



PSP SAR interferometry monitoring of ground and structure deformations applied to archaeological sites

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Archaeological sites and cultural heritage are considered as critical assets for the society, representing not only the history of region or a culture, but also contributing to create a common identity of people living in a certain region. In this view, it is becoming more and more urgent to preserve them from climate changes effect and in general from their degradation. These structures are usually just as precious as fragile: remote sensing technology can be useful to monitor these treasures. In this work, we will focus on ground deformation measurements obtained by satellite SAR interferometry and on the methodology adopted and implemented in order to use the results operatively for conservation policies in a Italian archaeological site.

The analysis is based on the processing of COSMO-SkyMed Himage data by the e-GEOS proprietary Persistent Scatterer Pair (PSP) SAR interferometry technology. The PSP technique is a proven SAR interferometry technology characterized by the fact of exploiting in the processing only the relative properties between close points (pairs) in order to overcome atmospheric artefacts (which are one of the main problems of SAR interferometry). Validations analyses [Costantini et al. 2015] settled that this technique applied to COSMO-SkyMed Himage data is able to retrieve very dense (except of course on vegetated or cultivated areas) millimetric deformation measurements with sub-metric localization.

Considering the limitations of all the interferometric techniques, in particular the fact that the measurement are along the line of sight (LOS) and the geometric distortions, in order to obtain the maximum information from interferometric analysis, both ascending and descending geometry have been used. The ascending analysis allows selecting measurements points over the top and, approximately, South-West part of the structures, while the descending one over the top and the South-East part of the structures.

The interferometric techniques needs to use a stack of SAR images to separate the deformation phase contributions from other spurious components (atmospheric, orbital, etc.). Historical/reference analyses of the period 2011-2014 have been performed to obtain such deformations and to have a start point for the next updates. In fact, starting from the reference analyses the deformation monitoring has then continued with monthly updates of the PSP analysis with new COSMO-SkyMed acquisitions both in ascending and descending geometry. In addition to this traditional monitoring service, the satellite interferometry analysis has been realized over specific time frame that have been selected on the bases of some important events (damages to structures, collapses, works etc.) and the analysis have been correlated with additional site information as weather conditions, critical meteorological events, historical information of the site, etc. The objective is to find a nominal behaviour of the site in response to critical events and/or related to natural degradation of infrastructures in order to prevent damages and guide maintenance activities. The first results of this cross correlated analysis showed that some deformation phenomena are identifiable by SAR satellite interferometric analysis and it has also been possible to validate them on field through a direct survey.