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ISTIMES project: status and outcomes

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ISTIMES is a project approved in the Seventh Framework Programme of the European Union under the Joint Call FP7-ICT-SEC-2007-1. It has a three years duration and will be completed within June 2012.
According to the aims of the proposal, ISTIMES project has designed, assessed and developed a prototypical modular and scalable ICT-based system, exploiting distributed and local sensors, for non-destructive electromagnetic monitoring; the specific application field was the reliability and safety of critical transport infrastructures, even if the modularity of the ISTIMES approach has permitted to extend it successfully to other critical infrastructures as dams. The continuous and fruitful involvement of end users (as Italian Civil Protection) allowed to develop applications focused on users needs.

ISTIMES couples current monitoring of infrastructures with a high situational awareness during crises management, providing updated and detailed real and near real time information about the infrastructure status to improve decision support for emergency and disasters stakeholders.
The system exploits an open network architecture that can accommodate a wide range of heterogeneous sensors, static and mobile, and can be easily scaled up to allow the integration of additional sensors and interfaces with other networks. It relies on state-of-the-art electromagnetic sensors, enabling a networking of terrestrial sensors, supported by specific satellite and airborne measurements. The integration of electromagnetic technologies with new ICT information and telecommunications systems enables remotely controlled monitoring and surveillance at different temporal and spatial scales, providing indexes and images of the critical transport infrastructures.

The project has exploited, assessed and improved many different non-invasive technologies based on electromagnetic sensing as: Optic Fiber Sensors, Synthetic Aperture; Radar (SAR) satellite platform; Hyperspectral Spectroscopy; Infrared Thermography; Ground Penetrating Radar; low-frequency Geophysical Techniques; ground based SAR and optical cameras for the assessment of the dynamical behaviour of the infrastructure. A great effort has been devoted to "transfer" these novel and state-of art technologies from the laboratory experience to actual on field applications by adapting/improving them and developing prototypes for the specific application domain of the monitoring of transport and critical infrastructures.
Sensor synergy, data cross correlation and novel concepts of information fusion have permitted to carry out a multi-method, multi-resolution and multi-scale electromagnetic detection and monitoring of the infrastructure, including surface and subsurface aspects.
The project has allowed to develop an ICT architecture based on web sensors and serviceoriented- technologies that comply with specific end-user requirements, including interoperability, economical convenience, exportability, efficiency and reliability. The efforts have focussed mainly to the creation of web based interfaces able to control "not standard" sensors, as the ones proposed in the project, and to the standardization necessary to have a full interoperability and modularity of the monitoring system. In addition, the system is able to provide a more easily accessible and transparent scheme for use by different end-users and to integrate the monitoring results and images with other kind of information such as GIS layer and historical datasets relating to the site.
The ISTIMES system has been evaluated at two test sites and two test beds.
At the two test sites of Montagnole rock-fall station (Chambery, France) and Hydrogeosite Laboratory (Potenza, Italy), the attention was posed to a thorough analysis of the performances of the in situ sensing techniques, by investigating, with good outcomes, also the possibility to correlate and have a synergy from the different sensors. In particular, it is worth noting that the experiment realized at Montagnole is unique, at least at European level, regarding both the high mechanical impact on a real scale elements of civil engineering structure, and also for the exploitation of all sensor techniques set up in a cooperative way.
The effectiveness of the overall monitoring system has been assessed by the experiments at real test beds as

Sihlhochstrasse bridge, a 1.5 km bridge representing one of the main entrance road to Zurich city (Switzerland), Varco Izzo railway tunnel and Musmeci motorway bridge located in the area of Potenza city in Basilicata region (Italy) affected by a high seismic risk. In particular, for the Musmeci bridge, the main entrance road to Potenza city and a masterpiece of architectural/civil engineering realized by Sergio Musmeci in 60' years, all the sensing technologies involved in the project have been exploited to perform a monitoring/diagnostics; the Musmeci bridge results have been correlated and tested also by the comparison with the sensors mostly used by civil engineers for this kind of infrastructures (Proto et al., 2010).

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