SAR Interferometry Applications: the outlook for sub millimeter measurements

F. Rocca (Politecnico di Milano)

Optical leveling campaigns, tiltmeters, GPS and InSAR are geodetic techniques used to detect and monitor surface deformation phenomena. In particular, InSAR data from satellite radar sensors are gaining increasing attention for their cost-effectiveness and unique technical features, making it possible the monitoring of large areas, even revisiting the past. Moreover, more advanced InSAR techniques (PSInSAR^{TM}, SqueeSAR^{TM}) developed in the last decade are capable of providing millimeter precision, comparable to optical leveling, and a high spatial density of displacement measurements, over long periods of time without need of installing equipment or otherwise accessing the study area.

Thanks to the high density and quality of the measurements the PSInSAR data can be successfully used in geophysical inversion, to measure the permeability of oil reservoirs and/or to evaluate the possibilities and risks due to seismic faulting in the sequestration of CO2. In these cases, the precision, the sub weekly frequency of the measurements and the time required for the data to be available are the most important aspects, more relevant than the spatial resolution.

Until recently, the main limitation to the application of InSAR was the relatively long revisiting time (24 or 35 days) and the quite long waiting period for the delivery of the acquired data. The new Sentinel-1 mission, based on a constellation of two satellites, is expected to reduce such limitations guaranteeing a revisit cycle of 6 days on a global scale and in particular over Europe and Canada and providing a high level of service reliability with near-real-time delivery of data within 24 hours, important for risk management applications. The new X band satellite SAR constellations like Cosmo Skymed and TerraSAR X have also a short revisiting time, from 4 to 11 days. However, their coverage is limited to well definite areas, and an expensive decision has to be made if to initiate the observations on any target. Sentinel 1, instead, yields global and costless observations and thus, after the end of the commissioning phase, will always produce present **and past** ground motion for any target.

It's important to underline that the millimeter accuracy, applying the InSAR analysis with Sentinel-1, will be achieved within a shorter observation time frame, thanks to the increased number of acquired images per year. Results from ground based radar show that this improved precision is indeed achievable from C to Ku band, provided that an accurate model of the delay due to atmospheric water vapor is available or that precise reference points are close by.