A Comparative Analysis of Median Filter on Various Types of Images

M.Renuka Devi, Ph.D.
Assistant professor in Department of MCA,
Sree Saraswathi Thyagaraja College, Pollachi,
Coimbatore, Tamil Nadu, India.

S.Shenbagavadivu
Research Scholar of Computer Science,
Sree Saraswathi Thyagaraja College, Pollachi.
Coimbatore,Tamil Nadu,India.

ABSTRACT
Digital image processing is used to process with digital images by using digital computers. Digital images are electronic representations of images that are stored on a computer. Image preprocessing is the technique of enhancing data images prior to computational process. Image filtering is one of the preprocessing operation which is allows to apply various effects on photo, to reduce noise and improve the visual quality of an images [1]. Filter operations can be used to sharpen or blur images, to selectively suppress image noise, to detect and enhance edges, or to alter the contrast of the image. Smoothing is often used to reduce noise within an image or to produce a less pixilated image. One kind of the smoothing filter is median filter. There are three kinds of images three kinds of images such as still image, medical image, and satellite image [2]. This paper is mainly focusing the usage of median filter in these three images.

Keywords
Median filter, still images, medical images, satellite images, pixel, noise, data.

1. INTRODUCTION
Median filter is the nonlinear filter more used to remove the impulsive noise from an image. With the median filter, all the pixels in the neighborhood are ranked by intensity level and the center pixel is replaced by that pixel which is mid-way in ranking. In addition, it is a more robust method than the traditional linear filtering, because it preserves the sharp edges. Most scanned images contain noise caused by the scanning method (sensor and its calibration -electrical components, radio frequency spikes) this noise may look like dots of black and white. The Median Image Filter is commonly used as a robust approach for noise reduction. This filter is particularly efficient against salt-and-pepper noise. Median filter helps us by erasing the black dots, called the Pepper, and it also fills in white holes in the image, called Salt " impulse noise ".Median Image Filter computes the value of each output pixel as the statistical median of the neighborhood of values around the corresponding input pixel. When applied on:

1.1 Gray scale images (see figure 1.1.1): The brightness-ranking is done by first placing the brightness values of the pixels from each neighborhood in ascending order. The median or middle value of this ordered sequence is then selected as the representative brightness value for that neighborhood.

Fig 1.1.1 Gray scale image

1.2 Color Scale images (see figure 1.2.1): Here each pixel in RGB is not use the brightness value but compare each pixels color of every other in the neighborhood. The pixel whose red, green, and blue components have the smallest sum of squared differences from the color coordinates of its neighbors is then chosen to replace the central pixel of the neighborhood. Then the result may get brighter or darker pixels from the neighborhood and they wind up at the top or bottom they can be removed.

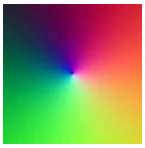


Fig 1.2.1 Color scale image

2. MEDIAN FILTER FOR STILL IMAGES
Median Filter in still images finds the median pixel value within the artifact diameter that specified. It removes bright or dim features that are much smaller than the artifact diameter. Median filters are very effective in removing salt and pepper and impulse noise while retaining image details because they do not depend on values which are significantly different from typical values in the neighborhood. Median filters work in successive image windows in a fashion similar to linear filters. However, the process is no longer a weighted sum. It sorts all the pixels in an increasing order and takes the middle one. If the number of pixels is even, the median is taken as the average of the middle two pixels after sorting.

Fig 2.1: Noise image **Fig 2.2: Most of the noise is removed by using median filter**

The filtered image (see Figure 2.1 & 2.2) looks almost the same as the original, if both are not zoomed. The zoomed image shows a slight degree of smoothing e.g. the gray hairs in the beard loose detail. The median filter replaces the center pixel with the median value. Median filtering smoothes the image and is thus useful in reducing noise. Median filtering can preserve discontinuities in a step function and can smooth a few pixels whose values differ significantly from their surroundings without affecting the other pixels.

In a median filter, a window slides along the image, and the median intensity value of the pixels within the window becomes the output intensity of the pixel being processed. For example, suppose the pixel values within a window are 5, 6, 55, 10 and 15, and the pixel being processed has a value of 55. The output of the median filter and the current pixel location is 10, which is the median of the five values. The median filter replaces a pixel by the median of all pixels in the neighborhood:

$$y[m,n] = median\{x[i,j],(i,j) \in w\}$$

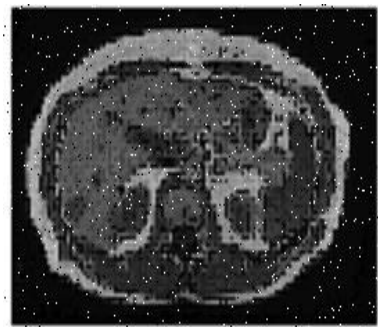
Where w represents a neighborhood centered around (m,n) location _____in the image. *x* is the input image and *y* is the output image

Median filtering is needed to remove impulse noise from an image. Pixel intensity is replaced with the median of pixel intensities within a window centered at that pixel. If a part of the window falls outside the image, intensities within the portion of the window inside the image is used. Circular windows are used to make smoothing independent of the image orientation.

