A landscape-ontology scale MTInSAR deformation monitoring solution for the sustainable conservation of architectural heritage sites

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Architectural heritage is cultural and spiritual symbol of our predecessors with immeasurable historical, artistic, and technological value. However, these heritages are exposed to long-term degradation due to the combination impacts from the natural erosion and anthropogenic activities. Consequently, it is important to establish an effective deformation monitoring system to support the sustainable conservation of those properties. In order to make complementary to conventional geodetic measurements such as global navigation satellite systems (GNSS) and leveling in terms of spatial density, we propose a landscape-ontology scale multi-temporal InSAR (MTInSAR) solution for the preventive deformation monitoring of large-scale architectural heritage sites through the adaption of current MTInSAR approaches. We apply different solutions in Shanhaiqian section of the Great Wall in China and the Angkor Wat in Cambodia based on their onsite characteristics. At the cultural landscape scale, we improve the small baseline subset (SBAS) approach by the induced pseudo-baseline strategy in order to avoid the errors caused by inaccurate external DEM, resulting in a robust deformation estimation in mountainous areas where the architecture heritage of the Great Wall located; at the ontology scale, we integrate the differential SAR tomography (DTomoSAR) with the finite element method (FEM) for the structural instability detection of the Angkor Wat Temple, pinpointing the structural defects from the 3D deformation measurements and simulation. This study demonstrates the capability of adaptive MTInSAR approaches for the preventive monitoring the deformation of large-scale architectural heritage sites.

**Keywords:** Architectural heritage; two-scale; deformation; MTInSAR