Target Analysis in InSAR Data using a Phase-Scale Approach

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While InSAR images are bi-dimensional complex signals, they reveal structures both in magnitude and in phase. Data collected by a TerraSAR-X / TanDEM-X sensor and processed by a SAR processor are inherently complex-valued and are provided to users in the form of single look complex (SLC) products and the interferograms. Thus, the use of magnitude, coherence and phase for target analysis is advised for utilization of the complete information. The classical time-frequency as well as statistical methods for target analysis are generally applicable only to the amplitude SAR images in form of multi-scale approaches such as Wavelet decomposition [1], Gabor expansion [2] etc., thus ignoring the valuable information present in the phase. We demonstrated the use of this relevant phase information by proposing an extension to the SAR relevant sub-look decomposition [3] in order to provide a visual exploration tools for SAR analyst. We term this methodology as Multiple Sub-Look Decomposition (MSLD) [4]. Subsequently, a chirplet-derived transform- the fractional Fourier transform (FrFT) [5] has been found to be a true SAR relevant multi-scale approach, focusing on the application of SAR image categorization [6]. Here, the scaling is carried out in the phase, thus we term this approach as `phase-scale' techniques for SLC SAR images. Motivated from the simulation results of MSLD and the FrFT on the SLC SAR images, we propose to extend this `phase-scale' approach to the InSAR data, where joint use of information from two SLC SAR images provides an added advantage. The limitation of the traditional multi-scale approaches for the complex valued InSAR images will be another focus of this paper. Apart from understanding methods, it’s important to have a qualitative analysis of algorithm in relevance to the considered application. Thus we also propose a robust methodological classification framework under which a review and quantitative analysis of well-established, state-of-the-art and proposed methods will be carried out. References [1] Daubechies, I., Ten Lectures on Wavelets, Philadelphia, PA: SIAM, 1992. [2] Gabor, D., Theory of Communication, J. Inst. Elect. Eng.. Vol. 93, pp. 429-457, 1946. [3] Spigai, M. and Tison, C. and Souyris, J.-C., Time-Frequency Analysis in High-Resolution SAR Imagery, IEEE Transactions on Geoscience and Remote Sensing. Vol. 49, No. 7, pp. 2699-2711, Jul. 2011. [4] Singh, J. and Datcu, M., SAR Target Analysis based on Multiple-Sublook Decomposition: A Visual Exploration Approach, IEEE Geoscience and Remote Sensing Letters. Vol. 9, No. 2, pp. 247-251, Mar. 2012. [5] Namias, V., The Fractional Order Fourier Transform and its Application to Quantum Mechanics, J. Inst. Maths Applies. Vol. 25, pp. 241-265, 1980. [6] Singh, J. and Datcu, M., SAR Image Categorization With Log Cumulants of the Fractional Fourier Transform Coefficients, IEEE Transactions on Geoscience and Remote Sensing. In Press.