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Paper Authors

S.Ranjitha, Dr. S G Hiremath

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HIGH DENSITY IMPULSE NOISE REMOVAL AND EDGE DETECTION IN SAR IMAGES USING DWT AND CRIMMINS FILTER

***S.Ranjitha, Dr. S G Hiremath**

[*]Research scholar, VTU, Dept. Of ECE, East west institute of Technology, Bengaluru-560091, India
E-Mail ID: renjithaneha@gmail.com
Professor and Head, , Dept. Of ECE, East west institute of Technology, Bengaluru-560091, India
E-Mail ID: hiremathsg@ewit.edu

Abstract - Synthetic aperture radar (SAR) images are usually istorted by speckle noise. This problem is resolved by de-speckling the noisy image. The proposed method denoises SAR image by applying discrete wavelet transform (DWT). This scheme is proposed in db4 type wavelet transform. The difference between a noisy image and its denoised image, which is also defined as method noise is applied thresholding for both approximate and detail part of wavelet decomposition. This article presents an improved and enhanced filtering technique using median and Crimmins filter as pre-processing and post processing technique, for main method DWT, to avoid blurring and to increase the clarity of an image. The performance of the scheme is evaluated by calculating Peak signal to noise ratio (PSNR), Mean square error (MSE), Percentage of Spoiled Pixels (PSP), structural similarity index measure (SSIM). The execution of the subsequent improved strategy is compared with some standard techniques and it indicates better outcomes regarding numerical and visual examination.

Key words –SAR images, Crimmins filter, median filter ,method noise

I. INTRODUCTION

As synthetic aperture radar (SAR) has been broadly utilized almost in each field, SAR image de-noising turned into a significant research field. Most of the inquiries about image de-noising have been centered on how to utilize the compelling data of images to diminish noise. With the improvement of sparse representation, the blend of adaptive dictionary and low rank model features its favorable circumstances. Existing de-noising calculations are not impeccable. The distinction between an original image and its de-noised image, which is additionally characterized as method noise contains image data. An ever-increasing number of scientists have understood the significance of strategy disturbance and proposed many preparing techniques to improve the de-noising execution. For instance, Chen et al. planned a sort of different separating to manage the leftover image in [6].

The success of the applications depends on the removal of noise from the image data as the removal of the noise has a major impact on the performance of image processing. Noise

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removal is a difficult process as the noise restoration filter must not garble the useful info in the image. There are various methods which are proposed for impulse noise removal from digital images.

In the midst of image acquirement or transmission computerized images are debased by various disturbances primarily known as impulse noise. During the time spent imaging the noise taints the images by substitution of couple of pixels of unique image with some new pixels, these new pixels have luminance which can be inside the base luminance range or it tends to be past the luminance go named as motivation clamor. This happens because of flawed exchanging. Amid transmission normally these sorts of loud images happen.

The accomplishment of the applications relies upon the expulsion of noise from the image information as the evacuation of the clamor majorly affects the execution of image handling. Noise removal is a troublesome procedure as the noise reclamation channel must not distort the valuable information in the image. There are different strategies which are proposed for motivation of noise expulsion from advanced images.

SAR [Synthetic-aperture radar] is utilized to make 2D images or 3D images which are otherwise called landscapes. Radar reception apparatus is utilized on an objective district by SAR which gives better spatial resolution. SAR movement is superior to anything conventional beam-scanning radars. SAR is set on air ship, a moving stage and it is started from SLAR [side looking airborne radar].SAR gadget separation to the objective is equal to the time taken by the radar pulses. Immense synthetic antenna aperture is made as the recieving wire measure. In light of the size the image resolution is chosen. Bigger gap size would give great image resolution. It doesn't make a difference if the recieving wire is extensive or in the event that it is a moving reception apparatus. In spite of the fact that the physical status of reception apparatus is little it gives a high-resolution image.

The 3D image preparing is achieved basically in 2 steps:

1. The azimuth and range bearing are engaged for generating 2D images.
2. Next, a digital elevation model (DEM) is utilized to calculate the phase difference between complex images which is resolved from various look angles to recoup the height information.

