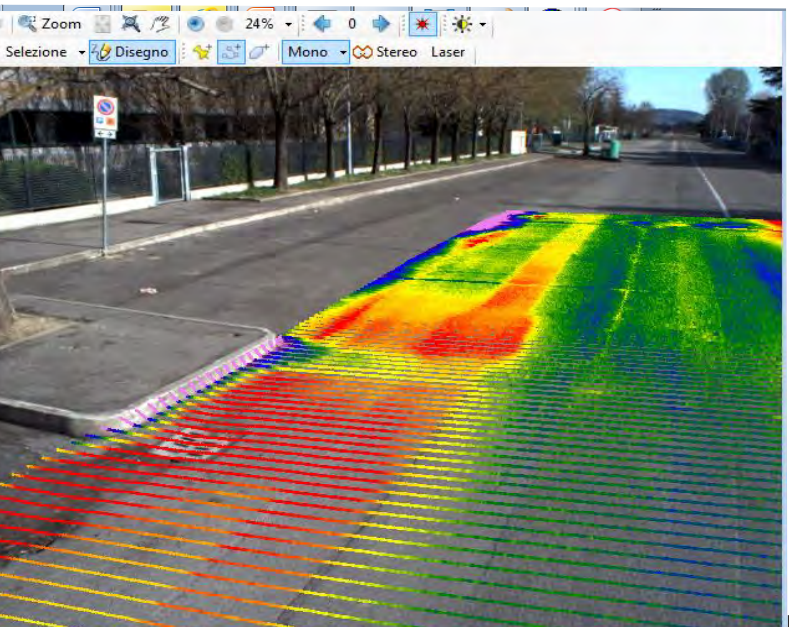
The powerful Decision Support System allows the optimization of the investments, and cost effectiveness of the maintenance plan during the time.

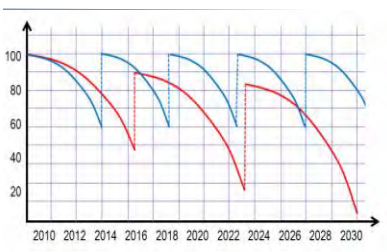
ROADSIT PMS









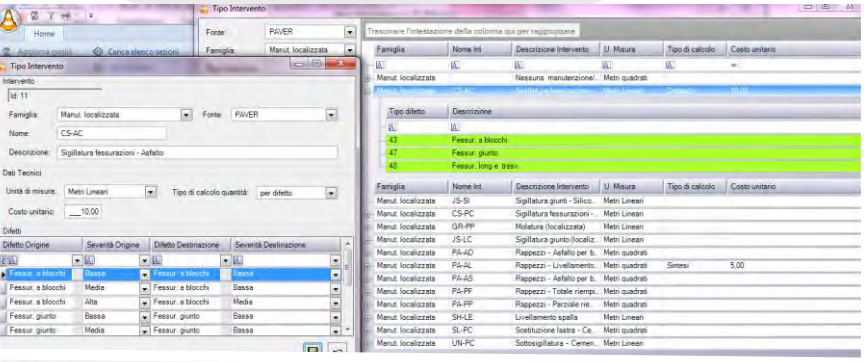


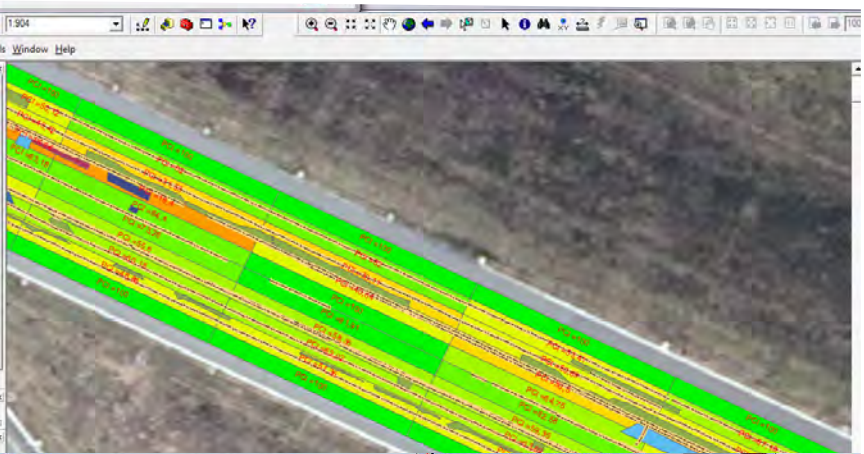
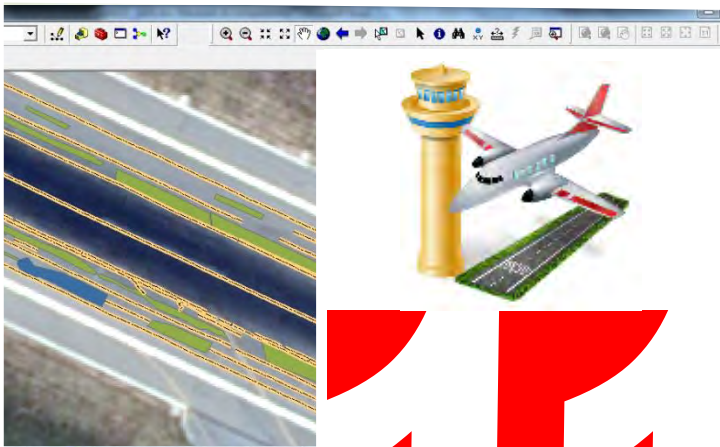
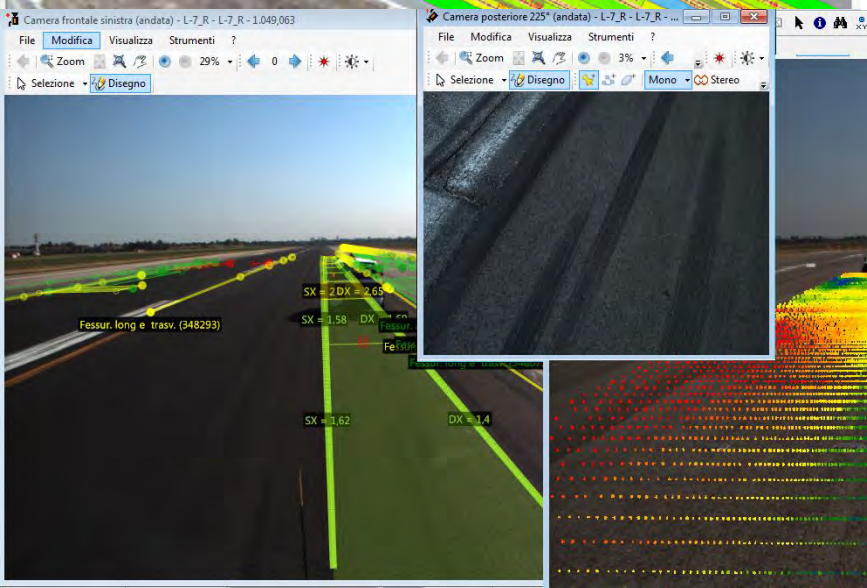
08. ROAD-SITPMSforAIRPORTS

