Advanced differential interferometry synthetic aperture radar techniques for deformation monitoring: a review on sensors and recent research development

ABSTRACT

This paper reviews the advanced differential interferometry synthetic aperture radar (A-DInSAR) techniques, with two major components in focus. First is the basic concepts, synthetic aperture radar (SAR) data sources and the different algorithms documented in the literature, primarily focusing on persistent scatterers. In the second part, the techniques are compared in order to establish more linkage in terms of the variability of their applications, strength and validation of the interpreted results. Also, current issues in sensor and algorithm development are discussed. The study identified six existing A-DInSAR algorithms used for monitoring various deformation types. Generally, reports of their performance indicate that all the techniques are capable of measuring deformation phenomena at varying spatial resolution with high level of accuracy. However, their usability in suburban and vegetated areas yields poor results, compared to urbanized areas, due to inadequate permanent features that could provide sufficient coherent point targets. Meanwhile, there is continuous development in sensors and algorithms to expand the applicability domain of the technology for a wide range of deformable surfaces and displacement patterns with higher precision. On the sensor side, most of the latest SAR sensors employ longer wavelength (X and P bands) to increase the penetrating power of the signal and two other sensors (ALOS-2 PALSA-2 and SENTINEL-1) are scheduled to be launched in 2013. Researchers are investigating the possibility of using single-pass sensors with different look angles for SAR data collection. With these, it is expected that more data will be available for various applications. Algorithms such as corner reflector interferometry SAR, along track interferometry, liqui-InSAR, and squeeSAR are emerging to increase reliable estimation of deformation from different surfaces.