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Change Detection in SAR Images using Image Fusion and Supervised Classifier

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Abstract:*The paper proposes an approach based on a fusion o bject and a supervised classification system to improve detection f or SAR images. Here we are using CNN denoising method for removing noise in the input image. Then information from first image is processed using mean ratio operator. Second image is processed by log ratio operator. These two images are fused using PCA algorithm and the output is provided to KNN supervised classifier for finding change detection in the image.*

keywords: *SAR (Synthetic Aperture Radar), difference-image, image-fusion, CDA (change_Detection_algorithms) , CNN.*

I.INTRODUCTION

Remote sensing-technology's most important application is identification of changes occurring on the earth's surface using multitemporal remote sensing images. Change detection usually involves examining two co-registered remote sensing images that were collected at different time instances over the same geographic area. Such an approach is considered unattended when it is meant to discriminate between two different groups without any experience of the scene beforehand. Different automated and unsupervised methods of change detection are developed and described in the literature of remote sensing. Unsupervised-Change-Detection in SAR images can be divided into different modules such as image pre-processing, Producing change in image, and analysis of that change in image [2]. In the first step, co-registration, geometric corrections and noise reduction are included in pre-processing the images. In the second step, in order to generate the difference image, two co-registered images are compared pixel by pixel. When differentiating, shifts are calculated by pixel-by-pixel subtracting the intensity values between the two temporal images that are considered. In the third step, a decision threshold is usually applied to the histogram of the difference image to detect the changes. Many Threshoulding methods such as Minimum-Error Threshoulding (K&I) algorithm and the Expectation-Maximization-algorithm were proposed in the literature to evaluate the threshold in an unsupervised manner.

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Taking into account Zheng et al the speckle noise and non-stationary association in two multitemporal SAR images [3] proposed a method to multi-temporal synthetic aperture radar detection. Given the existence of speckle noise, local statistics are measured in a sliding window instead of pixel by pixel analysis.

For SAR imaging, shift-detection techniques are developed using Seasat SAR observations for the temporal monitoring of multi-year sea-ice floes. Changes in detection techniques can be classified into several SAR image groups, each corresponding to specific image quality specifications. Changes are found in a first category based on temporary object tracking or stable geometric form recognition image characteristics. In many applications for signal and image processing, the combination of information acquired from multiple sensors has become very common. For earth observation applications, data provided by different sensor-types provides a complement that improves the limitations of a particular type-of-sensor. User must use the photos available in the database or the first acquisition available after an interest case. Both image capture and alteration detection strategies consist of comparing more than one pictures of reference image and second image obtained over the target scene at two distinct dates with same time. The reference image is usually retrieved from a database and the second image processing is planed after a mark-able change. In change detection, the aim for each pixel of the region of interest is to generate an indicator of change. This shift indicator is the product of applying a measure of similarity to the two objects locally.

II.PROPOSED TECHNIQUE

The objective of the proposed technique is to detect and locate changes with feed forward network model between SAR images using stationary wavelet-based transform fusion and back propagation. To test technique performance in terms of specificity and ground truth comparison.

Based on Stationary-Wavelet based image-fusion approach and artificial neural network with feed forward propagation system, the proposed method analysis of multi-temporal SAR-image for The cover of the land shift-detection is Used.

In this proposed method, four modules are used. Difference Generation, Differenced Image Fusion, Supervised Image Segmentation and Performance analysis.

Difference Image Creation

This process's first step to produce the difference images to improve information of change in source pictures.

Rationing will be done here to obtain log and mean-scale differential images. Speckle noise is extremely robust. Log-scale dependent difference component will be produced to Identify unchanged region, high intensity and changes will be weakened and the low intensity pixels will be increased. Because of this weakness, there is the risk of a significant portion of data loss. In addition, the ratio means operator and fusion method are used to minimize this constraint and to generate precise portions of origin images to detect changes accurately.

