AN EVALUATION OF POLSAR SPECKLE FILTERS

Samuel Foucher[(1)], Carlos-Lopez Martinez[(2)], Grégory Farage[(3)]

(1) Computer Research Institute of Montreal, Montreal, 550 rue Sherbrooke Ouest, Montreal, H3A1B9, QC, Canada,
(Presenting Author) Email: sfoucher@crim.ca
(2) Remote Sensing Lab. (RSLab.), Signal Theory and Communications Dept. (TSC), Universitat Politecnica de Catalunya (UPC), Campus Nord, Edif. D3-203, Jordi Girona 1-3, 08034 Barcelona, Spain,
Email: carlos.lopez@tsc.upc.edu.
(3) Université de Sherbrooke, Sherbrooke, QC, Canada,
Email: gregory.farage@usherbrooke.ca

Speckle suppression in PolSAR data is an important step for the extraction of meaningful information from PolSAR images especially in heterogeneous areas where there is the possibility to mix pixels with different scattering mechanisms. It has been shown that insufficient noise filtering resulting in low equivalent number of look values (ENL) will increase bias on incoherent polarimetric parameters such as the Cloude-Pottier parameters [1][2]. In addition, meaningful high-frequency information, such as edges and point targets must be preserved. Adaptive filters [3] have been the most successful in reaching a good compromise between noise suppression and detail preservation. Recently, new filtering approaches have been proposed that are trying improve this compromise by grouping pixels with similar scattering mechanisms [12], using a more refined noise model [11] or based on more sophisticated image processing techniques [4][6][7][9][10].

The best approach in order to objectively and quantitatively compare filter's performances is to use an artificial dataset where the ground truth is perfectly known (see for instance [8][1]). The artificial image is usually based on a simple hand-made ground truth image describing the layout of different the scattering classes. However, there are at least three obvious limitations regarding this methodology: 1) performance measures will be dependent on the artificial image particular design; 2) the hand made ground-truth is usually composed of simple geometric shapes with straight edges; 3) it is difficult to derive confidence intervals on the performance measures. We choose to generate a set of artificial images using a Markov model (Gibbs distribution) for the stochastic generation of the underlying image structure, this model is usually used as a prior distribution for Bayesian restoration and segmentation of images [13]. This experiment can be seen as a Monte-Carlo process where a new artificial image is generated at each run, this way confidence intervals on each performance measure can be derived. We consider 4 types of typical polarimetric responses: 1) surface scattering (rough water), 2) rough surface scattering, 3) forest (volume scattering), 4) coherent point targets.

Performance metrics are focusing on speckle suppression (ENL), edge preservation, bias reduction on polarimetric parameters (Cloude-Pottier parameters), polarimetric signature preservation, point target preservation and classification performance. In addition, the various speckle filters will be evaluated on real PolSAR images.

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