International Journal of Scientific & Engineering Research, Volume 4, Issue ЊУ, . ÊÙÖber-2013
ISSN 2229-5518

Analysis of effect of noise removal filters on noisy remote sensing images

Narayan P. Bhosale, Ramesh R. Manza

Abstract— In this work, we have applied various filters on remote sensing images for denoising them. The fundamental key challenge to noise reduction is to reduce or eliminate the noise without failing other aspects of the image. RS (Remote Sensing) Image denoising involves the manipulation of the image data to produce a visually high quality image. There are many kinds of noise that affect on remote sensing images but we have selected only impulsive noise i.e. Gaussian noise and Salt & Pepper Noise. In a simulation we took remote sensing images and analyzed it with an Average filter, Median filter, unsharp filter and Wiener Filter and using statistical quality measures. The analysis of effect of noise removal technique is given in this paper.

Index Terms —RS Image, Gaussian Noise, Salt & Pepper Noise, Average Filter, Unsharp filter, Median Filter and Wiener Filter .

1. INTRODUCTION

Reducing noise from the satellite image is a challenge for the researchers in digital image processing. Several approaches are there for noise reduction. Generally speckle noise is commonly found in synthetic aperture radar images, satellite images and medical images etc [1], [3], [8], [9]. To give considerations and suggestions that is relevant for the development of methods for the detection, reduction. To creating a link to fields direct importance to the image analysis community. This can help people to understand better the context in which the remote sensing image analysis takes place [10], [11]. Digital image processing is the most important technique used in remote sensing. It has helped in the access to technical data in digital and multi-wavelength, services of computers in terms of speed of processing the data and the possibilities of big storage [12]. Several studies can also take the benefit of it such as technical diversity of the digital image processing, replication sites and maintaining the accuracy of the original data. Remote sensing is used to obtain information about a target or an area or a phenomenon through the analysis of certain information which is obtained by the remote sensor [13], [14]. It does not touch these objects to verify. Images obtained by satellites are useful in many environmental applications such as tracking of earth resources, geographical mapping, prediction of agricultural crops, urban growth, weather, flood and fire control etc.

2. IMAGE AND NOISE SOURCES

This is an original RS image has used for the testing of results with different filters for denoising RS Images as shown in fig-

Fig.1.Original image: Concordorthophoto [20-21].

Each pixel having own location and gray level values [1], [20]. Gaussian and salt & Pepper are called impulsive noise. This RS image which holding huge noise at pel or pixel level as shown in Fig-2 Gaussian noise RS image and Fig-3 Salt and Pepper Noise.

Images taken with both digital cameras and conventional film cameras or Satellite sensor will pick up noise from a variety of sources. Many further uses of these images require that the noise will be (partially) removed [15], [17].

The sources of noise in digital images arise during image acquisition [1],[3],[11]. The performance of imaging sensors are affected by a variety of factors during acquisition, such as

- Environmental conditions during the acquisition
- Light levels (low light conditions require high gain amplification).
- Sensor temperature (higher temp implies more amplification noise) Depending on the specific noise source.

There are different types of noises but we are concentrating below noises through this experimentation.

- *Bhosale Narayan is currently pursuing Ph.D. degree program in Computer Science at Dept. of Computer Science & IT, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad India, Mobile-09766868984. E-mail: narayanbhosale@gmail.com*
- *Ramesh Manza is currently working as Assistant Professor in Dept. of Computer Science & IT, Dr. Babasaheb Ambedkar Marathwada University, Aurangabad India,*

1. It has taken on dated 12-Oct-2012, time 01:37.

International Journal of Scientific & Engineering Research, Volume 4, Issue ЊУÛш . ÊÙÖÉÌÙı2013
ISSN 2229-5518

