METHOD OF PERSISTENT SCATTERER PAIRS (PSP) AND HIGH RESOLUTION SAR INTERFEROMETRY

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ABSTRACT

Synthetic aperture radar (SAR) interferometry is a powerful technology for measuring slow terrain movements due to landslides, subsidence, and volcanic or seismic phenomena. The extraction of this information is a complex task, because the phase of the signal is measured only modulo 2π and is affected by noise and systematic terms. The persistent scatterer (PS) approach brought important advances in the solution of this problem.

We have recently proposed a new approach, named persistent scatterer pairs (PSP), for the identification of persistent scatterers in series of full resolution SAR images, and the retrieval of the corresponding terrain height and displacement velocity. The PSP technique overcomes problems related to the presence of atmospheric and orbital artefacts in the signal by exploiting their spatial correlation, thus removing the need for model-based interpolations starting from a preliminary set of measurements obtained by radiometric or low resolution analyses. It does not require data calibration or pre-selection of radiometrically stable points, thus being robust to errors in the pre-selection phase and to density of pre-selected points. Moreover, the PSP method is characterized by the exploitation of redundant information, which makes for a very good robustness to noise.

The PSP method has been extensively tested on real SAR data. The obtained results show that the proposed approach is very effective. In particular, it is expected to obtain a higher density of persistent scatterer measurements than previous techniques, at least in the cases where the atmospheric artefacts are not very well described by the models used in standard approaches. Moreover, the method proved to be very robust to noise and disturbances. In this work we analyze the qualifying characteristics of the PSP method and show the results obtained in a large sample of cases.

In this work we also analyze the use of high resolution SAR data, both for the application of the PSP method and for SAR interferometry in general. In fact, the new X-band SAR missions provide SAR images characterized by a much higher resolution, opening new possibilities for SAR interferometry. Thanks to the high resolution, a larger number of coherent points or persistent scatterers per unit area are typically found, resulting in more detailed and accurate measurements by means of SAR differential interferometry techniques. However, it is necessary to better understand the characteristics of the high resolution signal, more likely dominated by few strong scatterering mechanisms, to better exploit all its potential.

As for the short wavelength (X band), it could negatively affect the coherence of the interferometric signal, the maximum terrain velocity measurable, and bring some difficulties in the atmospheric artefacts managing. However, these negative effects are compensated by the higher spatial resolution and shorter revisit time. Moreover, new and/or improved methodologies can be considered in order to fully exploit the characteristics of the new high resolution (wide-band) data.