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Satellite interferometry for monitoring ground instability in the urban environment

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Satellite differential synthetic aperture radar interferometry (DInSAR) is an attractive technique for detecting and monitoring ground surface deformations arising from regional scale processes (eg seismic/volcanic). The technique, however, is not effective for site-specific evaluations, because of coarse resolution and coherence loss limitations. Permanent Scatteres interferometry (PSInSAR), developed at Politecnico di Milano and improved at T.R.E.s.r.l. company, overcomes the limitations of DInSAR and extends the applicability of radar interferometry to local-scale investigations of slope instability and soil settlement/ground subsidence. The PSInSAR analysis allows the identification of numerous radar targets (the PS) where very precise displacement information can be obtained. Considering the regular re-visit time and wide-area coverage of satellite radar sensors, and that PS usually correspond to buildings and other man-made structures, this technique is particularly suitable for applications in urban environments, which often represent a harsh setting for GPS or conventional topographic surveying.

To demonstrate the effectivness of PSInSAR in monitoring urban ground deformations we present examples of applications from Italy and other countries.

PS data can assist in:

- Identification and delimitation of areas affected by slow deformations.

- Estimation of surface velocity and acceleration fields with millimetric precision.

- Identification of the source of ground instability by analysing in situ and multitemporal remotely sensed data.

The regular monitoring from space of urban areas offers a unique possibility for detecting precursory deformations associated with the initiation of ground instability, a key element for early warning and hazard mitigation in highly populated areas. Satellite data have to be well ground truthed, because they reflect performance of targets, whose actual or apparent displacements may arise from a variety of causes (eg true slope movements, fill settlement, subsurface civil engineering, mining and fluid extraction, engineering structure settlement, deterioration of engineering structures, expansion/shrinkage of soils).