Road Pavements & Bridge deck Health monitoring / early warning using advanced inspection Technologies

Grant Agreement 606645: 06/2014 - 05/2016

The European Road Network is undoubtedly one of the most important land infrastructures in the EU. Since the maintenance is considered to be highly expensive function of a highway operating agency there is a special need for early detection of deterioration mechanisms and of potential presence of defects through advances in pavement and bridge deck inspection technology.

The major aim of the RPB HealTec project is to upgrade and optimize the current survey procedures for the assessment of the pavement structural condition. This should assist decision making related to increasing the life expectancy of road infrastructure and help reduce the cost of future construction and maintenance to the European road network.

The RPB HealTec system is an automated and integrated NDT (Non-Destructive Testing) solution for traffic speed assessment of road pavement/bridge deck structural condition. Integration of Ground Penetrating Radar (GPR), Infrared Thermography (IRT) and Air-Coupled Ultrasound (ACU) NDT techniques provides multidimensional information on the pavement condition with high level coverage for detection of surface and subsurface defects, structural and material changes and deterioration regions.

The system is operates at 40-60 km/h speed thus eliminating substantial disruptions to traffic.

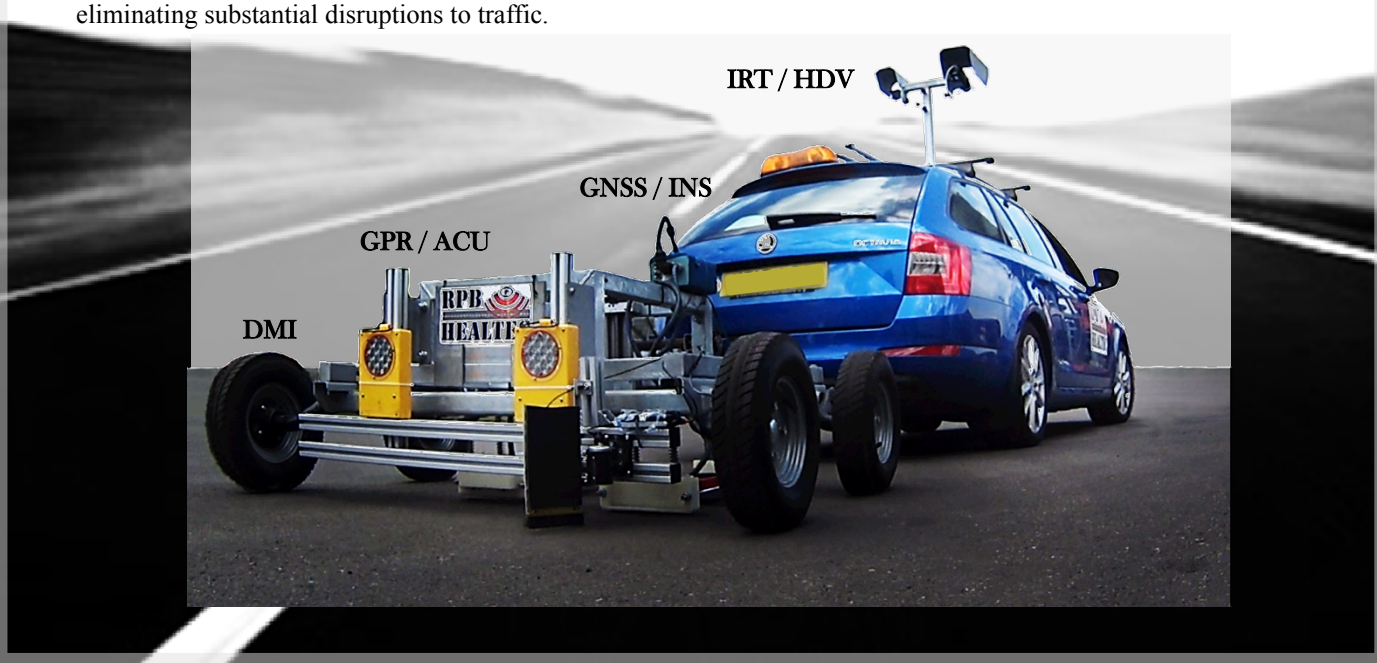
Based on the analysis of thermal segregation patterns, the high-resolution IRT FLIR camera is employed for inspection of the structural condition of the top asphalt layers. This includes detection of surface defects, deviations in the material properties and shallow subsurface delaminations.

The GPR system provides information on the pavement structure profile with an array of low and high frequency GSSI GPR antennas ensuring coverage of all subsurface layers. The GPR module is optimised for detection of subsurface defects such as delaminations between the layers, voids, material deterioration regions and deep cracks as well as changes in the pavement structure.

