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SPECKLE SUPPRESSION OF SAR IMAGES BASED ON WAVELET SINGULARITY DETECTION

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Abstract. A new algorithm for speckle suppression in synthetic aperture radar (SAR) images based on wavelet singularity detection is presented. The wavelet coefficients of the SAR images that correspond to the regular parts of the signal are first selected by Mallat's wavelet transform modulus maxima (WTMM) approach. Then, the singularity of the residuary wavelet coefficients is detected in every scale by using the Lipschitz-Hölder exponents, which represents the singularity strength of noise. Speckles can then be suppressed by a weighted averaging filter with coefficients determined by the Lipschitz-Hölder exponents. The final image is formed by the fusion of the selected thematic signals and the Lipschitz-Hölder exponent based weighted averaging parts. As demonstrated by the simulations, this approach can improve the denoising effect, in terms of speckle suppression, edge preservation, equivalent number of look (ENL), and radiometric resolution, as well as the visually-natural images generated.

Keywords. Speckle reduction; SAR image; WTMM; Lipschitz-Hölder exponent; singularity; land application.

AMS (MOS) subject classification:

1 Introduction

SAR image is the spatial distribution of the target scattering properties reconstructed by scattering center model of a target, which are closely related with the bandwidth, polarization method of radar, and targets states, and so on. Since SAR images are generated by the coherent processing of scattered signals, they are highly susceptible to speckling effects. Fully developed speckles possess the characteristic of random multiplicative noise, in the sense that the noise level is increased with the average gray level of a local area. Therefore, their presence will reduce the ability of a human observer in resolving the fine details of an image.In order to suppress the speckles in a SAR image, filtering techniques are commonly used. Due to the computational efficiency, standard filters such as the Lee-filter [8] and the Kuan-filter [7] have been suggested. However, their performance on noisy and coherent images is