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InSAR techniques as a tool for assessing the vulnerability of cultural heritage sites - The SCIENCE Project

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SCIENCE is a large bilateral project between Greece and China **introducing advanced engineering research to the service of monument protection**. In particular, SCIENCE develops a new approach to estimate the vulnerability of cultural heritage monuments through the innovative technique of multitemporal Synthetic Aperture Radar Interferometry (MT-InSAR), which detects the ground deformation in time and space. In the framework of this project are used: a) open access **ERS-1 & 2 and Envisat SAR datasets, Copernicus SAR datasets (Sentinel-1)** and **third part mission high resolution SAR datasets (TerraSAR-X and Cosmo-SkyMed)** and b) the commercial optical datasets of **Pleiades 1A and Pleiades 1B** (with spatial resolution up to 0.5m).

The **four case studies under investigation** are: a) the Acropolis of Athens and b) the Heraklion City Walls in Crete (Greece) and c) the Ming Dynasty City Walls in Nanjing and d) Great Wall in Hebei and Beijing (China). **Spaceborne SAR interferometry** has proven to be a powerful remote sensing tool for detecting and measuring ground deformation (including major seismic events and induced seismicity) and studying the deformation's impact on man-made structure with a millimetric accuracy. Considering **the limitations of conventional MT-InSAR techniques**, such as **Persistent Scatterers Interferometry (PSI)**, a **two-step Tomography-based Persistent Scatterers (PS) Interferometry (Tomo-PSInSAR) approach** is proposed for monitoring ground deformation and structural instabilities. The high-resolution optical data is used for the identification of the persistent scatterers. Furthermore, the **validation of the results** is taking place through **in-situ measurements** (geological, geotechnical e.t.c) and **data for the cultural heritage sites' structural health**. In conclusion, SCIENCE project aims to **introduce a risk assessment analysis of the cultural heritage monuments and their surrounding areas 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.**