A. Gaussian noise
B. Salt-and-pepper noise

Fig.2.Gaussian noise added Image

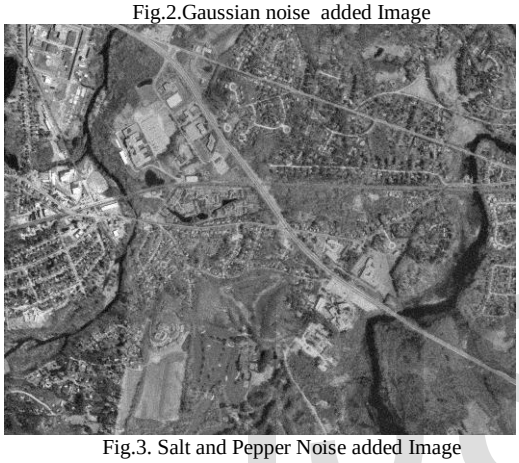


Fig.3. Salt and Pepper Noise added Image

A. Gaussian Noise

Gaussian noise is a noise that has its PDF equal to that of the normal distribution, which is also known as the Gaussian distribution [2], [3], 10]. Gaussian noise is most commonly known as additive white Gaussian noise. Gaussian noise is properly defined as the noise with a Gaussian amplitude distribution. As the name indicates, this type of noise has a Gaussian
distribution, which has a bell shaped probability distribution function given by,

——— ….. (1)

Where g represents the gray level, m is the mean or average of the function and σ is the standard deviation of the noise in equation (1).

B. Salt-and-Pepper Noise

Salt and pepper noise is an impulse type of noise, which is also referred to as intensity spikes. This is caused generally due to errors in data transmission. The probability of each is typically less than 0.1. The corrupted pixels are set alternatively to the minimum or to the maximum value, giving the image a "salt and pepper" like appearance. The salt and pepper noise is generally caused by malfunctioning of pixel elements in the camera sensors, faulty memory locations, or timing errors in the digitization process [1], [2], [4], [7].

And other random occurrences of both black and white intensity values, and often caused by threshold of noise image. Salt and pepper noise is a noise seen on images. It represents itself as randomly occurring white and black dots. An effective filter for this type of noise involves the usage of a median filter. Salt and pepper noise creeps into images in situations where quick transients, such as faulty switching, take place [19], [20], [21].

3. LITERATURE REVIEW

Sora Parrolli and et al. [2012], has proposed a novel despeckling algorithm for (SAR) images based on the concepts of nonlocal filtering and wavelet-domain shrinkage., recently proposed for additive white Gaussian noise denoising, but modifies its major processing steps in order to take into account the peculiarities of SAR images.. Results on simulated speckled images are quite satisfactory with a consistent PSNR gain over the best reference algorithms to date. Another sore point is the lack of objective quality measure for SAR images which weakens all experimental analyses [1].

Elorjan Lusier and et al. [2011], has developed PURE LET method to optimize a wide class of transform thresholding algorithms for denoising images corrupted by Gaussian noise [2].

D. Zhang and et al. [1997], has detected impulse noise and corrupted image from 'Lena' (8bit/ pel). They have used Peak Signal to Noise Ratio (PSNR) method to remove noise. As per their view this works to provide fuzzy technique to avoid the influence of bad information in image [6].

Bin WANG and et al. [1999], has developed fusion technique to remove clouds & shadow noise from Land Sat Thematic Mapper(TM) images [7].

Zhang Xiangjun and et.al [2001], has proposed and studied space and frequency domain technique to remove stripe noise from "Hangtian Tsinghua-1" Satellite Image TS-1 [8].

Fuan Tsai and et al. [2008], used Fast Fourier Transfer (FFT) to striping noise detection and designed strip detection algorithm and spine based interpolation scheme for correcting identified stripes in Landsat Multispectral Scanner (MSS), Thematic Mapper(TM) Hyperion Band 192 images [3].

Mr. Salem Sahel Al-amri and et al. [2010], worked on Saturn image and passed MF, AWF, GF, AMF filters to de-noise Salt and Paper Noise (SPN), Random variation Impulse Noise (RVIN) and Speckle noises. As a view they were arrived on Standard Median Filter (SMF) is good for filter for SPN with less than 40% density noise [10].