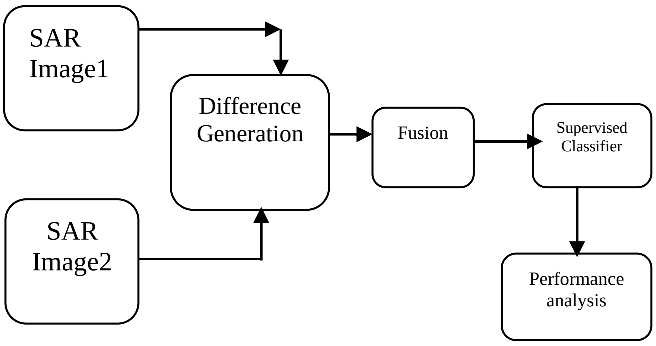

Fig. 1. System architecture.

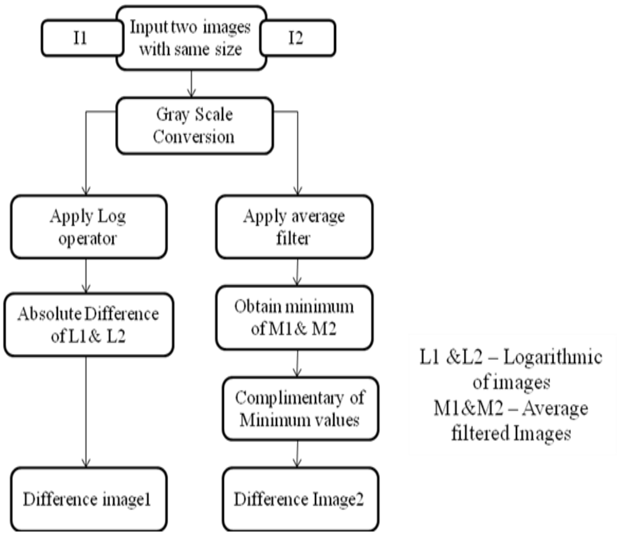

Fig. 2. Process Flow

In first step DI are generated by following formula,

Log-ratio:

DI1 = | log Y2 – log Y1|

Where,

Y2 – Input picture1 and Y1 – Input picture 2

Mean_ratio:

DI2 = 1 – min(v1/v2,v2/v1);

Where,

v1 – average-filtered-image1, v2 – average-filtered-image

III.PARAMETER EVALUATION

In order to establish an objective criterion for digital image quality, a parameter called PSNR (Peak-Signal-to Noise-Ratio) is defined as follows in the equation.

PSNR = 10*log10 (255*255/MSE) ,

Where, MSE-(Mean Square Error) is the mean-square - difference between the cover-image and the stegoimage. The mathematical definition for MSE is defined in equation as follows,

$$MSE=1/(M*N) \sum_{i=1}^{M} \sum_{j=1}^{N} (a_{ij}-b_{ij})^2$$

In this above formula, aij means value of pixel in the input image at position I j) and bij is the value of pixel in the output image at the same position. Typically the measured PSNR takes dB value for assessment of performance. The greater the PSNR, the higher the value of the image (which means that there is only a small difference in the image output and the image fused). On the contrary, a low dB value of P-S-N-R means that the input-image and the fused-image are significantly distorted.

Coefficient of correlation: it offers continuity between the original and reconstructed objects in the small structures. Higher correlation value means retaining more data. The space domain coefficient correlation is defined by:

Correlation = sum (sum (Q.*P))/Sqrt (sum (sum (Q.*P))*sum (sum (P.*P)));

Where, Q is difference between fused image and its overall mean value.

P is difference between source image and its overall mean value.

Sensitivity: tests the proportion of real positives correctly identified by,

Sensitivity = Ta./(Ta + Fb) Where,

Ta = True Positive: correctly classified as changed-region.

Fb = False negative: incorrectly classified as changed-region.

IV. EXPERIMENTAL ANALYSIS

We had selected Water reservoir near Aurangabad city as an Area of Interest. I used satellite images provided by USGS and European Space Agency website. Following are the screens of experimental result obtain using MATLAB.