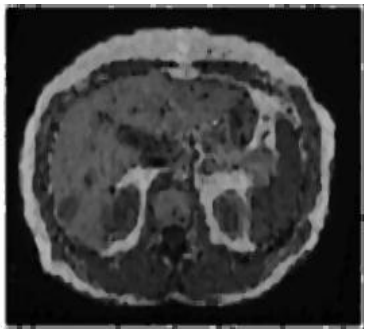
3. MEDIAN FILTER FOR MEDICAL IMAGES

Medical imaging is a discipline within the medical field which involves the use of technology to take images of the inside of the human body. These images are used in diagnostics, as teaching tools, and in routine healthcare for a variety of conditions. One of the most famous types of diagnostic imaging is the x-ray, which uses radiation to take a static image of a specific area of the body. Figure (see Figure 3.1 & 3.2)[3] shows the different noise which has find in these medical images and after applying the filtering techniques in these medical images how the noise has been removed. Salt & Pepper noises are detected and also removed these noises from the below medical images by applying the median filtering technique.

3.1.1 Original cancer image



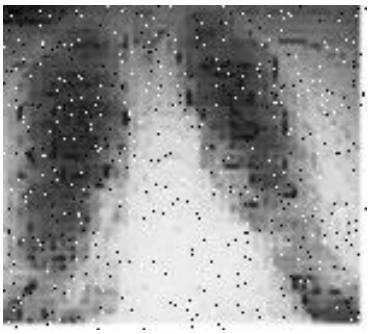
3.1.2 Finding Salt & Pepper



3.1.3 Applying Median Filter

Fig 3.1 cancer Image

3.2.1 Original cancer image



3.2.2 Finding Salt & Pepper

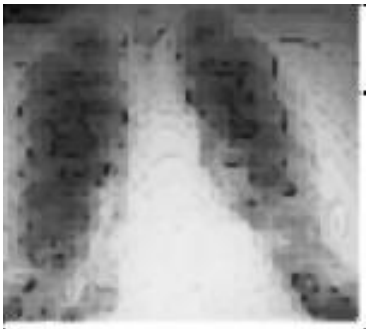


Fig 3.2 X-ray Image

3.2.3 Applying Median Filter

All medical images contain some visual noise. The presence of noise gives an image a mottled, grainy, textured, or snowy appearance. Noise in medical image means random phenomena. In X-ray radiography there are several random processes [5]. For example number of photons leaves the source, those photons that pass unaffected through the object, etc.

To finding salt & pepper noise and then applied median filtering technique for removal of noise. After removing a noise by using median filtering techniques again standard derivations and mean are evaluated (see Table 3.3)[3]. The median filter will improve the accuracy of MRI, Cancer, X-ray and Brain images for easy diagnosis. The result is more useful and it proves to be helpful for general medical practitioners to analyze the symptoms of the patients.

The choice of filters for de-noising the medical images depends on the type of noise and type of filtering technique, which are used. It is remarkable that this saves the processing time [2]. Median filter is one of filter techniques which are applied for denoising process. After finding the salt and pepper noise in these medical images, the median filter works better for cancer images and X-ray images. The standard derivation for the noisy image is 64.0972 for cancer images and 64.8242 for X-ray images (see Table 3.3)

Table 3.3: Noise removal using median filter for salt & pepper

Image	Original Image		Noisy Image		Filtered Image	
	Std	**Mean**	**Std**	**Mean**	**Std**	**Mean**
MRI	70.0623	182.2473	74.0267	180.0172	68.8923	182.5818
Cancer	61.2939	62.4918	64.0972	63.9113	53.1813	60.3204
X-Ray	65.4542	145.47576	68.2635	144.9646	64.8242	145.9382
Brain	91.0872	85.9561	92.5692	87.1018	90.5972	85.7115

4. MEDIAN FILTERING IN SATELLITE IMAGES

Satellite images contain the same information about surface objects, and they differ in reflection of presence of dust particles in the air [9]. Correlation between two images can thus be used for detection for dust particles, localization of sources of their emissions and possible prediction of this type of air pollution. A geometric correction of the image is required whenever the image is to be compared with existing maps or with other images [4].