Then the height information, alongside azimuth-range provides third dimension.

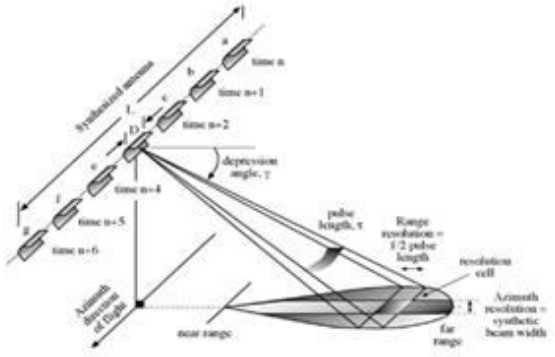

Fig 1. SAR imaging

For SAR image creation, radio wave pulses are lit up to target scene each pulse echo is recorded and obtained. Pulse transmission and echoes receivable is finished utilizing reception apparatus of single beam. The

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wavelengths of a meter are decreased to a few millimeters. Movement of SAR gadget set on flying machine will do changes in target when there is change in time and area. Recorded radar echoes of numerous reception apparatus places of progressive radars are acquired and signal processing of the equivalent gives consolidating of various radio wire positions. This procedure is synthetic antenna aperture which delivers high resolution images.

SAR image is delivered by exchange of electromagnetic waves that is space borne or it tends to be conceived in air close to surface target and consistently process the returned signs from different targets. The consistent preparing prompts dusty impact as a result of which the image becomes noisy, these granular noises will diminish resolution of the image and frustrate elucidation of image and investigation of image.

The aim of SNR de-noising project is to reduce the impulse noise present in images by using algorithms along with filters, comparison Random Forest method and method noise thresholding, preserving textural contents and features of structure and accuracy is increased in detecting the noisy pixels.

The rest of the thesis follows as, literature survey is explained in second section explains, explanation of the methodology used, is given in third section, experimental results and comparison of parameters are provided in fourth section and fifth section is all about the conclusion and future scope.

II. METHODOLOGY

The undermined image shown in Figure 2 is gone through the Pre-handling based median filter separating to beginning drive noise clearing at that point. This pre-processed image is passed through Wavelet decomposition up to level 2 and at each level's row and column stage, method noise thresholding is applied. These wavelet coefficients obtained are then used for reconstruction of an image. The resultant image obtained after reconstruction is then passed through crimmins filter for post-processing, which smoothens the image and final image is obtained.

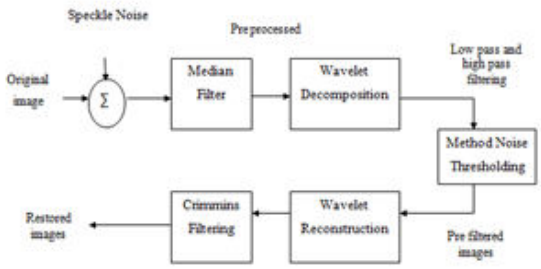

Fig.2. Block diagram

1.Noisy Image:

Noisy image is got by adding sound on the original gray images of the given size 512×512. Here 512×512 designates that an image is having 512 rows and 512 columns. Consider salt and pepper noise and impulse noise.

2.Pre-processing median Filter:

Next step is where the noisy image is headed through the pre-processing median filter. Image filters are primarily used for removal of noise, detection of edge, sharpen contrast. This removes artifacts from the original image. Median filter is a non-linear digital filtering method, frequently utilized to

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evacuate noise from an image or signal. Such noise lessening is a pre-processing step to make strides the comes about of afterward handling (for case, edge location on an image). Median filtering is exceptionally broadly utilized in advanced image handling since, beneath certain conditions, it preserves edges whereas eradicates noise.

3.Discrete Wavelet De-noising:

The discrete Wavelet De-noising-based image de-noising has below steps. Apply 2D wavelet change and change the noisy image into orthogonal area. Apply method noise thresholding (here soft thresholding is used) to the uproarious detail coefficients of the wavelet change. Execute inverse discrete wavelet transform to get the de-noised image. Here, the edge assumes an imperative part in the procedure used for de-noising. Finding an ideal limit is a little difficult procedure. A little limit esteem will hold wavelet coefficients while a vast edge esteem prompts the loss of wavelet coefficients that convey points of interest of an image.

