3D Phase Unwrapping Based On Quality Indicator Of Differential SAR Interferograms

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Abstract:
The 3D phase unwrapping is a key step to extract the deformation signal from the temporal differential interferograms. It consists on determining the ambiguous phase values across all the 3D_differential interferograms, where the third dimension is the time.

The Generalization and the temporal continuity of 2D / 3D phase unwrapping involve methods of contextual voxels unwrapping. In that sense, methods of 2D phase unwrapping can be applied to each 2D image in the 3D phase volume independently of the entire volume unwrapping. However, these methods cannot detect the phase shift necessary to ensure temporal continuity of the unwrapped phase by the third dimension. In contrast, the 3D phase unwrapping which operates in the volume of the phase can avoid this problem and has the additional information provided by the third dimension. In this context, the algorithm we propose is based on the phase unwrapping process that is guided by the reliability of the edges to prevent the errors spread. The basic method of this process, inspired by the algorithm of Herraez et al [Herráez, 2002] based on a 3D quality map and edges of the latter on the three planes (x, y, z). In fact, an edge being the intersection of two pixels of the quality map that are connected in the x, y or z, the unwrapping follow a discrete path, going from the most reliable edge at first and the lowest quality edges at last. However, two main criteria determine the phase unwrapping results: i) the choice of the quality map, ii) how to determine the path that minimizes error propagation the best?

We have, for this purpose, quality maps generated by the first and second derivatives 3D and 3D pseudo-correlation. We tested the process on interferograms simulated to verify the algorithmic side then applied to real interferograms obtained from SAR images acquired on seismic regions.

Keywords:
SAR, interferometry, Earthquakes/Tectonics