Combined Difference Image and Fuzzy C-Means Clustering for SAR Image Change Detection

O. Chitrapraba

[1]Department of ECE , Adhiparasakthi Engineering College, Melmaruvathur, India

Abstract: **This paper introduces noise suppression using adaptive filtering especially for Gaussian and speckle noise. This filter is used for the sharpness enhancement of degraded image and performs well for Gaussian noise and speckle noise reduction. A simple and effective based on the combined difference image and k-means clustering is proposed for the synthetic aperture radar (SAR) image change detection task. First, we use one of the most popular denoising methods, the probabilistic-patch-based algorithm, for speckle noise reduction of the two multitemporal SAR images, and the subtraction operator and the log ratio operator are applied to generate two kinds of simple change maps. Then, the mean filter and the median filter are used to the two change maps, respectively, where the mean filter focuses on making the change map smooth and the local area consistent, and the median filter is used to preserve the edge information.**

Keywords: **Change detection, Difference image, K-means clustering, SAR images.**

I. INTRODUCTION

Hyper spectral imagery, usually acquired from aircraft, measures the visible spectrum of many narrow spectral bands and generally has a spatial resolution on the order of a meter. Multispectral imagery, acquired from satellites, measures the visible spectrum in a few bands, typically with 2-20m spatial resolution. The advantages of airborne hyper spectral imagery are a narrower band resolution and higher spatial resolution. The advantages of hyper spectral imagery are offset by the logistics of requiring over flight by an aircraft to acquire the imagery.The AVIRIS (Airborne Visible/Infrared Imaging Spectrometer) is a hyper spectral remote sensor that retrieves upwelling spectral radiance in 224 contiguous bands, encompassing the 400-2,500nm wavelengths. The AVIRIS is flown on four different aircraft types operated by the Jet Propulsion Laboratory. The image used in this research was acquired from the AVIRIS mounted on a Twin Otter turboprop.

Denoising is often carried out in image processing through filtering, usually based on convolutions with sliding windows in the image domain, on operations in the frequency domain, or on estimated noise statistics or degradation functions, if these are known for the image acquisition process [5]. In the case of hyper spectral images, the high dimensionality of the data and the correlation between adjacent bands can be exploited to carry out effective de noising procedures based on dimensionality reduction (DR) algorithms Through comparisons with other algorithms it is shown that the new interpolation is not only mathematically optimal with respect to the underlying image model, but visually it is very efficient at reducing jagged edges, a place where most other interpolation algorithms fail.

The main contributions of this work include the following: 1) We propose a new spectral un mixing based image de noising framework which combines the local consistency and spectral information of two kinds of classical difference images and can be implemented easily, and 2) with this combined difference image is used to find change detection through kmeans clustering(CDIK) ,which makes the proposed approach suitable for septic applications.

II. DIMENSIONALITY REDUCTION

Dimensionality reduction algorithms [5], as the name suggests, are typically designed to reduce the dimensionality of the feature space without losing desirable information.

Minimum Noise Fraction (MNF) is one kind of DR methods needs the number of noisy components to be estimated, which is not a trivial problem [9]. In addition, this estimation is different for bands with different SNR, as it is not possible to achieve an optimal de noising for all the bands at the same time. The spectral un mixing [13], which aims at quantitatively decomposing each pixel in signals related to each other.

Preserving edge structures is a challenge to image de noising algorithms that reconstruct a high resolution image from a [15]corrupted resolution counterpart. We propose a spectral unmixing technique through spectral correlation nature of hyper spectral images and with wavelet based data fusion.

A. Spectral Redundancy:

In hyper spectral images adjacent are contain redundant information. But each has some unique contents will be useful for classifications. To remove redundancy while retaining unique information's in each bands image fusion is used. By creating wavelet decomposed multi-resolution image from various neighboring bands. This mixing is done separately in low & high frequency regions and final image will be reconstructed through concatenation.

PROPOSED ALGORITHM:

Select two bands of HSI images with same content

- ***Step1:*** *Image smoothening -> MNF based spectral unmixing method…*
- ***Step 2:*** *Image difference using subtraction and the log ratio operator..*
- ***Step3:*** *To perform mean filter on subtraction operator output & median filter on the log ratio operator output..*
- ***Step4:*** *Perform fuzzy c-means clustering*
- ***Step5:*** *Image restoration based on estimated values.*

III. CHANGE DETECTION

Here we used to generate change maps using subtraction and the log ratio operator. To smoothening maps using mean & to preserve the edge information using median approach. To perform Change Detection using fuzzh C-MEANS clustering.