Furthermore, the use of ACU system with low frequency DR. HILLGER transducers are applied for sensitive profiling of the surface layer condition and identification of the variations in the asphalt density.

The GNSS/INS navigation systems and HDV are employed for high accuracy spatial mapping and referencing of the detected defect locations.

The NDT modules are mounted on the specially designed trolley and camera holders that can be straightforwardly installed on a survey vehicle along with the other hardware components.



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GDT

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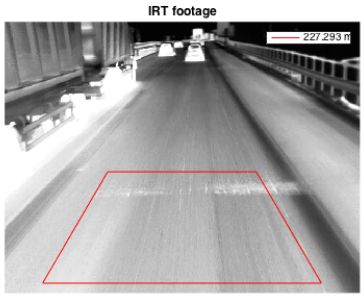

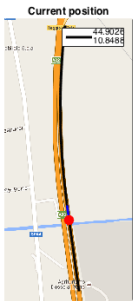

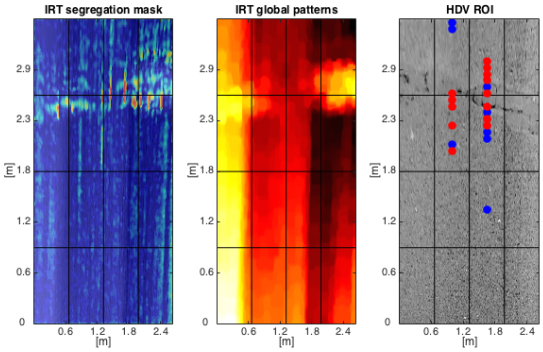

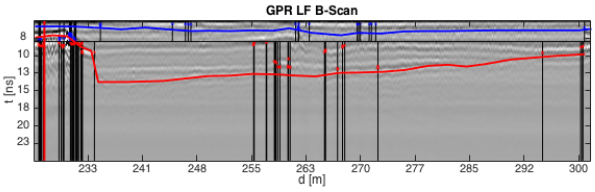

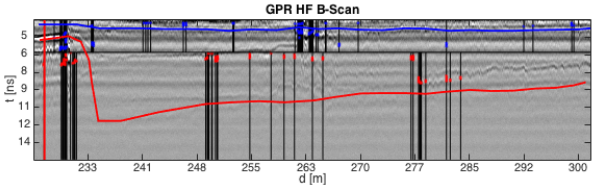

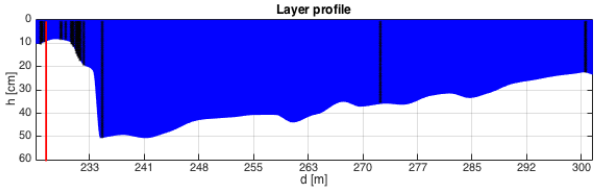

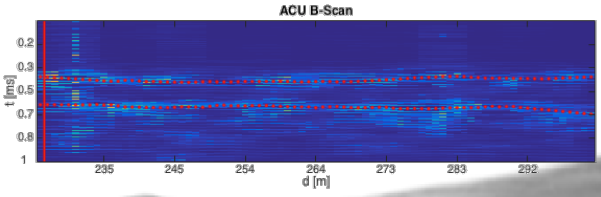

On the software integration level, synchronization of the sensor data is based on the timestamp recording and distance trigger pulses from a DMI. The data acquisition (DAQ) software is designed to provide functionality for synchronised collection and storage of spatially referenced sensor data as well as the system performance control.

At the final stage, the acquired survey data are exported into the RPB HealTec post-processing software for the analysis. The corresponding methodology involves automated processing of the individual sensor datastreams for detection of critical trend deviations in the pavement subsurface features together with the extraction of layer thickness profile from the low and high frequency GPR scans. Spatial registration of multidimensional sensor data is based to the timestamp, GNSS reference point and the sensor positioning offset information. The sensor fusion is performed on the decision level with respect to the presence of detected surface and subsurface defects mapped on the 2D reformatted road lane surface.

The report for an inspected road section includes the processed sensor data and the "defect mask" sensor fusion output along with extracted global IRT segregation patterns and pavement structure profile. This decision-support information can be further used for the evaluation of the defect severity and extent and general assessment of the road quality condition.

NDT sensor components:

- GSSI GPR SIR-30 system with an array of 0.9 and 1.6 GHz antennas
- FLIR A655sc IRT camera
- DR.HILLGER AirTech ACU system with 75 kHz transducers
- Logitech HDV camera
- ADVANCED NAVIGATION INS/GNSS system

System integration components:

- GPR/ACU trolley and IRT/HDV holders
- hardware integration equipment and DMI
- DDR3 32GB RAM workstation
- RPB HealTec DAQ software
- RPB HealTec post-processing software

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