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SpaCeborne SAR Interferometry as a Noninvasive tool to assess the vulnerability over Cultural hEritage sites (SCIENCE)

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Cultural heritage is a key element of history as the ancient monuments and archaeological sites enrich today's societies and help connect us to our cultural origins. The project entitled ''SpaCeborne SAR Interferometry as a Nonivasive tool to assess the vulnerability over Cultural hEritage sites (SCIENCE)'' has as ultimate objective to predict the vulnerability of the archaeological sites to ground deformation in time and space and protect them against natural/man-made damage. The SCIENCE project aims to develop, demonstrate, and validate, in terms of geotechnical local conditions and monuments' structural health, SAR interferometric techniques to monitor potential ground deformation affecting the archaeological sites and monuments of great importance.

During the last few years, spaceborne Synthetic Aperture Radar (SAR) interferometry has proven to be a powerful remote sensing tool for detecting and measuring ground deformation and studying the deformation's impact on man-made structures. It provides centimeter to millimeter resolution and even single buildings/monuments can be mapped from space. Considering the limitations of conventional MT-InSAR techniques, such as Persistent Scatterers Interferometry

(PSI), in this project a two-step Tomography-based Persistent Scatterers (PS) Interferometry (Tomo-PSInSAR) approach is proposed for monitoring ground deformation and structural instabilities over the Ancient City Walls (Ming Dynasty) in Nanjing city, China and in the Great Wall in Zhangjiakou, China. The Tomo-PSInSAR is capable of separating overlaid PS in the same location, minimizing the unfavorable layover effects of slant-range imaging in SAR data. Moreover, the demonstrations are performed on well-known test sites in China and in Greece, such as: a) Ming Dynasty City Walls in Nanjing, b) Great Wall in Zhangjiakou, c) Acropolis complex of Athens and d) Heraklion walls (Crete Island), respectively.

In particular, in the framework of SCIENCE project are processed several radar datasets such as Sentinel 1 A & B data of Copernicus program and the high resolution TerraSAR-X data. The products of Persistent Scatterers Interferometry (PSI) are exported in various formats for the identification of the persistent scatterers using high resolution optical images, aerial photographs and fusing with high accuracy Digital Surface Models (DSM). In addition, the validation of the results is taking place through in-situ measurements (geological, geothechnical e.t.c) and data for the cultural heritage sites conditions.

SCIENCE project's final goal is the risk assessment analysis of the cultural heritage monuments and their surrounding areas aiming to benefit institutions, organizations, stakeholders and private agencies in the cultural heritage domain through the creation of a validated pre-operation non-invasive system and service based on earth observation data supporting end-user needs by the provision knowledge about cultural heritage protection. In conclusion, SCIENCE project is composed by a bilateral consortium of the Greek delegation of Harokopio University of Athens, National Technical University of Athens, Terra Spatium S.A, Ephorate of Antiquities of Heraklion (Crete), Acropolis Restoration Service (Athens) of Ministry of Culture and Sports and by the Chinese delegation of Science Academy of China (Institute of Remote Sensing and Digital Earth) and International Centre on Space Technologies for Natural and Cultural Heritage (HIST) under the auspices of UNESCO (HIST-UNESCO).