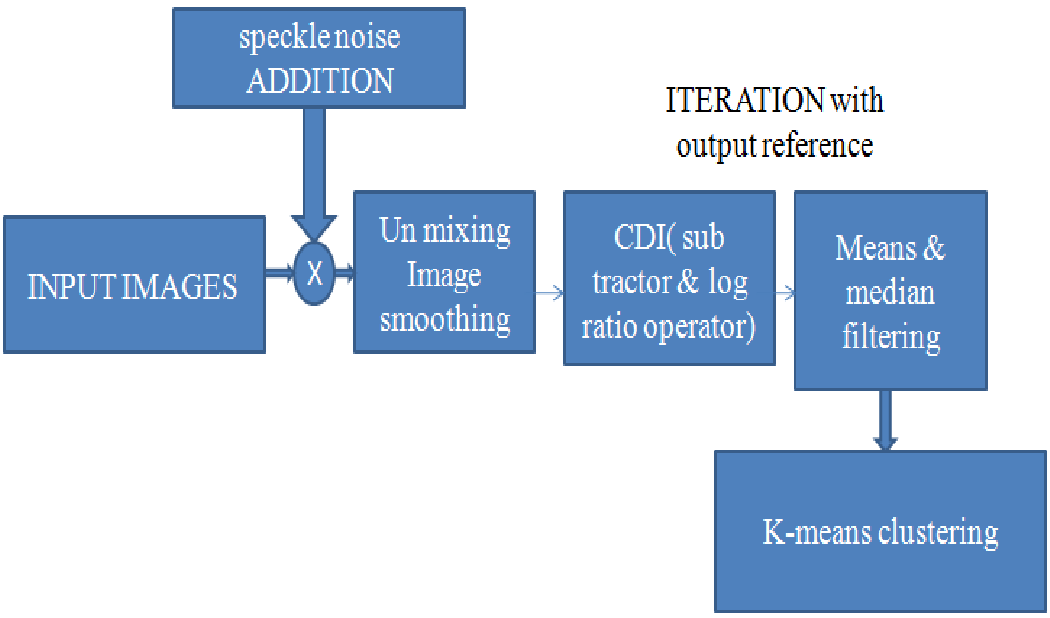


Fig 1 Block diagram of the proposed algorithm

Here we obtain the de noised images X1 and X2 corresponding to I1 and I2. Then, we use the traditional difference image generation operators to generate two kinds of difference images. The subtraction operator and the log ratio operator are used in this letter the combination can take advantage of the smoothness and enhanced local consistency provided by *D's* and the edge preservation by *D'l*. In order to make pixel values in the combined difference image *D* between 0 and 255, we use one regularization parameter $\alpha > 0$ to balance the effects of the smoothness term and edge preservation term. The weight of *D's* is set as α, and the weight of *D'l* is set as $1 - \alpha$.

The mean filter obtains many locally smooth regions which have strong local consistency. The median filter has a good nature in edge information preservation, so it preserves the shape of the changed area. In theory, the weight should be small for the smoothness term and be large for the edge preservation term. Too large weight for the smoothness term will lead to a large number of false alarms, and too small weight for the edge preservation term will lead to a large number of missed alarms.

Ds =|X1 − X2| (1)

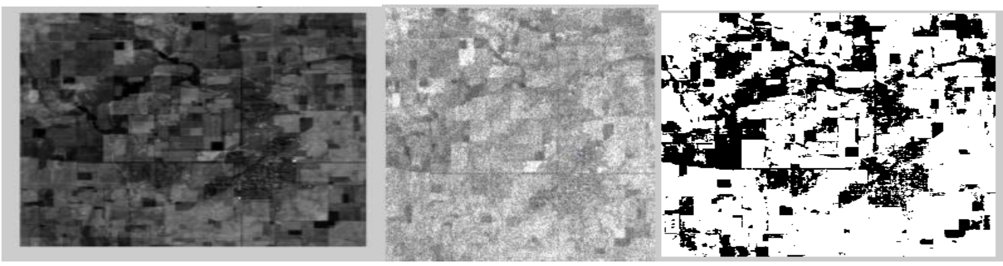
Dl =logX2 + 1X1 + 1|= |log(X2 + 1) − log(X1 + 1)|(2)

The mean filter is used for the change map *Ds* obtained by the subtraction operator. We use the mean filter because there are a lot of isolated pixels in *Ds*, and a filter with a large window size can make the region much more complete and the local area consistent. The median filter is then used for the change map *Dl* obtained by the log ratio operator. The median filter has better performance in edge information preservation. Thus, we use the median filter for *Dl* to suppress the isolated pixels and preserve the edge pixels to some extent.

IV. PROPOSED IMAGE RESTORATION

The main goal of this paper is to enhance the quality of an image by diminishing noisy artifacts from the image. To achieve this goal, the paper demonstrates the spectral correlation based DR technique to enhance PSNR and SSIM to the maximum than current leading techniques. This paper focuses on the restoration of non local images for better change detection in HSI images.

