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3D-Block Matching algorithm for satellite data Classification

[1]V.Venkata Sai Krishna, and [2]G.C.Narsimhulu

[1] M.Tech., URS Dept., IIRS, Dehradun, Uttarakhand.
[2]Assistant Professor, Government Polytechnic College for woman, Kadapa, AP, India.

Abstract: In this Paper, We Proposed a de-speckling method on Indian Synthetic-aperture radar (SAR) image with block matching 3D transformation. And it has been used for ALOS data. This block- matching 3D algorithm clearly explained how to generate de-speckling of SAR image for classification. In this technique has been tested on RISAT-1 SAR image data set and practical results exhibit that this technique is the better in terms of despeckling quality image factors.

Key Words: Synthetic-aperture radar, de-speckling, block matching 3D algorithm.

1. INTRODUCTION

RISAT-1 is our national microwave imagery sensor [1-2]. Microwave remote sensing has obtained a lot in importance over the last decades with the usage and utility of active microwave or radar imaging systems for a wide range of scientific applications. Synthetic-aperture radar images are affected by the speckling noise at the time acquisition process. Due to this effect, the images are not clearly seen and interpretation of images is very difficult. It is compulsory to eliminate the speckle noise as much as possible to get maximum information from the image. So many techniques like filter based and transform domain based models have been proved in their quality parameters. Lee filter, khan filter, frost filter, Map filter, wiener filter are used in filter domain and wavelet, curvelet, Principal component analysis, non local mean algorithm are used in transform domain. But still there is scope for further denoising. The algorithm is generally based on pixel grouping and group matching. This is the state-of-art algorithm in this denoising of images. We have studied the algorithm affect on our own satellite imagery. Lee filters are famous in denoising, but they cannot preserve the edges. For denoising purpose we used matlab software and for fusion and classification purpose we used ERDAS software. Finally accuracy calculations have to be performed. The SAR image is a grey image and optical image is multispectral image. In fusion process both input images are having different resolutions and different frequency bands, but finally we will get better resolution with multi spectral image. This algorithm can be applied at different applications like crop classification, land use and land cover classification [3-4].

2. BM3D TECHNOLOGY PROCEDURE

1. Take the image in geotiff format.
2. Add noise to the image.
3. Divide the SAR image to small blocks.
4. Calculate euclidean distance between blocks.
5. If the distance is less than a threshold then apply DWT.
6. Apply hard threshold to low frequency region.
7. Apply IDWT.
8. Apply DWT once again.
9. Apply wiener filter to low frequency region.
10. Apply IDWT.
11. Calculate the quality parameters.