Raymond H. Chan, Chung-Wa Ho, and Mila Nikolova [2005], proposes a two-phase scheme for removing salt-and-pepper impulse noise. In the first phase, an adaptive median filter is used to identify pixels which are likely to be contaminated by noise (noise candidates). In terms of edge preservation and

International Journal of Scientific & Engineering Research, Volume 4, Issue ЫγÒı . ÊÛÖÉÌÙı2013
ISSN 2229-5518

noise suppression, our restored images show a significant improvement compared to those restored by using just nonlinear filters or regularization methods only. Our scheme can remove salt-and-pepper-noise with a noise level as high as 90% [6].

4. Experimental Results

In RS image denoising, performance assessment is quite a challenging task. We start with experiments carried out on RS image corrupted by simulated Gaussian and Salt and Pepper, obtaining objective performance which allow among different denoising algorithms. Then, we discuss experiments with Average Filter, Median Filter, UnSharp Filter and Wiener Filter and comparative result with RS images.

The performance is quantified by the peak signal-to-noise ratio (PSNR)

$$PSNR = 10\log_{10}\frac{|x|^2_{\max}}{MSE} \quad \text{....... (2)}$$

is the maximum value admitted by the data format equation (2) and (3) the mean-square error (MSE)

$$MSE = \left\langle [x(n) - \hat{x}(n)]^2 \right\rangle \quad \text{........ (3)}$$

is computed as a spatial average ·, with x and ˆx being the original and denoised images, respectively. In the TABLE I who gives comparative results of original, add Noise, with filter Average G_1, Median G_2, UnSharp G_3 and Wiener G_4. (G for Gaussian Noise and filter name respectively).

And then, TABLE II who gives comparative results of original, add Noise, with filter Average S_1, Median S_2, UnSharp S_3 and Wiener S_4. (S for Salt & Pepper Noise and filter name respectively).

In this Gaussian noise and its rate has shown below which gives recognition rate in a respective order i.e. average and Wiener filter are more compare to all by PSNR ratio. While MSE gives better result in this order Median, UnSharp. The result has shown in TABLE I. So far as Salt & Pepper noise is concerned which gives the recognition rate at good according MSE quality measure. While PSNR ratio not orders so this is a limitation of this work. The result has shown in TABLE II.

While looking on histogram of Gaussian noise and Salt & Pepper Noise which have showing all information in gray level intensity varies with different filters. See details in below the Histogram of Gaussian Noise, Salt & Pepper Noise and with all nomenclature of filters. See at Histogram I and Histogram II.

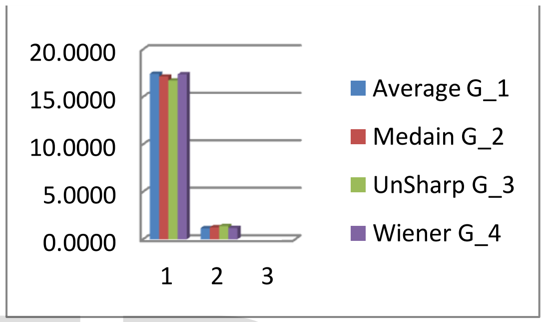
TABLE I

PSNR and MSE Reselust for Gaussian Noise Images with Filters

Images	PSNR	MSE
Original	17.3729	1.1906
Add Noise	17.2959	1.2119
Average G_1	**17.4364**	1.1733
Median G_2	17.1348	**1.2577**
UnSharp G_3	16.7108	**1.3867**
Wiener G_4	**17.3681**	**1.1919**

GRAPH I has shown the denoising results of Gaussian Noise among various Filters.

