DIRECTIONAL-ADAPTIVE DESPECKLING FOR HIGH-RESOLUTION SAR IMAGERY

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Speckle noise is supposed to be dependent on the signal intensity in the sense that the noise level increases with the brightness. Many approaches have been proposed to reduce the speckle effect in coherent imaging. Early works used the adaptive filters based on linear minimum mean square error by taking local statistics. The best-known filters include the Lee filter[1], Frost filter[2], Kuan filter[3]. More recent works include the use of anisotropic diffusion. Diffusion algorithms remove noise by modifying the image via a partial differential equation. Since Perona and Malik[4] introduced the formulation of anisotropic diffusion using an edge stopping function, the PDE-based approaches have been suggested to remove speckle noise with effective edge preserving. They include speckle-reducing anisotropic diffusion (SRAD)[5], detail-preserving anisotropic diffusion (DPAD) [6] and oriented speckle reducing anisotropic diffusion (OSRAD)[7].

In this study, an iterative *maximum a posteriori* (MAP) approach using a Bayesian model of Markov random field (MRF)[8]proposes for despeckling high-resolution SAR images. Image processes are assumed to combine the random fields associated with the observed intensity process and the image texture process respectively. The objective measure for determining the optimal despeckling of the "double compound stochastic" image processes is based on Bayes' theorem, and the MAP estimation employs the Point-Jacobian iteration[9] to obtain the optimal solution. In the proposed algorithm, MRF is used to quantify the spatial interaction probabilistically, that is, to provide a type of prior information on the image texture and the neighbor window of any size is defined for contextual information on a local region. However, the window of a certain size would result in using wrong information for the estimation from adjacent regions with different characteristics at the pixels close to or on boundary. To overcome this problem, the new method is designed to use less information from the neighbors located in the direction to an adjacent different region and more information from the neighbors located in the inner region of same characteristics. It can reduce the possibility to involve the pixel values of adjacent region with different characteristics. For this purpose, directional non-homogeneity coefficients are defined to find the direction to the adjacent region of different characteristics as follows:

1) Sum of North-bound Differences $Sum_{north} = \sum_{k=-order_w}^{k=-1} \sum_{l=-order_w}^{l=order_w} x(i, j+l) - x(i+k, j+l)$

2) Sum of South-bound Differences $Sum_{south} = \sum_{k=1}^{k=order_w} \sum_{l=-order_w}^{l=order_w} x(i, j+l) - x(i+k, j+l)$

3) Sum of West-bound Differences $Sum_{west} = \sum_{k=-order_w}^{k=order_w} \sum_{l=-order_w}^{l=-1} x(i+k, j) - x(i+k, j+l)$

4) Sum of East-bound Differences $Sum_{east} = \sum_{k=-order_w}^{k=order_w} \sum_{l=1}^{l=order_w} x(i+k, j+l) - x(i+k, j)$

where $order_w$ is the order of neighbor square-window whose size is $(2order_w + 1) \times (2order_w + 1)$. If the neighbors located in a direction are homogeneous, the sum values are close to 0.

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