Getting to the point: Rapid, high quality point selection and variable point time series for deformation monitoring

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Résumé

Due to the short revisit time and high data acquisition capacity of current satellites, much emphasis has recently been placed on the development of deformation monitoring and rapid disaster response capability using InSAR. This requires efficient, fast data processing, due to the need for timely updates on movements in the case of, for example, earthquakes and volcanic activity, and also to limit the computing resources required to process the vast quantities of data being acquired. Although high resolution is often not a critical requirement in the case of volcanic or tectonic applications, the monitoring of anthropogenically induced movements and urban monitoring requires processing of the data at the highest resolution possible. Here we present Rapid time series InSAR (RapidSAR), a method that can efficiently update high resolution time series of interferograms, and demonstrate its effectiveness over urban areas.

The RapidSAR method uses ensembles of neighbouring pixels with similar amplitude behaviour through time to estimate the coherence of pixels on an interferogram-by-interferogram basis. Newly acquired images can be rapidly ingested due to the individual coherence estimate, as the remainder of the time series does not have to be reprocessed. The coherence estimate does not suffer from smearing, as is the case with the conventional boxcar method. The timely, high quality coherence estimate makes the RapidSAR method suitable for urban monitoring. The individual point selection maximizes the amount of information extracted from the time series. The downside of this is that the selection of points for each individual interferogram varies, making the time series analysis more challenging. We overcome this by connecting points in both time and space.

We demonstrate the effectiveness of the method over both urbanized and rural areas. We show how the algorithm is able to successfully extract a high density of points in full Sentinel-1 resolution, and is able to distinguish coherent points on buildings from incoherent points surrounding them. We further examine the effectiveness of the time series estimation using the dense time series available from Sentinel-1. Finally, we show that the method is able to manage the high data volumes, both in space and time, generated by the mission.

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