4.Post processing using Crimmins filter :

Crimmins filter is basically used for de-speckling and smoothening of an image. The calculation employments a non-linear noise diminishment technique which compares the escalated of each pixel in an image with those of its 8 closest neighbors and, based upon the relative values, increases or decrements the esteem of the pixel in address such that it gets to be more representative of its environment.

5. Random forest classifier:

Random forests is also known as random decision forests. Random decision forests are ensemble learning method which is used for classification. It is also used for regression. Random forests operation is carried out by constructing decision trees multitude during training and the output is mode of classes which is used in classification or mean prediction which is used in part of regression.

A supervised learning algorithm termed as Random Forest. This method as the name indicates a forest is created and it is made random. The forest built is ensemble of Decision Trees. These Decision Trees are trained by “bagging” method. Bagging method is a learning model where the overall result is increased.

Random forest advantages are, it is applied for classification problems, applied for regression problems and it used majorly in today’s machine learning systems

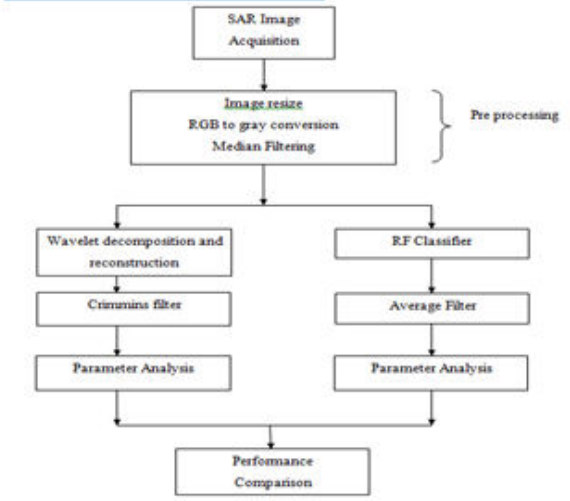

Fig 3: design flow

Steps for de-noising SAR image is as follows:

Step 1: Input the original noise free Synthetic aperture radar (SAR) image to the summation block.

Step 2: The second input is impulse also called as salt and pepper noise of anticipated noise density.

Step 3: The output of summation is now the SAR image is noisy and is corrupted with impulse noise of certain noise density.

Step 4: SAR image corrupted by this impulse noise is now provided to the median filter for preprocessing of the image. Here around 20% to 30% of the noise present in the image is removed.

Step 5: On this pre-processed image, DWT (discrete wavelet transforms) is applied, where detail and approximate wavelet coefficients are obtained and these are subjected to method noise thresholding.

Step 6: Now from this decomposition, we obtain wavelet coefficients from which we then reconstruct an image.

Step 7: In final stage Crimmins filter is applied on to the image to further reduce the amount of noise in the image and smoothen the image.

Mat lab is a well-organized programming language for matrix processing. This programming language can be termed as Matrix Laboratory. It contains readymade functions for manipulations and visualization of images. It allows program as a modular structure. Mat lab [matrix laboratory] is known as multi-paradigm computation environment and it is also known as fourth-generation language used for programming. An exclusive language technologically advanced through Math works.

III. EXPERIMENTAL RESULTS

A set of parameters are used to calculate the results of the reconstructed images. Different parameters define the performance of proposed algorithm. The results obtained with the proposed methods have been compared with the existing methodologies.

A. Peak Signal to Noise Ratio

The peak signal-to-noise ratio figures, in decibels, between two images. This ratio is frequently utilized as a quality measurement. It is used between the original and a compacted image. The higher the PSNR, the quality of compacted image is better.

B. Mean Square Error [MSE]

The Mean Square Error is one of the metric and the Peak Signal to Noise Ratio (PSNR) is another error metrics. They are used to do comparison of image compression quality. The MSE signifies the cumulative squared error. It occurs between the compressed image and the original image. PSNR signifies a measure of peak error. The error will be reduced as the MSE value is reduced.