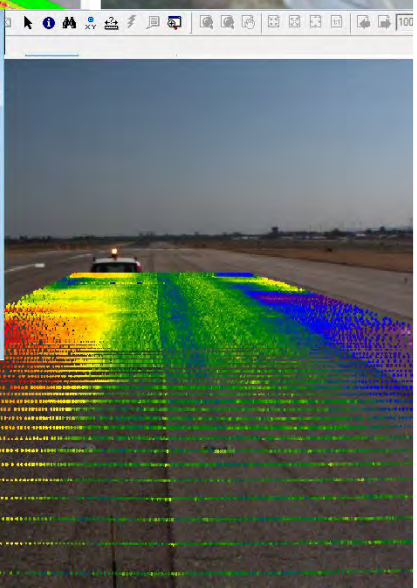
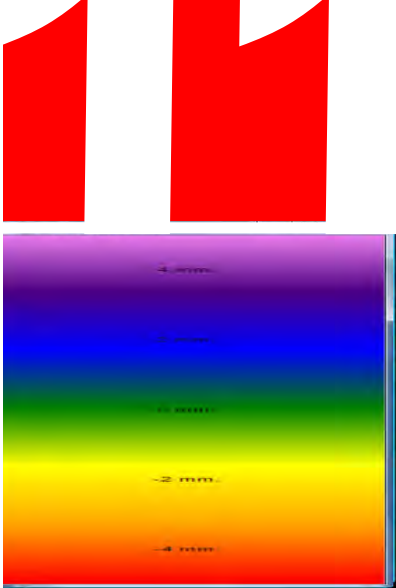
Road-SIT Airport PMS is a special application conceived to manage the airport pavement conditions and all the maintenance and monitoring activities. It has the same architecture of Road-SIT PMS, based on ESRI ArcGIS mapping system, to allow an effective and immediate vision of the pavement conditions, and to assist the engineers to plan the maintenance activities with a powerful Decision Support System.

The Geographical data-warehouse includes all the data obtained by using Road-Scanner (imagery, laser-scanner, distresses, PCI, IRI), together with other test campaigns (FWD, friction, FOD, etc.).
The maintenance features allow the planning of different maintenance programs, and their subsequent simulation of the pavement conditions.
The paved surface is divided into homogeneous sections, having similar traffic and structural features, associated to different decay curves.
The users can add their own catalog of maintenance intervention types, relating prices and expected effects on distresses and indices..

ROADSIT AirportPMS



ROADSCANNERZ

Road-ScannerZ comes from the consolidated technical competence of SITECO in the field of mapping, asset and facility management applied to the road networks.

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References

Public Amministrations

Italian Ministry of Transportation

Regions:
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Cervia
Cesano Maderno
Bitonto
Rivalta
Carate Brianza
Grosseto
Livorno
Sestri Levante
San Remo
Casarza Ligure
Pergine Valsugana
Schio
Quiliano
Savona
Genova
Castiglione Chiavarese
Casalecchio di Reno
San Lazzaro di Savena
Arzachena
Arese

Highways

Autostrade per l'Italia SpA
Autostrade Centro Padane
Autostrada del Brennero
Autostrada Padova-Brescia
Autostrada Milano-Serravalle
Autocamionale della Cisa
Autostrade Siciliane
Autostrada Torino-Savona

Other Companies

ANAS SpA
Spea Spa
ITALFERR SpA
Terna SpA
Sea Aeroporto di Malpensa SpA
Ferrovie Nord SpA
Consorzio Venezia Nuova SpA
SAB SpA Aeroporto di Bologna
ADR Engineering SpA Aeroporti di Roma

Foreign market

Paraguayan Ministry of Transportation
Mairie de Paris EDF (Eléctricité de France)
Ministère de l'Equipement DRE Bordeaux
LaCUB Communauté Urbaine de Bordeaux
USTRA Federal Bureau of Swiss Roads

Géosat Société de Géomètres-Experts (France)
Prime Consulting & Technologies K/S (Latvia)
Nolte de Mexico S.A. de C.V. (Mexico)
Sarl S.T.T.P. (France)
Municipality of Merida (Mexico)