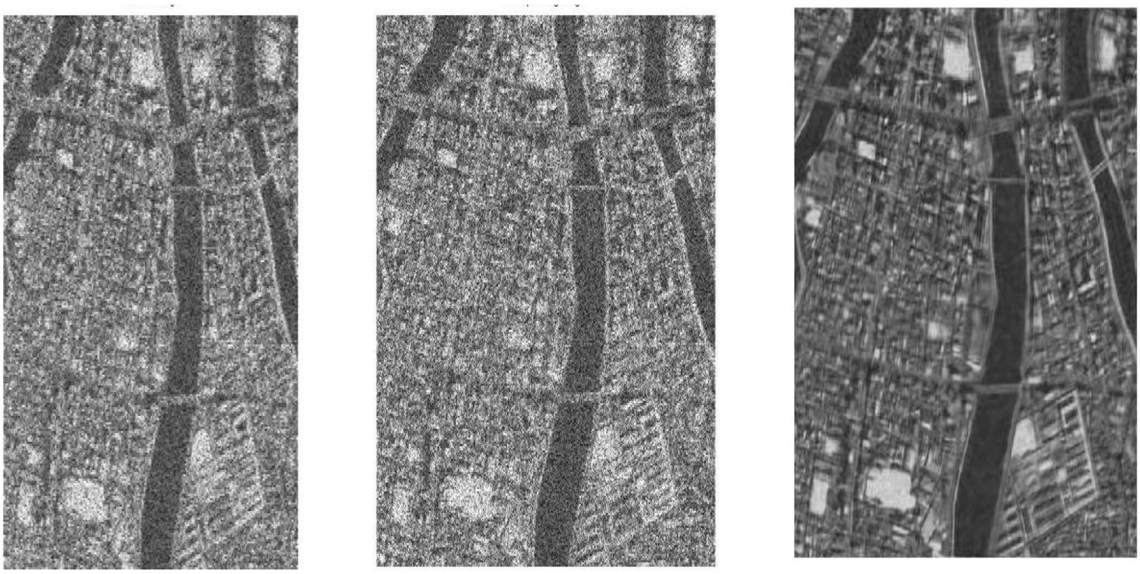
Table 1: Quality factors for ALOS data

	CC	ESI	PSNR
LEE	0.542641	0.237261	12.69533
WAVELET	0.629434	0.163542	13.38714
PCA-LPG	0.764238	0.566608	17.75203
BM3D	0.910328	0.617572	18.84444

Table 2: Quality factors for RISAT-1 data

	CC	ESI	PSNR
LEE	0.587824	0.2609	12.63503
WAVELET	0.651886	0.165638	13.20742
PCA-LPG	0.991427	0.694076	25.77491
BM3D	0.909661	0.611382	18.42953

(a) (b) (c)



(d) (e) (f)

Figure 1: (a) Original Image (b) Noisy Image (c) Lee noised Image (d) Wavelet Denoised Image (e) PCA-LPG Denoised Image (f) BM3D denoised Image

Table 3: Quality factors for RISAT-1 data (HH)

	ENL	SSI	CC	ESI	PSNR
LEE	14.02162	0.22968	0.60234	0.26845	12.72096
WAVELET	0.417097	0.66023	0.66129	0.17218	13.26927
CURVELET	0.333365	0.85223	0.87324	0.42131	19.96674
PCA-LPG	0.339668	0.78794	0.94507	0.52301	21.65689
BM3D	18.21977	0.39630	0.92561	0.63544	19.20952

Table 4: Quality factors for RISAT-1 data (VH)

	ENL	SSI	CC	ESI	PSNR
LEE	27.92204	0.13515	0.48948	0.24571	11.36118
WAVELET	0.61512	0.57989	0.58189	0.16895	11.99679
CURVELET	0.28418	0.77940	0.80652	0.41399	18.13353
PCA-LPG	0.24349	0.72973	0.95054	0.54092	22.07292
BM3D	21.66057	0.28769	0.89625	0.61292	17.24902

Table 5: Quality factors for RISAT-1 data (VV)

	ENL	SSI	CC	ESI	PSNR
LEE	0.55084	0.68467	0.79035	0.24068	14.16556
WAVELET	0.58806	0.58296	0.58457	0.16667	12.48269
CURVELET	0.39220	0.74066	0.76365	0.35313	17.9062
PCA-LPG	0.37298	0.69658	0.93178	0.54436	21.52579
BM3D	20.93430	0.34077	0.90850	0.62609	18.24214

4. RESULTS AND DISCUSSIONS

Correlation coefficient gives how any the two pictures are related or correlated to each other; it gives how the denoised image is away from the original image. From table 1, we can say that our method gives better CC value. In table quality parameters of ALOS satellite have been listed. Ideally the coefficient value is one and it should be nearby one. In any image processing, the main and crucial area is edge. It may be in horizontal or vertical index.

This value should be high for a denoising method. The denoising results of the new method and other existing technologies to microwave image are given in the Figure 1. From table 2, it is understood that the new method gives better CC value, better ESI value and better PSNR value. We have compared the BM3D technology to latest RISAT-1images. Along with above quality parameters, other parameters like QNL and ESE are also to be calculated in microwave images. Table 3, Table 4 and Table 5 show the quality parameters evaluation for different polarizations.

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