C.Structural Similarity Index Measure [SSIM]

Structural similarity [SSIM] index method computes the similarity between two images. The measure of two windows which has the same size.

D. Percentage of Spoiled Pixels

It is the measure which gives unaffected original pixels and swapped with different gray value after filtering. Small value of PSP will give improved performance. High value of POSP removes original image property.

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Image 1a: RF SAR image with Noise density 0.4

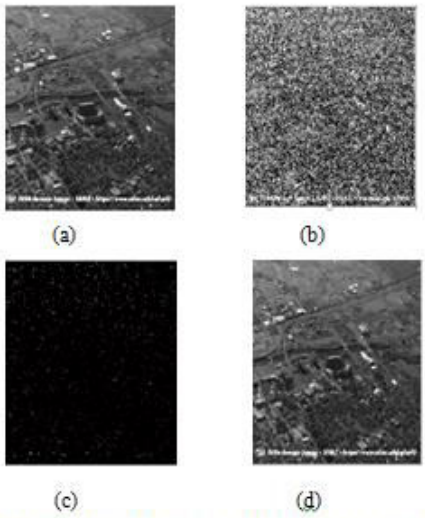

Fig.4. (a) depicts the original SAR image, (b) depicts the image after noise is added , (c) depicts the image after pre-processing , (d) depicts the filtered SAR image.

Image 1b: DB4 wavelet with method noise thresholding image for noise density 0.4

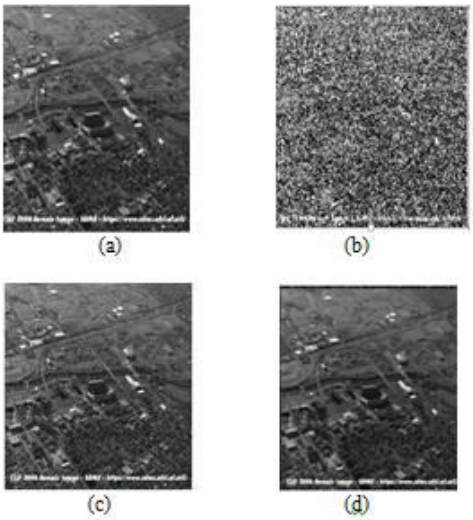

Fig 5. (a) depicts the original SAR image, (b) depicts the image after noise is added, (c) depicts the image after pre-processing, (d) depicts the filtered SAR image.

Table 1 Comparison of RF and method noise thresholding for 0.4 noise density on standard SAR image

Parameters	RF	Db4 wavelet+ method noise threshold
PSNR (db)	49.6234	64.1384424
MSE	0.0032	0.03
SSIM	0.84175	0.98745
PSP	38.62	12.3534

Image 2a: RF pentagon SAR image

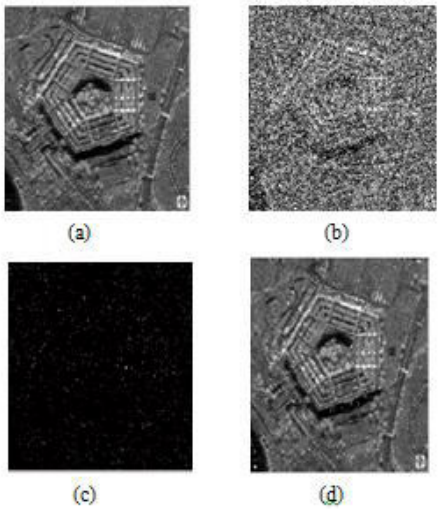

Fig.6. (a) depicts the pentagon SAR image , (b) depicts the image after noise is added , (c) depicts the image after pre-processing , (d) depicts the filtered pentagon SAR image using RF

