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High Density Impulse Noise Removal and Edge Detection in SAR Images Based on DWT-SVM-NN Technique

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***Abstract* - Image de-noising is a classical inverse issue in the field of image processing. In the process of image acquisition or transmission, the unsatisfactory photography environment or the noisy transmission channel is the main cause for noisy images. In this paper, Discrete Wavelet Transform- Support Vector Machine-Neural Network (DWT-SVM-NN) technique is introduced to remove the impulse noise from the images. Additionally, in this work, Peak signal-to-noise +(PSNR), the computation speed value will be increased and Mean Square Error (MSE) value will be decreased in the DWT-SVM-NN technique. Finally, the accuracy of the impulse noise will be improved in DWT-SVM-NN method compared to the existing methods.**

Keywords: image acquisition and transmission, impulse noise removal, discrete wavelet transforms, Peak signal-to-noise ratio, computation speed, Mean Square Error, field programmable gate array.

I. INTRODUCTION

A digital image is frequently corrupted by additive noise during acquisition and transmission, which leads to visible loss of image quality. The main goal of image de-noising technique is the removal of noise from the original image. In recent days, many algorithms have been implemented to control the image de-noising effect in image processing. Spatial or transmission domain can also be applied in image de-noising algorithm [1]. During the signal acquisition stage, impulse noise occurs due to bit error in the transmission of images. Random valued noise, Salt and pepper noise are two types of impulse noise. Salt and pepper noise can corrupt the image where corrupted pixel takes either maximum or minimum gray image. As the nonlinear filter is used to restore the original images, the image is contaminated by salt and pepper noise, [2]. Image de-noising is a low level technique, which occurs problem in image processing. Image is contaminated by mixed Gaussian impulse noise, which is more difficult due to the various probability distributions of noise in de-noising problem. To obtain a proper image, it is very necessary to analyze and implement de-noising problems[3]. Swam optimization algorithm is used in image for reducing de-noising, and it is also utilized in the wavelet threshold optimization. Many effective de-noising filters are used in image processing such as Gaussian filter, neighboring filter and Non- local- means filter. The high peak signal to noise ratio can maintain a large noise variance [4].

The combination of Empirical mode decomposition (EMD) and Variation Mode Decomposition (VMD) is one of the de-noising methods that is gaining interest in image processing and this method was developed by Huang. A relative review is made utilizing eleven techniques generally used in the image processing. These techniques are first- order local statistic, winner filter, fourth partial differential equation, linear complex diffusion process, nonlinear complex diffusion process, non- local means, non- local patch regression, etc. Linear Complex Diffusion Process (LCDP) and VMD domain process obtained better performance compared with EMD [5]. Multi-scale wavelet threshold (MWT) and Bilateral filter (BF) techniques are constructed by image de-noising. The image is deteriorated into multistate sub-bands by wavelet change. At that point, from the top scale to the bottom scale, bilateral filter is used to estimate sub-bands. The filtered sub-bands are reconstructed into reverse process, which are used to estimate Sub-bands of the lower scale. Sub-bands are reconstructed in all scales for de-noised image. This proposed method's drawback is computational time for wavelet threshold much less than bilateral filter [6].

De-noising is a major challenge facing in medical image processing. For modeling the noisy medical image, GGMM is used for minimum-mean square error. Edge information achieves competitive de-noising performance, especially gray level image by Generalized Gaussian Mixture Model GGMM. The drawbacks of this technique are that it provides larger data sets for analyzing various effects in images [7].The wavelet method based on Computed Radiography image de-noising, this method used for two noises with computed radiography image are poison noise and Gaussian noise. Computed radiography in image de-noising is based on wavelet method, which is used in poison and Gaussian noise. In Computed radiography, Maximum Mean square error

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(MMSE) is calculated and noise is reduced using a Gaussian filter [8].Image de-noising is a fundamental process in image processing. The Quality of the image is reduced by noise. This is not easily noticeable. Image de-noising is a traditional issue in the field of low level image processing. To overcome this problem, DWT feature extraction will be used to extract the features, which provides fast multi resolution analysis of image signals to give high quality images [9]. To enhance quality of images, the neural network is implemented. BM3D algorithm is used to reduce noisy patches into noise-free image [10].To overcome this problem, in this paper will be used DWT for feature extraction, SVM and NN for classification. In de-noising of image, PSNR, Structural Similarity Index values of image (SSIM) are increased and Mean square error (MSE) is reduced to enhance best image quality in image processing than the existing methods.

