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STUDY OF IMAGE RESTORATION TECHNIQUES FOR REMOTE SENSING IMAGES IN AGRICULTURE FIELD

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Abstract - In this paper, we consider the problem of remotely sensed image. Data recorded by sensors on a satellite or aircraft contain errors related to geometry and brightness values of the pixels in agriculture field. These errors are corrected using different image processing operations like image restoration, image enhancement, image transformation, image classification. Different image restoration techniques are used to extract useful information from the images.
Aim of this research paper to provide a concise overview of the most useful restoration methods. Different type of image restoration techniques like spatial filter, median filter, wiener filter and wavelet based filter are described and the strengths and weaknesses of each approach are identified. Examples of remote sensing technique for agriculture field given. To provide guidelines for choosing a restoration technique for agriculture application, a comparison of the restoration techniques is made. The restoration methods are compared and evaluated based on quantitative and qualitative analysis.
Key words: Image Processing, Image restoration, Remote Sensing, Noise, Degradation, Filtering

1. Introduction

Digital image processing is use of computer algorithm to perform image processing on digital image. In diverse fields from planetary science to molecular spectroscopy and medical imaging to satellite imaging, the problem of recovering original images from blurred and noisy images is challenging. Image Restoration refers to a class of methods that aim to remove or reduce the degradations that have occurred while the digital image was being obtained.

All natural images when displayed have gone through some sort of degradation During display mode, during acquisition mode, or during processing mode The degradations may be due to sensor noise, blur due to camera misfocus, relative object- camera motion, random atmospheric turbulence, Others In most of the existing image restoration methods we assume that the degradation process can **be** described using a mathematical model.

A simplified version for the image restoration process model is

$$y(i,j) = H\left[f(i,j)\right] + n(i,j)$$

Where

$y(i,j)$	The degraded image
$f(i,j)$	The original image
H	An operator that represents the degradation process
$n(i,j)$	The external noise which is assumed to be image-independent

Image restoration techniques are used to recover some spatial information and improving the information content of remotely sensed images. The output of a remote sensing system is usually an image representing the scene being observed. Many further steps of digital image processing and modeling are required in order to extract useful information from the image.

Agriculture resources are among the most important renewable, dynamic natural resources. Comprehensive, reliable and timely information on agricultural resources is very much necessary for a country like India whose mainstay of the economy is agriculture. With increasing population pressure throughout the nation and the concomitant need for increased agricultural production (food and fiber crops as well as livestock) there is a definite need for improved management of the nation agricultural resources. Remotely sensed images can be used to identify nutrient deficiencies, diseases, water deficiency or surplus, weed infestations, insect damage, hail damage, wind damage, herbicide damage, and plant populations.

Information from remote sensing can be used as base maps in variable rate applications of fertilizers and pesticides. Information from remotely sensed images allows farmers to treat only affected areas of a field. Problems within a field may be identified remotely before they can be visually identified. Ranchers use remote sensing to identify prime grazing areas, overgrazed areas, or areas of weed infestations. Lending institutions use remote sensing data to evaluate the relative values of land by comparing archived images with those of surrounding fields.

3. Proposed Work

For remotely sensed images restoration is must process. For the agriculture field data different filter techniques are applied. Each filter result is tested separately.

3.1 Spatial Filter

Spatial filtering is an image processing procedure that accentuates contrasts locally in the spatial domain. Thus, if there are boundaries between features on either side of which reflectance (or emissions) are quite different (notable as sharp or abrupt changes in DN value), these boundaries can be emphasized by any one of several filters. The resulting images are often quite distinctive in appearance. Linear features, in particular, such as geologic faults can be made to stand out.

Although less commonly performed, spatial filtering techniques explore the distribution of pixels of varying brightness over an image and, especially detect and sharpen boundary discontinuities. These changes in scene illumination, which are typically gradual rather than abrupt, produce a relation that we express quantitatively as "spatial frequencies". The spatial frequency is defined as the number of cycles of change in image DN values per unit distance (e.g., 10 cycles/mm) along a particular direction in the image. Algorithm for this purpose are called "spatial filters" because they suppress (de-emphasize) certain frequencies and pass (emphasize) others.