Image 2b: DB4 wavelet with method noise thresholding pentagon SAR image

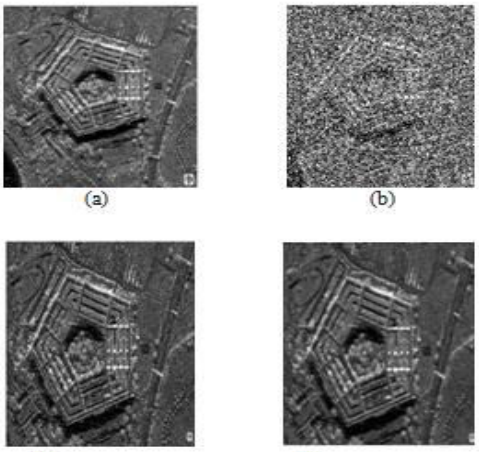

Fig.7. (a) depicts the pentagon SAR image, (b) depicts the image after noise is added , (c) depicts the image after pre-processing , (d) depicts the filtered pentagon SAR image.

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Table 2 Comparison of RF and method noise thresholding for 0.4 noise density on pentagon SAR image

Parameters	RF	Db4 wavelet+ method noise threshold
PSNR	46.5853	64.0221942
MSE	0.0046	0.03
SSIM	0.80465	0.9882
PSP	39.5645	11.9667

Image 3a : RF China lake SAR image

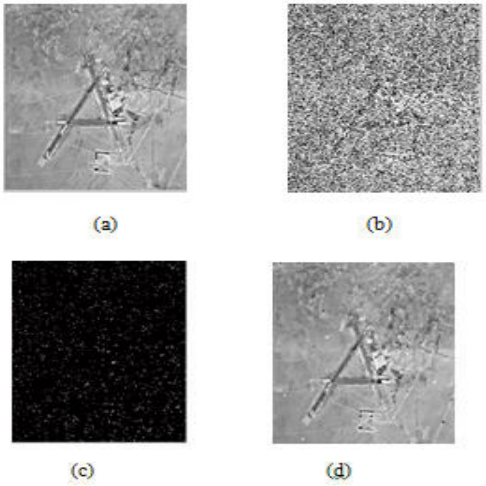

Fig 8(a) depicts the china lake SAR image , (b) depicts the image after noise is added , (c) depicts the image after pre-processing , (d) depicts the filtered China lake SAR image using method noise thresholding

Image 3b: DB4 wavelet with method noise thresholding China lake SAR image

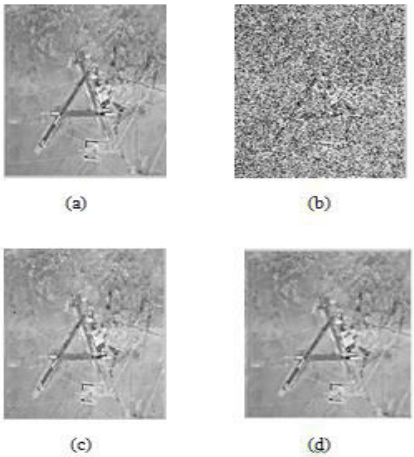

Fig 9(a) depicts the china lake SAR image , (b) depicts the image after noise is added , (c) depicts the image after pre-processing , (d) depicts the filtered China lake SAR image using method noise thresholding

Table 3 Comparison of RF and SVM for 0.4 noise density on China lake SAR image

Parameters	RF	Db4 wavelet+ method noise threshold
PSNR	54.7483	67.0335534
MSE	0.0020	0.01
SSIM	0.84505	0.98697
PSP	38.9771	12.7678

IV CONCLUSION AND FUTURE SCOPE

This project proposes a novel and productive method for de-noising the synthetic aperture radar images. This implementation is done in 2 stages. First the pre-processing stage is implemented, in which the image is resized and RGB to gray conversion is performed in presence of median filter (2 dimension). Median filter is used to reduce the impulse noise content to certain level. Then the pre-processed image is again filtered using the DB4 wavelet transform de-noisier. In this proposed scheme of filtration, there is a wavelet based filtering, hence the computational complexity increases but improved performance has been achieved in restoring results as compared to the previously reported schemes. There could be chances that this pre-filtered image can still be encountered with malicious pixels hence finally post-processing is done using crimmins filter. Crimmins filter is used to smoothen the reconstructed image and also removes the noise. The qualitative investigation is done by analyzing the visual appearance of the despeckled image counting the parameters just like the presence of the artifacts; edge conservation; visibility of low differentiate objects; surface conservation and conservation of homogeneous and non-homogeneous

locales. The quantitative examination is done utilizing parameters like PSNR, MSE, SSIM and PSP .These parameters shift with distinctive SAR images. The statistical results of the proposed strategy are normalized and empowering, which can be advance improved by the intelligent utilize of method noise.