II. PROBLEM DEFINITION

The sensing of the image is affected by a variety of factors during image acquisitions or transmission, which is subjected as follows.1) Environmental conditions of sensing the image. 2) Light levels (high gain amplification is required for low level conditions).3) Sensor temperature (more amplification noise required for high temperature).

a) Comparison of PSNR

The image Lena and Rice select as feedback image with resolution of 256X256 pixel and concentration level. But, the PSNR value is variable in different method and computational complexity in PSNR value.

b) Noise Reduction

The proposed technique widely used to reduce noise from an image and this method eliminates noise not only from low density of impulse noise, but also works attentively on the high density impulse noise.

c) Edge Detection

The memory space needed for storage is comparatively small. Original images can be restored from its edge map for better enhancement of original images. Method for edge enhancement is done by using Wavelet Transform for Automatic Edge Detection in SAR Images.

d) Computational Speed

Various algorithms are used in image processing to fulfill the purpose of image de-noising. Computational speed is very low in Nonlocal Means (NLM) filtering and also it is referred as a complex algorithm in image processing. Now a day it is reduced by using different method and techniques in processing.

e) Signal to Error Ratio (SER)

The Scaling factors effect is seen on the values of SER for both extracted logo image and received output. During image acquisition, processed image is affected by noise. Three types of standard noise models are additive, impulse, multiplicative noise.

III. LITERATURE SURVEY

L. Shao, et al. [11],they Employed Nonlocal Means filtering or sparse representation methods, The Advantages of these methods were Good noising ability,& Sparse vector helps to clean signal, The limitations are Computational time is low compared to various evaluation method. In Cong-Hua, et al. [12] Edge information achieves competitive de-noising performance in image by Generalized Gaussian Mixture Model GGMM. The Advantages of these methods are Minimize the MSE value. The disadvantage was it provides larger datasets for analyzing various effects in images. As in Al-Naffouri, etal. [13] The Orthogonal Frequency Division Multiplex (OFDM) is generally suitable within adaptive white Gaussian noise (AWGN) and frequency selective channels. Which is performing can be dramatically impacted by impulse noise. But they achieve good Spectral efficiency, high speed computational and less complicity. The limitation of this method are, Sensitive to frequency synchronization problems, high peak to average power ratio (PAPR)& Linear transmit circuit requiring. That is affected from poor power efficiency. Donoho. D.L, et al. [14] they apply Bi-dimensional Empirical Mode Decomposition methods. The Advantages of these methods were noise level is reduced very highly & processing time is smaller. Rudin. L.I, et al [15], they use an efficient combination model of the second-order ROF model and a simple fourth-order partial differential equation (PDE) for image de-noising. The advantages are less computational time & reduce blockly effort. The limitations are not fully complete reduced to noise in the image.

IV. OBJECTIVES

De-noising analysis is a widely used in the research field and it is used to improve noise-free images and to give quality images. The main objective of this work is given below. 1) Best error prediction. 2) Decreasing the mean square error. 3) Increasing PSNR. 4) Maximizing the structural similarity index value of image. 5) Maximizing testing rates. 6) Absolute difference between mean value and processing pixel. 7) The feature extraction concentrates on image de- noising using SVM and DWT in image processing. 8) To increases accuracy

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for mean, variance, standard deviation of de- noising image. 9) To study algorithm of existing image de-noising analysis in various method followed for noise free image and image enhancement.

V. DWT-SVM-NN METHODOLOGY

The DWT-SVM-NN method is focused on improving the quality and enhancement of the original image. DWT is the feature extraction technique which is used in the INR-DWT-NN method. SVM and NN classifier is used to classify the image during testing and training period. In de-noising of image, PSNR, Structural Similarity Index values of image (SSIM) is increased and MSE is reduced to enhance better image quality in image processing than existing methods. The following structure consists of the three steps such as, a) Pre-processing, b) Feature extraction, 3) Classification method.

a) Pre-Processing

Pre-processing is the process of changing input image to our convenient format based on our project requirement. That pre-processing output is given to the input of our project. In our project, we have used three pre-processing models such as RGB to gray, Contrast enhancement, Fuzzy filter (FF). In RGB to gray method, the input image will be converted to gray images. Then, that image will be performed contrast enhancement, which increases the quality of the image and noise free image.

b) Feature Extraction

This division identifies the collection of the best features and which is appropriate for classification. A number of feature collection systems have been utilized in the removal of features from the de-noising images. Feature extraction a type of dimensionality reduction that efficiently represents interesting parts of an image as a compact feature vector. In our method, we have used DWT method for extracting the features.

c) Classification Method

SVM and NN classifier are utilized to deliver the outcome, regardless of whether the question image de-noising is coordinated with enrolled image de-noising or not. SVM and NN classifiers are the best computational classifiers compared to the other classifiers. The image processing is generally followed particular steps such as the training and testing part are specified in the block diagram.