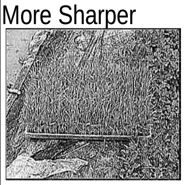
Original image	Low Pass Spatial Filter - Unequal Weights	High Pass Spatial Filter - More Sharper
		

Fig. 1: Applying Spatial Filter Shows Some intermediate steps of result

3.3 Median Filter

The **median filter** is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise.

The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries. The pattern of neighbors is called the "window", which slides, entry by entry, over the entire signal. For 1D signal, the most obvious window is just the first few preceding and following entries, whereas for 2D (or higher-dimensional) signals such as images, more complex window patterns are possible (such as "box" or "cross" patterns). Note that if the window has an odd number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median

Median Filtered Image	Salt & Pepper Noisy Image	Salt & Pepper Median Filtered Image
		

Fig 2: Applying Median Filter

3.3 Winner Filter

Wiener filter is a standard image restoration approach proposed by N. Wiener [7] that incorporates both the degradation function and statistical characteristics of noise into the restoration process.

By apply Wiener Filter on same image, use *deconvwnr* function to deblurr an image using the Wiener Filter. Wiener deconvolution can be used effectively when the frequency characteristics of the image and additive noise are known, to at least some degree. In the absence of noise, the Wiener Filter reduces to the ideal inverse Filter In this paper some intermediate steps of winner filter are shown.

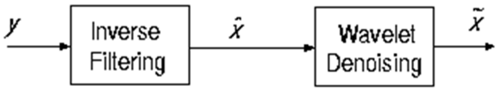


Fig 3: Applying Winner Filter shows Some intermediate steps of Result

3.4 Wavelet filter

The image restoration contains two separate steps: Fourier-domain inverse filtering and wavelet-domain image denoising. The diagram is shown as follows.

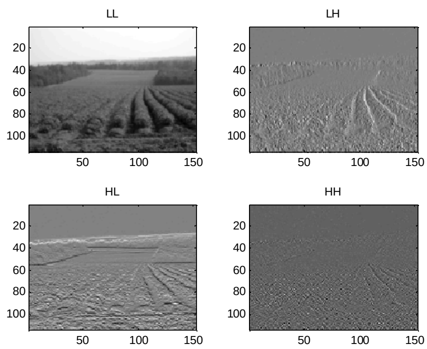


Fig 4: Wavelet Filter Result

4. Statistical Analysis

There are many quality measures that are used like Mean, variance, directional contrast, mean square error, peak signal to noise ratio and Fourier spectrum etc. In this work we have used Mean, Standard deviation, which is more useful to measure the quality of the image.

Table 1: Mean and Standard Deviation of original, noisy Images using Median Filter

Image No	Original image		Salt & Pepper Noisy Image		Median Filtered Image	
	Mean	STD	Mean	STD	Mean	STD
Rice Plant	0.4508	0.1921	13.1821	55.5383	0.4628	1.785
Farm Filed1	0.6098	0.2429	3.3949	55.6496	0.6295	2.2386
Tea Plant	0.4998	0.2313	0.2313	0.2307	0.5108	1.6965
Cotton Plant	0.3765	0.2993	13.2566	55.8491	0.3946	2.412
Farm Filed2	0.3828	0.1494	12.9527	55.2034	0.3999	2.2702

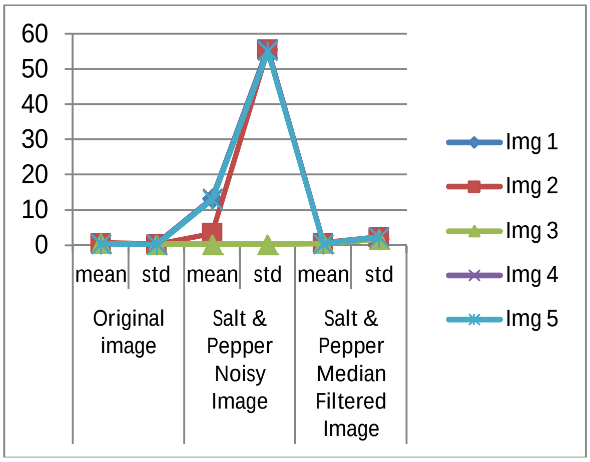


Fig 5: Graphical Representation

Table 2: Mean and Standard Deviation of original, noisy Images using Spatial Filter& it's graphical representation