Satellite imagery includes photographs of the earth taken through an artificial satellite revolving around the earth. The process of correcting these satellite images for haze, cloud and sensor induced defects within satellite image and overlaying the 2D satellite image on 3D surface of the earth is called satellite image processing [10].

Processed satellite images have different scientific and need based applications in the field of agriculture, geology, forestry, biodiversity conservation, regional planning, education, intelligence and warfare.

Median filtering standing for a non-linear method allows a very efficient removal of singularities in an observed sequence or image [6]. This method is very often applied in satellite image processing assuming application of overlapping matrices of size limited to 3 by 3 only. The central element of this matrix moves along all rows and columns of the original image [5]. The median value of the given sub image belonging to this window is then used instead of its reference element in every case. This method has been applied to remove specific elements of satellite images, especially meridian which form a part of the original data [7]. This method provides a very efficient tool for image denoising as well.

After histogram match and image mosaic, there is still missing data at of satellite scene. Thus to eliminate the minor missing data, several filtering method is tested and applied.

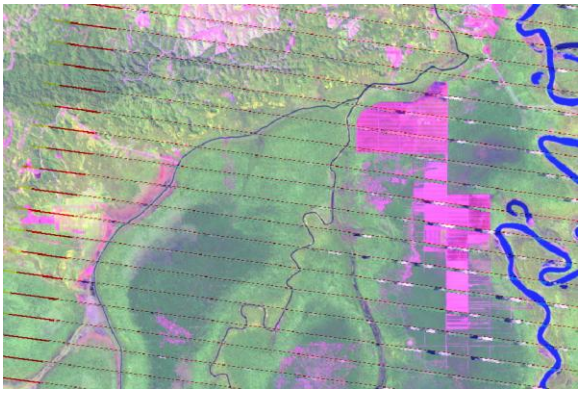


Fig 4.1. Missing data appear after missing line correction.

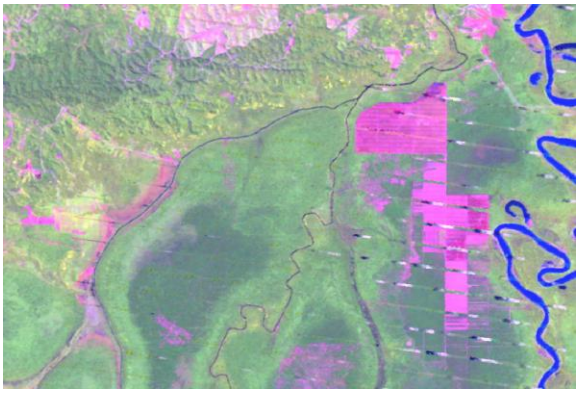


Fig 4.2. Data treated with Minority and Median 3X3 filtering

Before applying filtering, median 3x3, median 5x5 and median 7x7 is compare to examine the impact of softening to the detail of satellite image

By comparing the median filter to its own filter family, median 3x3 is much better in preserving detail and to fill minor missing data. However, to completely remove the missing line data, Minority 3x3 filter is use to remove the missing data at the center of image [8]. Median 3x3 filters is applied to remove the minor missing line data.

Minor missing data is corrected but the center missing data is not treated (see Figure 4.3). However, the image detail is much preserve [9].

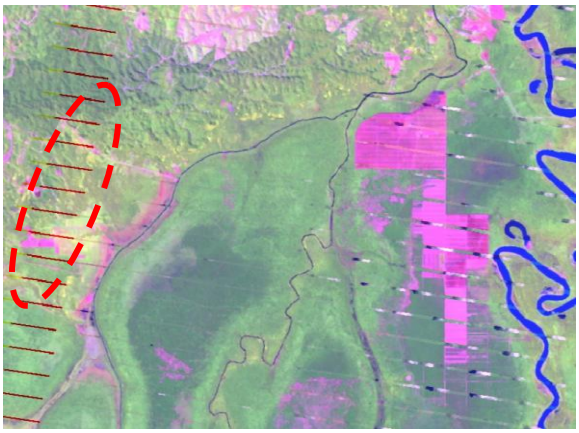


Fig 4.3. Median 3x3 filtering

Missing data is not treated. Detail of the image is blurred (see Figure 4.4)

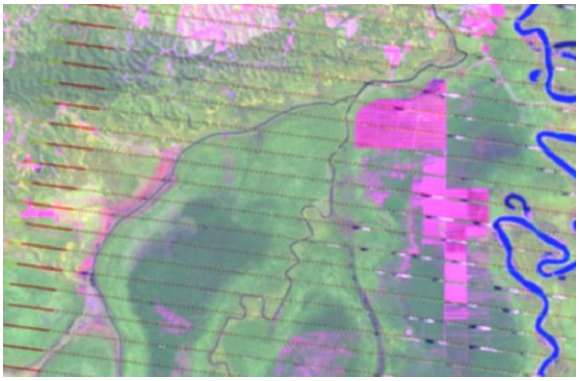


Fig 4.4. Median 5x5 filtering

Missing data is treated. But severe loss of image detail(see Figure 4.5). (Can be observe from the fading river circle in red)