Various methods to denoise a satellite image has been learnt as part of this project. Analyzing an image and the best suitable method to be selected, which would make the image appear more attractive for most of the images has been learnt. For example in satellite images, Crimmins filters proves to be best smoothening filter compared to lee filter, DSF (directional smoothing filter),average filter etc. All images cannot be de-noised with same efficiency with one single method as the parameters keep changing for different images. Hence the coding skill in MATLAB and study of various methodologies has been improved as part of this project.

REFERENCES

[1] “A new SAR image despeckling using directional smoothing filter and method noise thresholding “by Prabhishek Singh , Raj Shree published in Engineering Science and Technology, an International Journal, 14 May 2018 , pp 180-189

[2] “Weighted Nuclear Norm Minimization with Application to Image Denoising” by Shuhang Gu, Lei Zhang, Wangmeng Zuo, Xiangchu Feng published in IEEE Conference on Computer Vision and Pattern Recognition , October 2014, pp 155-162

[3] “Image denoising using local Wiener filter and its method noise” by Xiaobo Zhang published in elsevier magazine , September 2017, pp 6821-6828

[4]” Image Denoising using Wavelet Transform Method” by Vikas Gupta, Rajesh Mahle, Raviprakash S Shriwas, September 2012, pp 258-267.

[5]"Translation-invariant denoising using multiwavelets" by T. D. Bui and G. Y. Chen published in IEEE Transactions on Signal Processing, Vol.46, No.12, pp.3414-3420, 1998.

[6] “Noise reduction in SAR images by using fusion of stationary and discrete wavelet transforms” by R. Sunil, CHPulla Rao and A. Sarada, published in International Journal of Science, Engineering and Technology Research , Volume 5, Issue 2, February 2016 , pp515-521.

[7]“Efficient techniques for de-noising of highly corrupted impulse noise images” by Suresh Velaga, Sridhar published in International Journal of Soft Computing and Engineering ,Volume 2, Issue 4, September 2012, pp 255-258.

[8] “High Density Impulse Noise Removal Utilizing Switching Bilateral Filter”by T. Veerakumar, S. Esakkirajan and IlaVennila, published in International journal of circuits, systems and signal processing, 2012, Issue 3, Volume 6, pp 189-196.

[9] "Gaussian Noise Removal by a New Approach of Discrete Wavelet Transform", by PoojaPandey, PraveenChouksey, published in International Journal of Science, Engineering and Technology Research ,Volume 5, Issue 2, February 2016.

[10] "A Novel Filtering Scheme for Impulse Noise Cancellation",by G Panda, BMajhi , P K Dash and S K Meher published in IETE journal of research, March 2015, volume 48, pp 163-170.

[11] "Review Of Impulse Noise Reduction Techniques", by Manohar AnnappaKoli, published in International Journal On Computer Science And Engineering , Volume 4, February 2012, pp 184-196.

[12]"Image De-noising using Median Filter and DWT Adaptive Wavelet Threshold", by M.G.Srinivasa,Dhanushree.V published in IOSR Journal of VLSI and Signal Processing, Volume 5, Issue 3, pp 50-57.

[13] "Classification of Single and Multiple PQ Disturbances Based on DWT and RF Classifiers", by Anton Domini Sta. Cruz, published in Procurement of the 2017 IEEE , November 8, 2017, pp 2182-2187.

[14] "Detection and Removal of Salt and Pepper noise in images by using Improved Median Filter",by S.Deivalakshmi, P.Palanisamy and S.Sarath, IEEE, 2011, pp 363-368.

[15]. "Adaptive Image De-noising Using Wavelet Thresholding", by Liwen Dong, oublished in Third International Conference on Information Science and Technology, March 2013.