Geophysical Research Abstracts
Vol. 14, EGU2012-13048, 2012
EGU General Assembly 2012

Deformation analysis through the SBAS-DInSAR technique and geotechnical methods for structural damage assessment

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Monitoring of displacements affecting single buildings or human-made infrastructures is of key importance for their diagnostic and damage assessment. The evaluation of the structural damage in urban areas is a critical problem related to the complexity of soil-structure interaction. Indeed, the structural damage is influenced by several factors, such as the uniformity of the settlements, the variability on the soil property, the type of foundations, the rigidity and type of the considered structure, as well as the rate at which the settlements occur. Concerning this latter issue, settlements occurring very slowly over periods of decades or more may be tolerable by masonry or reinforced concrete structures; on the other hand, the same settlements related to a few months or a few years would result in severe structural damage.

In this context, remote sensing techniques allow non-invasive and non-destructive deformation analyses over large areas by properly exploiting a large number of space-borne radar data. Within this framework, Differential SAR Interferometry (DInSAR) has emerged as a valuable microwave methodology to detect and monitor ground displacements, with centimeter to millimeter accuracy, by exploiting the phase difference (interferogram) between two SAR images relevant to the same area.

Recent developments of advanced DInSAR techniques are aimed at investigating not only single event deformation phenomena, but also the temporal evolution of the detected displacements through the generation of deformation time-series. These approaches benefit of the availability of huge archives of SAR data, including the ones acquired over the last 20 years by the Synthetic Aperture Radar (SAR) sensors on-board the ERS-1/2 and ENVISAT satellites of the European Space Agency (ESA).

Among these advanced DInSAR approaches, we focus on the Small BAseline Subset (SBAS) algorithm (Berardino et al., 2002) that implements an easy combination of DInSAR data pairs characterized by a small separation between the acquisition orbits (baseline) in order to mitigate the noise effects, thus maximizing the coherent pixel density in the investigated area. The SBAS approach allows us to work at the full spatial resolution scale of the SAR acquisitions (Lanari et al., 2004), thus detecting and analyzing localized deformation affecting single structures or portions of them (intra-building movements). More recently, the full resolution SBAS approach has been extended in order to deal with multi-sensor SAR data collected by different radar systems acquiring with the same illumination geometry as for the case of ERS-1/2 and ENVISAT satellites (Bonano et al., 2012), thus effectively exploiting the huge ESA SAR data archive for generating very long-term deformation time-series spanning almost 20 years.

In this work, we apply the multi-sensor full-resolution SBAS-DInSAR technique for investigating the deformation phenomena occurring within the urban area of Roma (Italy), where almost 20 years of ERS-1/2 and ENVISAT SAR data are available. The achieved results are effectively exploited for analyzing the correlation between the ground deformation and the structural damage detected on some buildings located within the urban area of the city of Roma. To this aim, we benefit of the well-known geotechnical approaches, usually aimed at preventing buildings and infrastructures from settlements-induced damages, for better understanding and interpreting the temporal behavior of the detected displacements.

References

Berardino, P., G. Fornaro, R. Lanari, and E. Sansosti, “A new Algorithm for Surface Deformation Monitoring based on Small Baseline Differential SAR Interferograms”, IEEE Trans.Geosci. Remote Sens., Vol. 40, No 11, pp. 2375-2383, 2002.

Lanari, R., Mora, O., Manunta, M., Mallorqui′, J.J., Berardino, P. and Sansosti, E., “A small baseline approach for investigating deformations on full resolution differential SAR interferograms”, IEEE Transactions on

Geoscience and Remote Sensing, Vol. 42, pp. 1377-1386, 2004.

Bonano, M., Manunta, M., Marsella, M. & Lanari, R. “Long Term ERS/ENVISAT Deformation Time-Series Generation at Full Spatial Resolution via the Extended SBAS Technique”. In press on International Journal of Remote Sensing, 2012