**** Performance Metrics with sentinel1 images ****
Sensitivity: 98.9129
Correlation Coefficient: 0.2215
Root Mean Square Error: 0.1073
Peak Signal to Noise Ratio: 57.8235

**** Performance Metrics with lansat7 images****
Sensitivity: 98.8184
Correlation Coefficient: 0.0053
Root Mean Square Error: 0.1271
Peak Signal to Noise Ratio: 57.0887

**** Performance Metrics with sentinel2ab images ****
Sensitivity: 98.8144
Correlation Coefficient: 0.0033
Root Mean Square Error: 0.1089
Peak Signal to Noise Ratio: 57.7611

Fig. 3 Difference image.

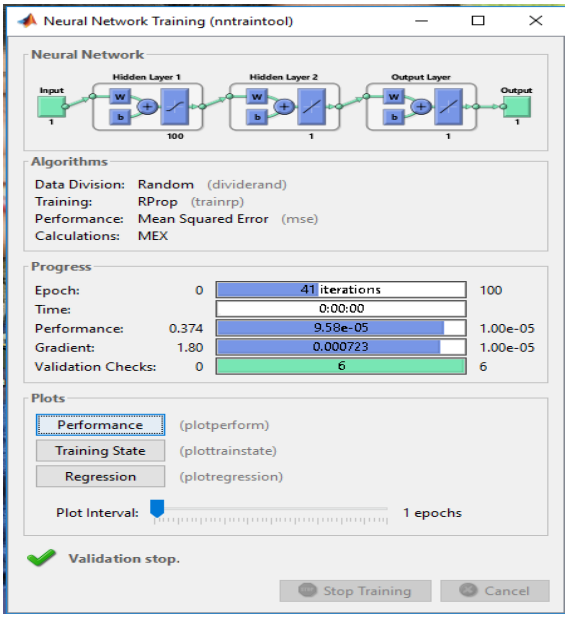

Fig. 4. Neural network training

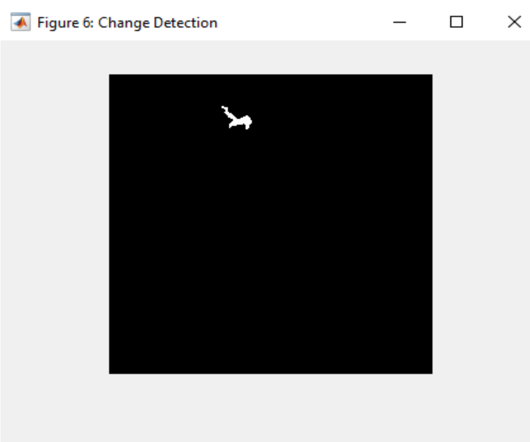

Fig.5. Change detection

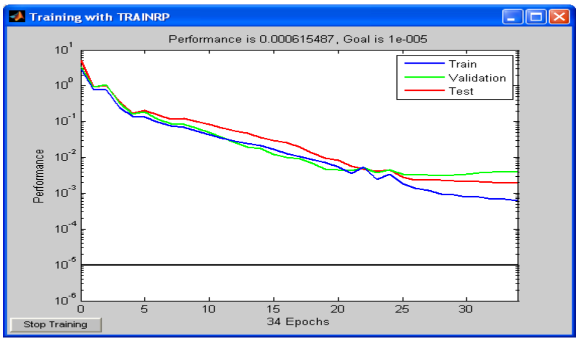

Fig.6 Neural network performance

V.CONCLUSION

In this paper SWT based image fusion is used for detection of changes in the Satellite images taken of the reservoir near Aurangabad city. It is found that using this approach we get improved result rather than the existing systems.

In this type, an averaging rule and maximum local Energy detection were utilized. We had used back propagation network to detect the changes with less time. The simulated results shown that generated fused image has less error and segmented changed region with better signal to noise ratio, better sensitivity and accuracy.

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