STABLE COHERENT AREA IN SAR INTERFEROMETRY

Guillaume Hochard [1,2]*, Renaud Binet* [1]*, Jean-Marie Nicolas* [2]

[1] Commissariat à l'Énergie Atomique, Bruyères-le-Châtel, France
[2] Signal and Image Processing Dept., Telecom ParisTech, Paris, France
E-mail: guillaume.hochard@cea.fr

1. ABSTRACT

The classic InSAR technique is often limited by temporal and geometrical decorrelation, especially in the context of long time series analyses.

In this study, we first present an area which is particularly remarkable due to the temporal stability of its interferometric coherence. This area is located in the French Alps on the embankment dam of Serre-Poncon (44.471N, 6.269E), which retains the water of the first artificial lake in Europe by its capacity. Observations based on eight years temporal baseline interferograms show an expected complete loss of coherence of the scene, excepted on the Serre-Poncon dam which coherence degree remains high despite the long time span between these acquisitions.

Using a set of 82 ERS-1/2 images acquired in repeat pass interferometric conditions from April 1992 to July 2002, we compute a theoretical decorrelation matrix of the scene based on the geometrical decorrelation due to acquisition differences [1]. This matrix is used as a reference metric distance instead of the classic time / perpendicular baseline / Doppler centroïd criterion.

The coherence degree of the dam surface is then estimated from the data and compared to the theoritical coherence matrix. The effect of volume decorrelation is neglected due to the terrain surface (small stones and rocks). The topography of the dam is firstly neglected in the estimation of the surface coherence. We establish a close correlation between the theoretical coherence matrix and the dam observed coherence matrix. In a second time, we compensate the phase topography component of the dam and we compare both coherence measurements to highlight and quantify the phase topography error in the computation of the coherence.

The results show that this surface has an uncommon coherent stability along time, while others areas totally decorrelate. This lead us to conclude that this area is non-sensitive to temporal decorrelation.

Using a set of TerraSAR-X images acquired in repeat pass interferometric conditions from September 2008 to April 2009, we perform the same study in order to demonstrate that this area is also non-sensitive to temporal decorrelation for X-band wavenumbers.

The second part of this study tends to evaluate the physical behaviour of the reflectors of the Coherent Stable Area. Indeed, in a SAR image, the value measured for each pixel is the coherent sum of all the elementary scatterers contributions located within the ground resolution cell. A change in range or azimuth look direction or a different spatial layout of the scatterers lead to a different coherent sum of the small scatterers, i.e. decorrelation. If there is a dominant and persistant scatterer located inside the ground resolution cell, the coherent sum is less affected by the relative movement of the other minor scatterers. The phase remains quite stable and is less sensitive to decorrelation.

The main issue is to determine whether the surface behaves as a gathering of permanent scatterers [2] concentrated in a very small area or as a surface composed by small stable reflectors within each resolution cell. The analysis of the magnitude and speckle pattern and spectrum correlation of a small area located on the dam give the first elements to characterize a stable coherent area.

2. REFERENCES

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