MONITORING OF LINEAR INFRASTRUCTURES WITH SATELLITE SAR INTERFEROMETRY

Federico Raspini[1], Stefano Morelli[2], Veronica Pazzi[3], Andrea Ciampalini[4], Nicola Casagli[5]

[1] University of Firenze, Department of Earth Science, Via La Pira 4, 50121 Italy, e-mail: federico.raspini@unifi.it
[2] University of Firenze, Department of Earth Science, Via La Pira 4, 50121 Italy, e-mail: stefano.morelli.geo@gmail.com
[3] University of Firenze, Department of Earth Science, Via La Pira 4, 50121 Italy, e-mail: veronica.pazzi@unifi.it
[4] University of Firenze, Department of Earth Science, Via La Pira 4, 50121 Italy, e-mail: andrea.ciampalini@unifi.it
[5] University of Firenze, Department of Earth Science, Via La Pira 4, 50121 Italy, e-mail: nicola.casagli@gmail.com

Abstract

Several methods are used for measuring, mapping and monitoring spatial extent and temporal evolution of regional and local deformation affecting man-made linear infrastructures. The conventional way of measuring deformation is using geodetic surveying techniques such as levelling or GPS (Global Positioning System). These techniques rely on materialization of a network of geodetic benchmarks and, despite their robustness and reliabilty, are time consuming and resources intensive, since a great deal of time and economic resources are required for timely updates.
In addition to traditional geodetic monitoring systems, Earth Observation (EO) techniques have successfully demonstrated in the last decades to be highly valuable in measuring ground motion in a wide range of application fields. Among the remote sensing techniques, multi-images InSAR (Interferometric Synthetic Aperture Radar), a method based on the phase analysis of several (at least 15, or more), co-registered, multi-temporal space-borne SAR images of the same target area, is ideally suited to measure the spatial extent and magnitude of surface deformation threatening linear infrastructures, thanks to its wide spatial coverage and its millimeter accuracy. Thanks to the exploitation of archive of satellite radar images, InSAR could provide retrospective surface movement information and time series of displacement dating back to 1992 for specific targets. Moreover, thanks to the systematic images acquisition, satellite InSAR provides regular and accurate updates of surface movement on a continuous basis. To highlight the suitability of SAR-based methods for deformation mapping and monitoring purposes, three case studies, showing deformation affecting linear infastuctures, are presented: i) the Fiumicino airport and the A91 highway connecting Rome to Fiumicino in the deltaic area of Tiber River (Rome, Italy); ii) the historical Roman acqueduct, in the southern peri-urban quarters of the city of Rome (Italy) and iii) a bridge along the A20 highway between Palermo and Catania in Sicily (Italy).
Presented results highlight that InSAR techniques can be recommended for the deformation mapping and monitoring of the man-made linear structures like airports, highways, bridges and cultural heritages.

Keywords: *linear infrastructures, deformation monitoring, SAR interferometry*