Graph I : The varitaion among filters for denoising RS Imges



Histogram I : RS Images of Gussian Noise and filter results

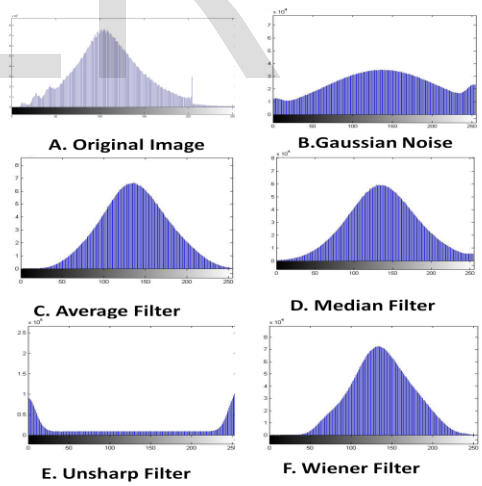


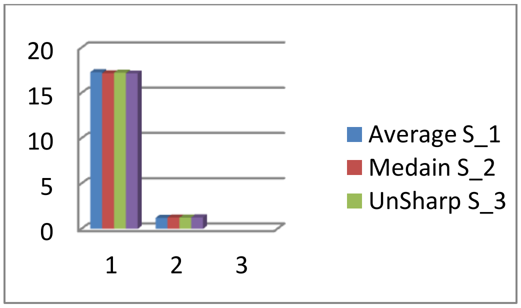
Table II PSNR and MSE Reselust for Salt and pepper Noise Images with Filters

Images	PSNR	MSE
Original	17.3730	1.1906
Add Noise	17.3702	1.1914
Average S_1	17.3005	**1.2107**
Median S_2	17.1741	**1.2464**
UnSharp S_3	17.2465	**1.2258**
Wiener S_4	17.1501	1.2533

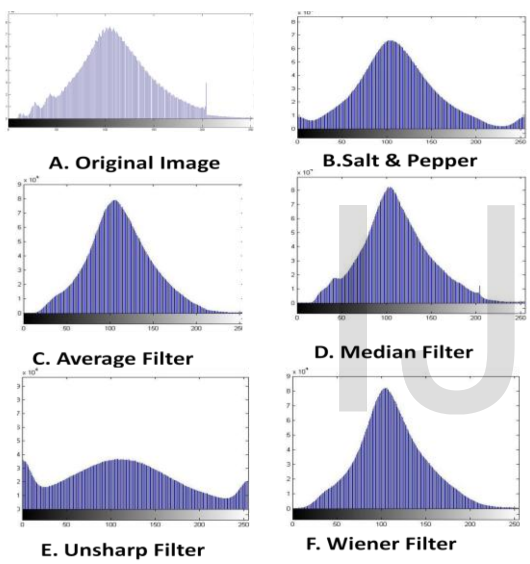
International Journal of Scientific & Engineering Research, Volume 4, Issue ŀƔŔ . ÊÛÖÉÌÙı2013
ISSN 2229-5518

GRAPH II has shown the denoising results With Salt and Pepper Noise among various Filters.

GRAPH II: THE VARITAION AMONG FILTERS FOR DENOISING RS IMGES



HISTOGRAM II: RS IMAGES OF SALT AND PEPPER NOISE AND FILTER RESULT



5. CONCLUSION AND FUTUTE WORK

In this paper, we have studied only impulsive noises means Gaussian and Salt & Pepper applied four filters on noise affected remote sensing images which have denoised successfully and quality has measured using quality controls. Throughout this experimentation we observed that the results of Gaussian and Salt and Pepper Noises are quite satisfactory. The future scope of this work will be sought to handle different noises in the RS image at minimum time. Another sore point is lack of objective quality measure for Remote sensing images which weaken maximum experimental analysis. Therefore, the effectiveness of all technique for pre-processing increases as the random noise decreases.

ACKOWLAGEMENT

We are very thankful to M1 STIC Info provide original image at their website for our experimentation. http://youssefhaiti.free. concordorthophoto.png

REFERENCES

[1] Sara Parrolli, "A Non Local SAR image denosing algorithm on LLMMSE Wavelet Shrinakge", *IEEE Transactions On Geoscience And Remote Sensing*, vol. *50*, No. 2, February 2012.