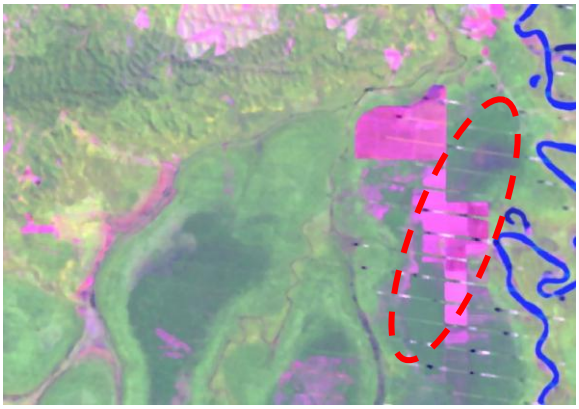


Fig 4.5. Median 7x7 filtering

5. CONCLUSION

Median filter is Easy to implement and Good in denoising for salt and pepper noises. The filter reduces noise without producing a smooth ramp at the border between a dark and a light area. Moreover, median filtering performance is unsatisfactory in the case of signal dependent noise. There is no error propagation. The median value must actually be the value of one of the pixels in the neighborhood; the median filter does not create new unrealistic pixel values when the filter straddles an edge. For this reason the median filter is much better at preserving sharp edges than other filter. The median filter is an effective method that can suppress isolated noise without blurring sharp edges. Median filter is shows better results for cancer images and X-ray images in medical images. In overall median filter produce accurate result by removing salt and pepper noises in still images than the medical images and satellite images.

6. REFERENCES

[1] Rafael C.Gonzalez & Richard E.Woods, "Digital Image Processing", Second edition, 2005.

[2] Bhausaheb Shinde, Dnyandeo Mhaske, A.R. Dani "Study of Image Processing, Enhancement and Restoration " IJCSI, Vol. 8, Issue 6, No 3, November 2011

[3] Bhausaheb Shinde, Dnyandeo Mhaske, A.R. Dani, 2012. "Study of Noise Detection and Noise Removal Techniques in Medical Images".

[4] Lt.Dr.S.Santhosh Baboo, M.Renuka Devi "Geometric Correction in Recent High Resolution Satellite Imagery: A Case Study in Coimbatore, Tamil Nadu"

[5] Bhausaheb Shinde, Dnyandeo Mhaske, Machindra Patare, A.R. Dani,A.R. Dani "Apply Different Filtering Techniques To Remove The Speckle Noise Using Medical Images" International Journal of Engineering Research and Applications, Vol. 2, Issue 1,Jan-Feb 2012, pp.1071-1079

[6] H. Hwang and R. A. Haddad "Adaptive Median Filters: New Algorithms and Results" IEEE Transactions on image processing vol 4. P.no 499-502, Apr 1995.

[7] Digital Image Processing - Kenneth R. Castleman, Prentice- Hall, 1996.

[8] Ramanjaneyulu M, KMM Rao , *A Novel technique to Resample High Resolution Remote Sensing Satellite Images*, Proc. of IGRASS-02, Colorado.

[9] Li, R., Zhou, G., Yang, S., Tuell, G., Schmidt, N. J. and Flower, C , 2000, Astudy of the potential attainable geometric accuracy of IKONOS satellite images, IAPRS, 33(B4), 587-595.

[10] Hanley,H.B. and Fraser,C.S.,2001.Geopositioning accuracy of Ikonos imagery : indications from 2D transformations,photogrammetric Record ,17(98) : 317-329.

7. BIBILIOGRAPHY

Dr. M.Renuka Devi has nearly 10 years of post-graduate teaching experience in Computer Science. She has indulged in training the post graduate students to complete real time projects and also guides research scholars in Computer Science. She has published 12 papers in various international journal and presented paper in 12 national conferences. She has acted as a resource person in various activities in different colleges. Currently she is working as Asst.Prof in the Department of MCA at Sree Saraswathi Thyagaraja College (Autonomous), and An ISO 9001 Certified / NAAC Accredited Institution**,** Pollachi, Coimbatore (Dt), Tamil Nadu,India

Miss .S. Shenbagavadivu has completed her post graduate in M.Sc(Software Systems). Currently she is doing research scholar of computer science at Sree Saraswathi Thyagaraja College (Autonomous), and An ISO 9001 Certified / NAAC Accredited Institution, Pollachi, Coimbatore (Dt), Tamil Nadu,India.