Image1	Mean	Standard Deviation
Original Image	0.4508	0.1921
Low pass Spatial-unequal wt	0.4508	0.1786
Low pass Spatial-equal wt	0.4508	0.1682
High pass Spatial-More Sharper	0.4508	0.4043
High pass Spatial-less Sharper	0.4508	0.7841
High –Boost Filter	0.4508	0.2380
Prewitt Derivative	0.00003	0.5310
Sobel Derivative	0.00004	0.7341

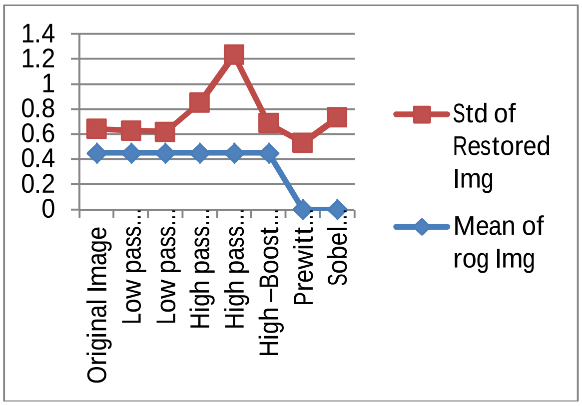


Fig 6: Graphical Representation

Table 3: Mean and Standard Deviation of original, noisy Images using Winner Filter& it's graphical representation

Image 1	Mean	Standard deviation
Original Image	109.4282	52.9742
Restored Blurred	109.4280	39.8384
True PSF	109.4297	50.1132
Long PSF	113.7881	87.1858
Restored Steep	110.5061	77.3596
Blurred & Noisy	119.6025	42.4921
Inverse filtering of noisy Data	126.4135	106.5167
Restored with NSR	114.5555	43.6649
Restored with NSR/2	117.0089	48.6194
Restored with ACF	119.6014	45.7869
Restored With NP & 1D-ACF	119.5948	46.0628

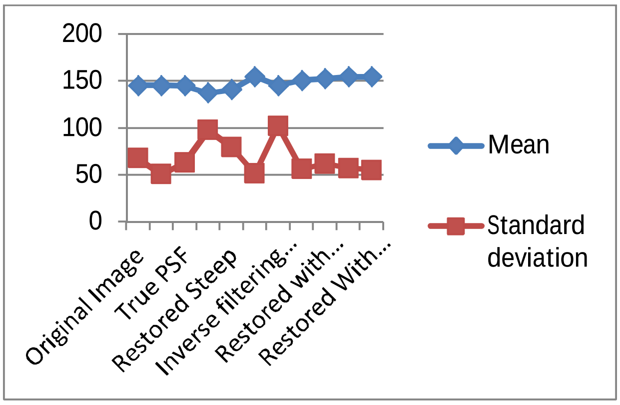


Fig 7: Graphical Representation

4. Conclusion

The comparative study to provide good restoration results, by preserving the image features, which may useful for agriculture researcher to gather information and associated statistics on crops, rangeland, livestock and other related agricultural resources.

Table 4: Mean and Standard Deviation of original, noisy Images using Wavelet Filter& it's graphical representation

Image 3	**Mean**	**STD**
Original	123.335	64.2339
LL	254.3791	17.6496
LH	0.6218	6.3652
HL	-0.0015	4.7823
HH	-0.0015	2.0034

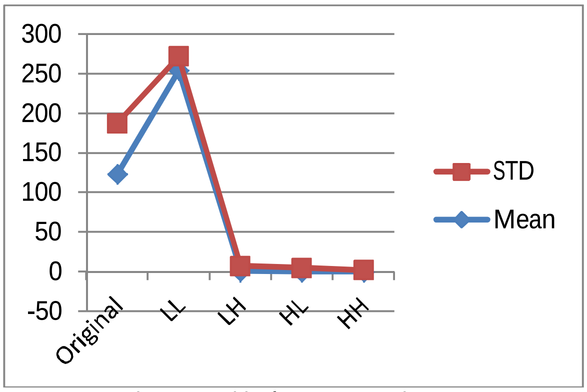


Fig 7: Graphical Representation

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