

# Speckle Modeling and Turbo Filtering of PolSAR Images

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## SUMMARY

SAR polarimetric radar images are affected by a granular noise called speckle, which degrades the quality of these images and makes it difficult to interpret. That is why a polarimetric filtering is essential. The diagonal terms of the covariance matrix  $C$  represent the intensity of the linear polarization and can be characterized by a multiplicative noise. The off-diagonal terms contain a noise that cannot be characterized by a multiplicative or additive model. In this paper, we are interested in modeling the speckle in the off-diagonal terms of the covariance matrix  $C$  and filter these terms with adjusting the filtering method already developed for the diagonal terms. Therefore, our objective is to adapt the filtering method called Turbo to filter PolSAR images containing noise that is not multiplicative or additive. The principle of Turbo filter is that it combines two complementary filters: the refined Lee filtering based on the estimation of the minimum mean square error MMSE and the wavelet filtering by using the stationary wavelet transform SWT. One filter can boost up the results of the other. We propose to optimize this method by adding a parameter in the calculation of the threshold in the wavelet filtering using multi-scale edge detection and the technique for improving the wavelet coefficients called SSC (sum of squared coefficients), this parameter will control the filtering effect and get a good compromise between smoothing homogeneous areas and preserving linear structures. The advantage of this algorithm is to use the advantages of both filters and to obtain images with well reduced speckle and filter all the elements of the covariance matrix, taking into account the noise type of each component. Visual and statistical evaluation and a comparative study are performed to validate the obtained results according to the following criteria: best filtering in terms of smoothing homogeneous areas, preserving edges and conservation of the polarimetric information