EXTRA-TN: A novel approach for an extended resilience analysis of transport networks

Fabrizio D’Amico, Chiara Ferrante, Luca Bianchini Ciampoli, Alessandro Calvi, and Andrea Benedetto
Roma Tre, Department of Engineering, Rome, Italy (fabrizio.damico@uniroma3.it)

Recent and dramatic events occurred on the Italian transport networks have pointed out the urgent need for assessing the actual state of health along the national transport assets. Analogous considerations can be addressed towards the high exposition and vulnerability of the transport system to major natural events, such as floods or earthquake.

Recently, the administrations and managing companies have increasingly made use of non-destructive techniques for achieving a denser knowledge about the health of the asset.

However, one of the major limitations concerning these methods is that each technology, according to its specific features, is usually suitable for a single specific application and has very limited effectiveness for other tasks. Accordingly, the integration of datasets collected with different NDTs stands as a viable approach to fill technology-specific gaps, thereby ensuring a more comprehensive assessment of the infrastructure [1-3]. Data fusion logic can also potentially allow for further data interpretation from merging different information [4].

The EXTRATN project aims at overcoming the state-of-the-art research in the field of non-destructive monitoring of linear infrastructures and, through a “data fusion” logic, at achieving a comprehensive rate of knowledge about the actual condition of the asset. The addressed concept is a “fully sensed infrastructure”, being sensed by different technologies and with different scopes. Specifically, interferometric synthetic aperture radar (DInSAR), Laser Imaging Detection and Ranging (LiDAR), Ground-penetrating Radar (GPR) and Falling Weight Deflectometer (FWD) are considered to the purpose.

A system of transport infrastructure being located in the Province of Salerno (IT), within an area subjected to hydrogeological risk, has been selected as a study case for the integrated approach. This system includes a motorway, a rural highway and a railway.

As a major advantage with respect to the state-of-the-art, such a methodology allows for analysing the evolution trend of the on-going distresses, meaning a significant upgrade of the monitoring activities that may provide valuable information for a priority-based scheduling of the maintenance.

Moreover, such an approach enables to simultaneously monitor exogenous and endogenous
events that may lead to a decrease of the safety, functionality or strength conditions.

The research is supported by the Italian Ministry of Education, University and Research under the National Project “Extended resilience analysis of transport networks (EXTRA TN): Towards a simultaneously space, aerial and ground sensed infrastructure for risks prevention”, PRIN 2017, Prot. 20179BP4SM.