Advanced SAR and InSAR techniques for monitoring surface deformations caused by seismic activities using TerraSAR-X and TanDEM-X SAR images

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The space-borne Synthetic Aperture Radar (SAR) Interferometric (InSAR) technique provides a powerful tool for surveying the surface changes covering areas from several to a hundred kilometers in size at a theoretical accuracy in the millimeter-range. It is widely applied for detecting deformations caused by geophysical and tectonic activities, such as earthquakes, volcanic activities, etc. Nevertheless the accuracy and availability of deformation measurements using InSAR techniques is limited due to decorrelation effects, atmospheric disturbances, the SAR side-looking geometry (which causes layover and shadowing). In order to overcome the limitations, advanced techniques have been developed based on high-resolution SAR acquisitions. In this paper, we will present our recent researches and achievements on advanced SAR and InSAR techniques using both high-resolution and wide-swath SAR images generated from recent satellite missions: TerraSAR-X and TanDEM-X.

In order to achieve millimeter accuracy, the effect of the atmospheric delay cannot be neglected in rural areas due to the presence of terrain topography. A new method has been developed to integrate the atmospheric delay along the radar propagation path by using global weather model data from numerical weather prediction (NWP). Active volcanic areas, such as el Hierro Island (high seismic activities), Stromboli Volcano, active volcanoes in Iceland, etc., as well as earthquakes have been selected to demonstrate developed advanced techniques.

Another highlight of this paper is including an experimental TanDEM-X Raw DEM with a posting of 12 meters in order to compensate the topographic phase in El Hierro test site. A significant improvement in single differential interferograms has been observed when compared to SRTM-DEM based topography removal.