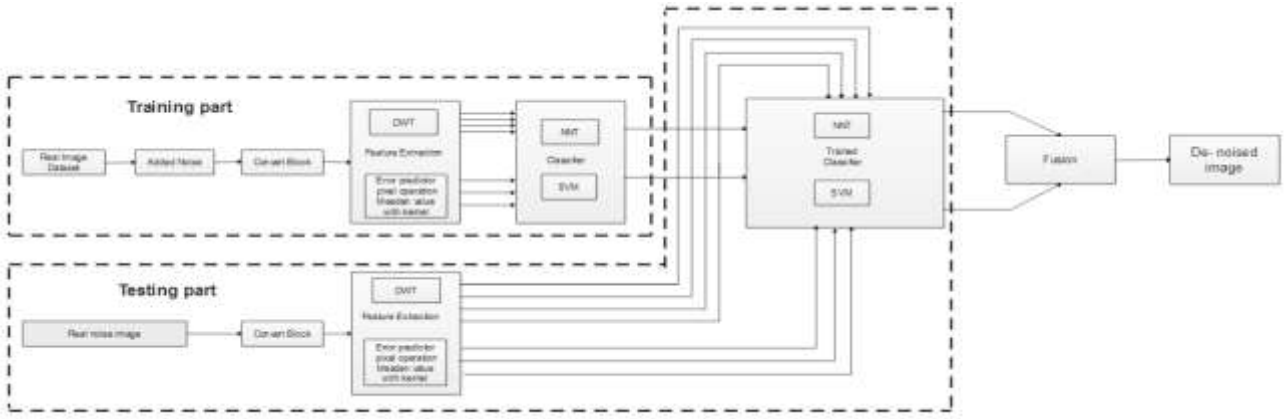

Figure-1: Block diagram of the training and testing process

In the training part an including various steps in image de-noising such as real image dataset, added noise, convert block, feature extraction and classifier. Initially the noise is added to the original image is known as noisy image. There are two types of feature extractions used in the de- noising process, first one is error predictor, pixel operation and median value with kernel it results can be applied on the SVM classifier and the noise free and noise image are classified by using SVM classifiers.

Another one feature extraction is DWT, the discrete time domain signal of Low Pass (LP) and High Pass (HP) filter is calculated by the DWT. DWT domain computed by low-pass followed by low pass (LPLP), low-pass followed high pass (LPHP), high- pass followed by high- pass (HPHP), high- pass followed by low- pass (HPLP) in the image.

The DWT feature extraction results can be applied on the NNT classifier. To extract image, detect drift or noise and complex to be observed by NNT classifier. Same process for testing part after that fusion will be used, because all the training and testing results have common mean, variance, and standard deviation value to remove the impulse noise. The possible outcomes are increasing PSNR value, maximizing SSIM, Decreasing the MSE and best error predictor. The

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results will be given to improve noise free images and quality of images.

VI. POSSIBLE OUTCOME

i) Accuracy: Exactness is the general accuracy of certain image de-noising models and mean, variance, standard deviation values increase as well as maximize within the accuracy.

ii) Mean square error (MSE): Is the normal absolute distinction between classifier expected result and genuine result; mean square error rates are mostly reduced.

iii) Noise density: combination of SVM and NN instruction with fuzzy filter gives best execution independent of noise free image where computational complicated quality is additionally decreased.

iv) Peak signal- to- noise ratio (PSNR): Peak signal-to-noise signal increase accuracy of the proposed methodologies.

v) Structural Similarity index value for image (SSIM): SSIM values are increasing in noise removal from the original image.

VII. EXISTING METHOD AND RESULT

L. Shao, et al. [11] used Nonlocal Means filtering or sparse representation methods and obtained Slice thickness (2mm),PSNR value - 43.92 (dB),SSIM - 0.999,Slice thickness (3mm),PSNR value - 37.78&SSIM - 0.995.Cong-Hua, et al. [12] implanted by Generalized Gaussian Mixture Model GGMM & Edge information achieves competitive de-noising performance in image, Noise density 34.23,PSNR value 24.30 (dB). Donoho. D.L, et al. [14] implements Bi-dimensional Empirical Mode Decomposition method and achieved the average processing time of the BEMD and tBEMD is 9.1510 s and 7.3792 s when noise level is to set S1. The average processing time of the BEMD and tBEMD is, respectively, 8.3790 s and 8.4139 s when noise level is set to S2. Finally, it is 8.3764 s and 8.4138 for S3. Rudin. L. I, et al [15] used An efficient combination model of the second-order ROF model and a simple fourth-order partial differential equation (PDE) for image de-noising. They achieved the ROF method result for iteration 4, PSNR value 29.88(dB), MSE value 8.17(dB), CPU time 0.8125,CM method result for iteration 4, PSNR value 4 29.98(dB), MSE value 8.07 (dB) & CPU time 1.18755.

VIII. CONCLUSION

In this Research work, DWT-SVM-NN technique will be used to increase PSNR, computation speed and reduce the MSE value in image transmission and acquisition process. DWT and SVM methods are used to perform the feature extraction value. Form this method, the value will be extracted from the feature. NNT will be used in classification method, which improves the accuracy of the de-noising image. Finally, all the performance parameters like PSNR, MSE, and accuracy will be improved in DWT-SVM-NN method than conventional method.

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