OUTPUT:



(a) **(b)** **(c)**

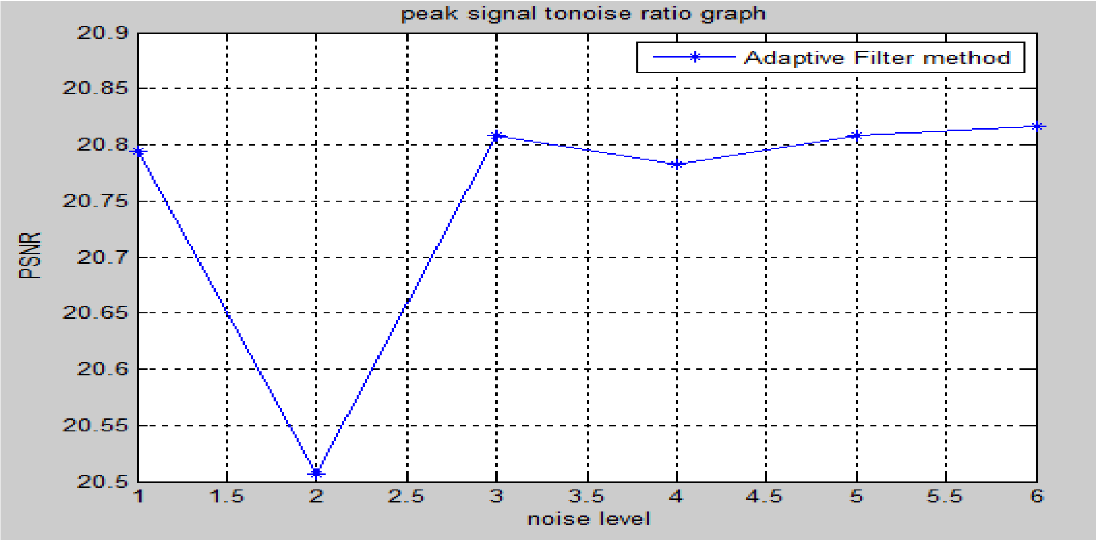
Fig. 2. (a) input image (b) Noise image (c) combined differenced image

The information of changed regions reflected by the mean-ratio image is relatively in accordance with the real changed trends in multitemporal SAR images

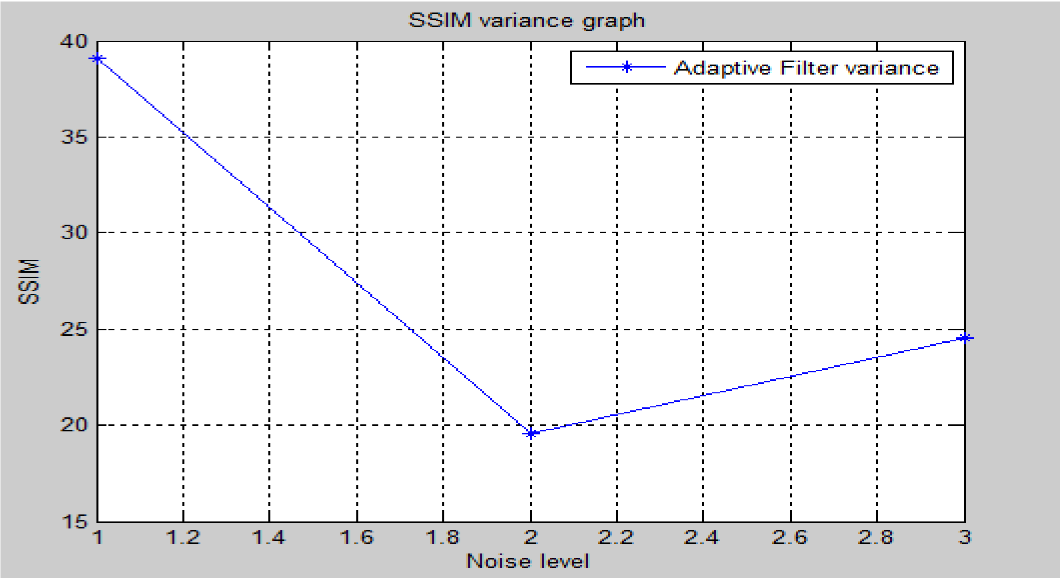
TABLE: I COMPARISION OF DETECTION RESULT ON THE PSNR Vs SSIM VALUE

Data Sets	Input Vs Noisy PSNR	Input Vs output PSNR	SSIM value
LN	19.2156	39.0665	0.8975
PCA	4.9568	19.5550	0.7584
NR	4.5444	25.5512	0.7248

1) GRAPH:



3.1 a) Noise level value Vs PSNR value



3.2 b) Noise levels Vs SSIM value.

V. CONCLUSION

In this paper, a new spectral-spatial classification scheme for hyper spectral images has been proposed. The method is based on the construction of an data sets based on both spatial & spectral information, rooted on the median & mean selected by using pixel wise classification results. Experimental results, presented here, have shown that the K means method improves the segmentation accuracies and provides accurate segmentation and difference maps.

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