[2] Florian Luisier, IEEE Member, "Image Denoising in Mixed PoissonGaussian Noise", *IEEE Transactions On Image Processing*, Vol. 20, No. 3, March 2011.

[3] Fuan Tsai, Walter W. Chen, "Striping Noise Detection and Correction of Remote Sensing Images", *IEEE*, vol. 46, No.12, Dec 2008.

[4] Raymond H. Chan, Chung-Wa Ho, and Mila Nikolova, "Salt-and-Pepper Noise Removal by Median-Type Noise Detectors and Detail-Preserving Regularization", *IEEE transactions on image processing*, vol. 14, no. 10, October 2005.

[5] Zhang Xiangjun, Yang Jianjun, "Stripe Noise Characteristic Analysis and Removal Algorithmsfor "Hangtian Tsinghua-1", Satellite Images", *IEEE*, 2001.

[6] D. Z. hang and Wang, "Impulse noise detection and removal using fuzzy techniques", *Electronic Latter*, Vol.33 No5, Feb 1997.

[7] Bin Wang, "Automated Detection & removal clouds and their shadows form Landsat TM image" , *IETCE,* vol. E82, Feb 1999.

[8] G. Chien N. Lin and Chung J. Kuo, "Channel Noise Recovery Of Images Through Anti-Gray Coding Technique", *IEEE*, 1996.

[9] Mr. Salem Saleh Al-amri, Dr. N.V. Kalyankar, "A Comparative Study of Removal Noise from Remote Sensing Image", *IJCSI, International Journal of Computer Science* Issues, Vol. 7, Issue. 1, No. 1, Jan 2010.

[10] Jaun C., Jimenez-Munoz, Jose A. Sabrino, "Surface emissivity retrival from airborne hyper spectral Scanner data; insights on atmospheric correction and noise removal", *IEEE Geoscience And Remote Sensing Letters*, vol. 9, NO. 2, March 2012.

[11] Ramesh Manza, "Wavelet and Multiwavelets based Synthetic Aperture Radar (SAR) Image compression" *VNSGU Journal of Science and Technology*, vol.2 Issue:1 , June 2010.

[12] Gurmeet Kaur, Rupinder Kaur, "Image De-Noising using Wavelet Transform and Various Filters", *IJORCS*, vol.2 Issue 2, pp. 15-21, 2012.

[13] V. Shaaradadevi, S. Sunanda, "Two stage Impulse Noise removal technique For SAR images based on ANFIS and Fuzzy Decision" *,European Journal of Scientific Research*, vol.68 No.4, pp. 506-522, 2012.

[14] Dr B.C. Panda, *Remote Sensing -principle and application*, First Edition, Viva book Pvt Ltd, 2005.

[15] George Joseph, *Fundamental of Remote Sensing*, Second Edition, University Press (India) Pvt Ltd, 2005.

[16] Hasan S. M. Al-Khaffaf, Abdullah Zawawi Talib, Rosalina Abdul, "Salt and Pepper Noise Removal from Document Images", Spinger, *Visual Informatics: Bridging Research and Practice Lecture Notes in Computer Science* Volume 5857, pp 607-618, 2009.

[17] Y. Wang, w. Chen, "MTV: Modified total Variation model for mage noise removal", Electronic Letter, vol.47 No.10, 12 May 2011.

[18] Sonali R. Mahakale & Nileshsingh V. Thakur, "A Comparative Study Of Image Filtering On Various Noisy Pixels", *International Journal of Image Processing and Vision Sciences*: 2278 – 1110, vol-1, Issue-2, 2012.

[19] Giancario B. O., Silva, "Issues in geographic data quality assessment by remote sensing techniques", 2012.

[20] Image, "Index of / M1STIC info/s2/Traitement".

[21] http://youssefhaiti.free.fr/M1%20STIC%20Info/S2/Traitement%20d'images/Roudet/TP/Images/faible_contraste/concordorthophoto.png